



Cyber-Supply Chain Due Diligence Researcher's Guide

DCIO/CS Risk Assessment & Operational Integration

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Cyber-Supply Chain Due Diligence Researcher's Guide

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This document, is one of multiple guides, and processes, developed for the Deputy DoD CIO for Cybersecurity's Director for Risk Assessment and Operational Integration (RA&OI) under IDA Project BC-5 4771, in support of ongoing DoD CIO efforts to manage supply chain risks in acquiring and using Cyber and Information and Communications Technology (ICT).

The Director, RA&OI believes that these documents, while developed individually for specific analytical purposes, can provide insight to the DoD community as examples for assessing Cyber and ICT supply chain risk.



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**Revision 0.8.9
June 15, 2021**



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Prepared for the Office of the Deputy DOD CIO for Cybersecurity,
Risk Assessment and Operational Integration Directorate

CYBER-SUPPLY CHAIN DUE DILIGENCE
RESEARCHER'S GUIDE
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Executive Summary

This is a guide for optimizing SCRM Internet searching - supply chain risk management (SCRM) is the systematic process for managing supply chain risk by identifying susceptibilities, vulnerabilities, and threats throughout the supply chain and developing mitigation strategies to combat those threats whether presented by the supplier, the supplied product and its subcomponents, or the supply chain.¹ In today's globally distributed supply chains, the components and subsystems may pass through many globally dispersed manufacturers and distributors before a manufacturer integrates them into a system. Identifying key information points related to the supply chain and assessing the threat opportunities presented by that point, becomes a daunting task.

Multiple organization within the DOD are leveraging various supply chain illumination, or supply chain mapping tools such as, but not limited to, Exiger, Interos, Govini, Bloomberg, Vertical Knowledge, or consulting/support services with other proprietary tools. This guide, developed by IDA for the Deputy DOD CIO for Cybersecurity, Risk Assessment and Operational Integration, can supplement those tools, or for analysts without those tools, provides guidance for manual searching of the Internet.

In addition to a myriad of business risks, a key part of overall due diligence analysis is to look at any foreign ownership, control, and influence of the company,^{2,3} its key people, and facilities at each point in the supply chain for their products in which adversaries may gain opportunity to insert malicious functions, or otherwise compromise the products, or impact DOD. Key data parameters for each vendor includes:

- Entity type – corporation, partnership, etc.

¹ Defense Acquisition University Acquipedia, "Supply Chain Risk Management (SCRM) – Overview" <https://www.dau.edu/acquipedia/pages/article/details.aspx#!240>

² Within DoD FOCI is defined within DoD M 5220.22, National Industrial Security Program: Procedures for Government Activities Relating to Foreign Ownership, Control, or Influence (FOCI) https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodm/522022_vol3.pdf?ver=2020-08-05-130555-740

³ More broadly across government, with respect to foreign influence, the DOD has also assessed FOCI considering the language of the CFIUS and FOREIGN INVESTMENT RISK REVIEW MODERNIZATION ACT OF 2018 (FIRRMA) <https://home.treasury.gov/policy-issues/international/the-committee-on-foreign-investment-in-the-united-states-cfius>

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- Accurate name – other names, doing business as (DBA) names, etc.
- Location of headquarters, manufacturing, research, and subsidiaries – city and country
- Ownership – founders, investors, their history and associations, etc., and their nationalities
- Leadership – directors, officers, shareholders, and their nationalities
- Interactions with the government
- Corporate cybersecurity maturity

The Internet can be an invaluable resource for the SCRM researcher to find this information. Most researchers, however, have never received any formal training on how to search the Internet. They have evolved their search techniques over years of trial and error. Most use only some basic tools and databases, but do not take advantage of the full suite available to them.

Searching the term “Internet research” on Amazon produces a very limited selection of books on the topic. Many are more than 10 years old, and outdated relative to the pace of Internet evolution. The one Government-developed resource is a guide published by the National Security Agency (NSA) back in 2007, which researchers can download for free. The NSA has not released an update of this resource.

This guide helps to fill this void, and provide a SCRM researcher with a framework, toolbox, and techniques. First, it provides an overview of the search environment – the search space, the browsers, and search engines available. This section discusses the strengths and weaknesses of each so that the SCRM researcher can select the one most suited for the specific situation. The experienced researcher can just skim this section. The novice should find it useful.

The surface web is the search space visible to most users and is searchable with standard web search engines like Google or Bing. The deep web, which includes sites like corporate internal web sites, online banking, medical records, and personal email accounts, requires credentials, like username and password, to get past the public-facing access page. The dark web is a very small subset of the Internet, and requires the user to access it through overlay networks.

Browsers are software applications that locate, retrieve, and display content on the Internet, including webpages, images, videos, and other files. A user can pick from a number of browsers, most of which are free. Google Chrome is a free browser that some users consider one of the best. A search engine is a website through which users can search Internet content. Search engines discover and organize the Internet's content in order to offer

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the most relevant results to the searchers' requests. Google is the most popular search engine.

There is an abundance of data available on the Internet both for free and for a fee. The challenge is finding data sets that are current, complete, and accurate. To be useful, data requires curation, which is time-consuming and expensive. Free sites may not have quality data, whereas pay sites need to provide quality data to attract and retain users. To attract new users, sites that charge a fee, often offer free limited searches or for a free trial period. To access such trial periods, most sites require the user to provide a credit card number, and after the free trial, the site converts to fee-based, charging the card.

The guide provides the researcher with tools and techniques for conducting searches. The basic search techniques use simple operators that apply to the content of the web pages, and help users narrow and focus their searches. The advanced techniques look at metadata and artifacts that web operators may have included when editing and changing web site content. Because Google Chrome is the dominant search engine, the guide provides techniques that work with Google Chrome. Though the basic techniques will work with other search engines, some advanced techniques will only work with Google Chrome.

Search engines automatically prioritize the results that relate to the geographic region of the searcher. Therefore, most search engines do not display foreign websites up front in searches. They will be within the search results, but with searches returning millions of results, unless they appear in the first ten pages of search results most users do not get to them. The guide provides the user techniques to help bring up foreign sites to the forefront of the results.

Certain websites can be particularly helpful to the SCRM researcher. These include:

- Wiki sites are hypertext publications that users collaboratively edit and manage using a web browser. They let groups of people quickly capture and share ideas by creating simple web pages and linking them together. Because the curators can remain anonymous and can publish without credentials, wiki sites may contain incorrect, outdated, incomplete, or biased information.
- Archives accumulate historical records and may include newspapers, newscasts, video, and other media. They provide researchers with material and content no longer readily available. The Internet is home to a number of archives, including the Wayback Machine, which is the Internet's own digital archive, housing almost half a trillion web pages. Users can see how a company evolved over time, business areas it entered or exited, leadership changes, and other information.
- The U. S. Securities and Exchange Commission (SEC) maintains a searchable database of corporate filings, EDGAR. Other government resources include public

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records that can provide birth, marriage, divorce, and death information. The challenge of accessing these records is that most reside at the local level and require the researcher to know which jurisdiction applies. Search Systems (searchsystems.net) located, analyzed, described, and organized links to over 70,000 databases by type and location. It provides some very basic information free, more detailed results require a paid membership with a monthly fee.

- The private database space, on the other hand, is rather crowded, with companies trying to differentiate by packaging information so that it targets specific user groups. Such user groups include sales and marketing teams, business development professionals, investors, competitive intelligence gatherers, and others. Four large providers dominate the financial data industry, Bloomberg, Eikon, Capital IQ, and FactSet. A number of other providers offer financial information on companies and often differentiate by focusing on different segments like alternative asset classes.
- A number of non-profit community, environmental, and labor activist groups publish and curate sites with guidance on how to gather information about corporations. Most do not require payment or will waive payment to other non-profit organizations and reporters. Their focus is on identifying information that activists can use to advance corporate accountability campaigns.
- Job search sites try to attract job seekers, and as part of the process, they provide free information about companies. The job description/qualifications listed for job opportunities can provide insights into the technical and business areas that a company is pursuing. This is particularly true for companies entering new business sectors where they do not have significant resident talent.
- There are a number of on-line libraries, but many focus on the arts and literature, and not data that would support open source searches on corporations and people. The U.S. Library of Congress has put together an excellent guide for researching corporations. It groups research into categories: basic information, U.S. private companies, U.S. public companies, peer group/competitor comparison, searching for the news, and non-U.S. companies. Each category provides information about tools that the Library makes available to users.
- The Internet Archive library collection occupies more than 90 Petabytes of server space that store two copies of 28 million books and texts, 14 million audio recordings, 6 million videos, 3.5 million images, and 580,000 software programs. Like most libraries, it respects the privacy of users, and does not keep their IP addresses. Other libraries include ibiblio (ibiblio.org) and Google books. Because

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of copyright issues, users can sign books out, but cannot download them to their files unless the copyright has expired or they are in the public domain.

The guide also provides links to databases and websites that provide specific information on companies and people associated with them. It guides the researcher through each of the vendor profile characteristics: entity type; accurate name; location of headquarters, manufacturing, research, and subsidiaries; ownership; leadership; interactions with government; and cybersecurity maturity.

It then moves on to researching a vendor's products. It does this by addressing key product-related data parameters

- Product suppliers
- Supply chain
- Branding and labeling
- Installation guides and manuals
- Component list or bill-of-materials
- Evaluations and reviews
- Proprietary technology
- Cybersecurity risk

Product installation and operation manuals are a good source of information for the SCRM researcher. The best place to get them is on the manufacturer's web site. If not available from the manufacturer, a number of sites provide them for free or for a fee. Free sites tend to be more limited in scope, often poorly organized, and often provide poor quality scanned images uploaded by other users.

For imported products, import/export data can be the source of much useful information on the product supply chain. Import/export transactions come with their own special terminology. The Incoterms® are a set of 11 individual rules issued and copyrighted by the International Chamber of Commerce (ICC) that define the responsibilities of sellers and buyers for the sale of goods in international transactions. Each Incoterms rule clarifies the tasks, costs, and risks borne by buyers and sellers in these transactions.

The Harmonized System (HS) is a standardized numerical method of classifying traded products. Customs authorities around the world use it to identify products when assessing duties and taxes and for gathering statistics. The HS assigns a six-digit code to classify commodities. Countries can add additional codes to follow the first six digits for further classification. The U.S. adds an additional four-digit suffix, called the Harmonized

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Tariff Schedule, HTS, to the HS. The Schedule B number is the complete 10-digit code that classifies products for import or export.

The U.S. Customs and Border Protection (CBP) regulations require the vessel to file shipment data for maritime containerized imports 24 hours before loading the cargo. On a typical day, the import and export trade data consists of almost 60,000 bills of lading. Various private databases provide information supplied in the bills of lading.

Companies use trademarks, service marks, and brand names to differentiate their product from competitors' products. The brand name and labeling convey attributes, quality, and promoted easy recognition on a crowded shelf. The label will also include information, like weight, safety warnings, and ingredients that laws and regulations may require. In the U.S., the owner registers a trade or service mark with the U.S. Patent and Trademark Office (USPTO). All personal information that an applicant submits to the USPTO, including the domicile address, email address, and telephone number, become part of a public record.

Product teardown and reverse engineering are processes of disassembling an item down to its individual components. Companies perform teardowns of competitors' products to identify patent infringement, benchmark the competition, and identify areas where they can derive cost or performance advantages in their own products. A number of companies provide teardown services, but most only provide results to customers and do not make the information available publicly.

A number of sites offer product reviews. Purchasers of the product or professional reviewers write the reviews. Customer reviews further partition into those who receive some form of compensation, like a free product or discounts, and those that contribute reviews simply as a social service. Analyses of reviews show that incentivized reviews rate products higher than those that volunteers contribute.

Businesses use independent testing laboratories to provide objective analytical data on the quality of a product or a process. A number of independent testing laboratories offer testing services to commercial companies. Client companies pay for most testing, and the results are their proprietary information. Major testing groups include those that support and validate claims made in advertising, performance (does it work as intended), comparisons to competitor products, mechanical to identify failure mechanism, and adequacy of user instructions. Underwriters Laboratories (UL) is the largest and best known independent, not-for-profit testing laboratory in the world. Users must register to search the UL website.

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Virtually all digital devices fall under 47 Code of Federal Regulations (CFR) Part 15 Subpart B, which covers incidental radiators, equipment not designed to emit radio frequency (RF) signals intentionally. Subpart C of the regulation covers equipment that intentionally transmits RF energy. Every manufacturer that wants to sell a product covered by these regulations must submit information to the Federal Communications Commission (FCC.) The filed information is public; the manufacturer must file a request and pay a fee to keep it private. Anyone can go to the FCC ID search website and look at the information that the company filed. FCC filings can produce valuable information about the product and manufacturer.

The analyses to understand and mitigate adversarial supply chain risk, especially in Information and Communications Technology should provide clarity on from whom we are buying our technology. Executive Order 13873, May 15, 2019, *Securing the Information and Communications Technology and Services Supply Chain*, prohibited

the unrestricted acquisition or use in the United States of information and communications technology or services designed, developed, manufactured, or supplied by persons owned by, controlled by, or subject to the jurisdiction or direction of foreign adversaries augments the ability of foreign adversaries to create and exploit vulnerabilities in information and communications technology or services, with potentially catastrophic effects, and thereby constitutes an unusual and extraordinary threat to the national security, foreign policy, and economy of the United States.⁴

The objective of this guide is to assist in meeting that challenge.

As a caveat to the user of this guide, the Internet is a highly dynamic environment, with new web sites appearing daily, while others fade into obscurity through lack of curation of the content or the dreaded “404 Not Found” indicating a broken link. All links referenced in this guide and in the companion, reference were active as of the time of publication.

Since the intended audiences of this guide are Government personnel and their contractors, it is important for the user to note the guidance that DoD Directive 3115.18⁵ and

⁴ <https://www.federalregister.gov/documents/2019/05/17/2019-10538/securing-the-information-and-communications-technology-and-services-supply-chain>

⁵ Office of the Under Secretary of Defense for Policy and Office of the Under Secretary of Defense for Intelligence and Security, “DoD Access to and Use of Publicly Available Information (PAI),” Change 1 Effective August 20, 2020. <https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodd/311518p.pdf?ver=2020-08-20-121154-277>







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the Office of the Director of National Intelligence⁶ provide regarding publicly available information (PAI.)

⁶ Office of the Director of National Intelligence, "Civil Liberties and Privacy Guidelines for Intelligence Community Professionals: Properly Obtaining and Using Publicly Available Information," July 2011. <https://www.hsdl.org/?abstract&did=755933>

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1. The search environment

This first chapter describes the current landscape of the components of the World Wide Web (WWW), and the browsers and search engines used to navigate the internet to discover PAI. Readers that are familiar with this landscape should move to Chapter 2, which describes the techniques and tools employed to maximize the effectiveness of PAI searches.

A. Search space

When most people interact with the WWW, they appreciate the huge number of web sites that they can access. In reality, they are interacting with only a relatively small fraction of the web. Most of the web is not visible to them and they do not have the tools or credentials to access those sites. As Figure 1 shows, there are three parts to the web, the surface web, the deep web, and the dark web.

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Figure 1: Most of the web is not visible to search engines⁷

1. Surface web

The surface web is that portion of the WWW that is readily available to the public and searchable with standard web search engines like Google or Bing. Search engines use web crawlers that read the website data, index the data found on the webpages, and follow the links. Search engines have indexed over 5.47 billion pages, but that is only 10% of the WWW.⁸

2. Deep web

The deep web is the secret web, which is not visible to the normal user. The deep web consists of websites or any pages within these sites that search engines have not indexed. Only authorized users with the necessary credentials, like username and password, can get past the public-facing access page for these sites and gain access to the data. Examples of the deep web include corporate internal web sites, online banking, medical records, and personal email accounts.

⁷ Image source: Y R Chandra Sekhar Varma, "CISO guide: surface web, deep web, and dark web - are they different?" April 19, 2018. <https://www.cisoplatfrom.com/profiles/blogs/surface-web-deep-web-and-dark-web-are-they-different>

⁸ Size on 5/28/2020 <https://www.worldwidewebsite.com/>.

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3. Dark web

The dark web is that layer of information and pages that a user can only access through "overlay networks," which run on top of the normal Internet and obscure access to sites on the dark web. Users need special software to access the dark web because much of it is encrypted, and most dark web pages are hosted anonymously.

A significant fraction of dark web content is involved in illegal activities such as child pornography, sale of stolen credit cards, drug trafficking, and even assassinations for hire. Transactions take place anonymously, and payment is mostly via crypto currency like Bitcoin, and delivery via rented mailboxes or other anonymous means.⁹

There is a lot of mystique associated with the dark web. In reality, it is a very small subset of the WWW; live reachable domains are less than 0.005% of the number of surface-website domains. A recent web crawler study identified only 55,828 domains, of which about 8,416 had a live site.¹⁰ This compares to more than 200 million unique, active surface web domains.

The domain name extension for Dark web sites is "dot onion" (.onion vs. .com). Unlike domains on the surface or deep web, onion domains are hashes, so they typically contain many characters that appear entirely random to a human user. For example, the onion domain 7rmath4ro2of2a42.onion is a news site called SoylentNews. This makes typo squatting a common fraud scheme on the dark web.¹¹

B. The uniform resource locator (URL)

Every website has a unique uniform resource locator, URL, which follows a protocol for specifying addresses on the Internet. As Figure 2 shows, the URL provides several pieces of information about the website.

⁹ See, for example, Metacortex and Grifter, "Touring the dark side of the Internet, an Introduction to Tor," DefCon 22, 2014 https://www.youtube.com/watch?v=To5yarfAg_E

¹⁰ J. Stone, "How many dark web marketplaces actually exist? About 100," *Cyberscoop*, May 6, 2019. <https://www.cyberscoop.com/dark-web-marketplaces-research-recorded-future/>

¹¹ Typo squatting relies on the user misspelling the domain name, for example Capital One Bank's web site is capitalone.com. The site capitolone.com, a common misspelling, could be a typo squatting site. Often squatting sites mimic the real web site, including graphics and logos. See also, <https://www.digitalshadows.com/blog-and-research/dark-web-typosquatting-scammers-v-tor/>

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Figure 2: The structure of a URL¹²

Currently, there are 20 top-level domains in the world. Table 1 shows the most common ones and who can obtain them.

¹² Source: <https://uscupstate.libguides.com/c.php?g=257977&p=1721715>

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Table 1: The most common top-level domains

Top level domain extensions	Type	Requirement to register domain with extension in the U.S.
.com	commercial	Any person or entity can register
.org	organization	Any person or entity can register, primarily used by not-for-profit organizations
.net	network	Any person or entity can register. Originally intended for domains that point to a distributed network of computers, or umbrella sites that act as the portal to a set of smaller websites.
.int	international	Limited to organizations, offices, and programs endorsed by a treaty between two or more nations.
.edu	educational	Limited to higher educational institutions like trade schools and universities. Almost exclusively used by American colleges and universities.
.gov	government	Limited to United States governmental entities and agencies, and qualifying state, county, and local municipal government agencies.
.mil	military	Limited to divisions, services, and agencies of the United States Department of Defense.

C. Browsers

A browser is a software application used to locate, retrieve, and display content on the WWW, including webpages, images, videos, and other files. The web browser fetches data written in hypertext markup language (HTML) from an Internet-connected server and it then uses a rendering engine to translate that data into text and images. Every webpage, image, and video has its own unique URL, also known as a web address. The URL tells the browser where to look for each item in the HTML, which then tells the browser where it goes on the web page.

A user can pick from a number of browsers, most of which are free. As with most applications, there is a dominator and a number of smaller players. Figure 3 shows browser market share. Most offer quite similar functions that a researcher would need, with the big difference being privacy. Given the sensitivity of some searches, it may be preferable to leave minimal digital exhaust in the wake of the research.

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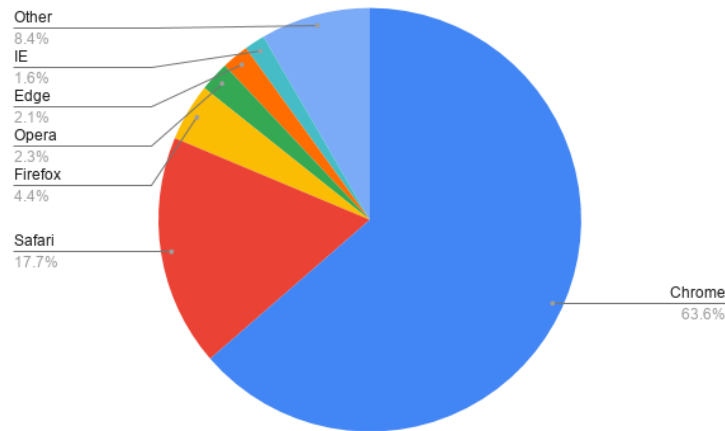


Figure 3: Browser market share 2019¹³

1. Google Chrome

Google Chrome is a free browser that users consider the best. The Chrome mobile apps that are available for every platform type make it easy to keep bookmarks, saved data, and preferences in sync across devices. Google is notorious for tracking location data even after the user turns off location history.¹⁴ Because of its popularity, most website designers target Chrome for compatibility, so users of Chrome are not likely to experience issues accessing content. Other browsers may experience some compatibility issues.

2. Apple Safari

Safari works only with the Apple ecosystem. MacOS integrates it in the system software. This improves battery life due to Apple's in-house optimizations for MacOS and the underlying hardware. It offers seamless transition among iPhone, iPad, and Mac computers. Safari focuses on privacy and security. Safari includes fingerprint protection, which prevents trackers from identifying the user based on their hardware and software setup. It minimizes tracking, and is therefore a good choice from privacy perspectives.

3. Firefox

Firefox Quantum is a free browser from the Mozilla Foundation, which is a longtime champion of privacy. In addition to the usual cookie and "Do Not Track" options that other browsers offer, Firefox Quantum has built-in anti-tracker protection. This is something that

¹³ "Browser Support 2020: Chrome and Edge." <https://www.wearegecko.co.uk/blog/browser-support-2020-chrome-and-edge/>

¹⁴ Ryan Nakashima, "AP Exclusive: Google tracks your movements, like it or not," August 13, 2018. <https://apnews.com/828acfab64d4411bac257a07c1af0ecb/AP-Exclusive:-Google-tracks-your-movements,-like-it-or-not>

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Firefox first offered as part of its private browsing mode, but now also offers during regular browsing. Besides increasing the user's privacy, blocking trackers improves the speed at which pages load. Firefox Quantum offers the most secure online browsing experience of all of the major browsers.

Firefox Quantum is also forward-looking. It is the first web browser that actively taps into the power of multi-core processors. Most browsers, like Chrome, do not take full advantage of multi-core chips. Given the speed of modern multi-core processors, however, page-loading speed is not a problem unless the user has many tabs open. Firefox Quantum typically uses less random access memory (RAM) than the competition. RAM is the resource that browsers like Chrome rely on heavily for their speed.

4. Opera

Opera is the only browser that includes a built-in virtual private network (VPN), which allows the user to hide browsing activities from internet service providers (ISP) and any other entities between the user and the site they are visiting. Opera is the only one of the popular web browsers that has a built-in cryptocurrency wallet and a screenshot tool.

5. Microsoft Edge

Edge is Microsoft's integrated browser for Windows 10. Edge initially used an in-house browsing engine, which updated when the user updated the operating system. Edge, however, has been unable to gain a substantial market share despite it serving as Windows 10's default web browser. Because most web page designers make their pages compatible with Chrome, on February 5, 2020, Microsoft launched a new version of Edge that uses the open-source Chromium web browser engine and webpage-rendering code. Users, however, must download and install this browser; and it does not upgrade through Windows Update.

Microsoft Edge provides simple privacy settings through a user-friendly graphic interface, and offers three security levels: basic, balanced, and strict. When balanced security is set as the default, many sites request the user to disable the pop-up blocker, even though the site's design does not utilize any pop-up windows. In addition, Microsoft Edge offers voice reading of webpages with realistic speech, and a screenshot tool.

6. Vivaldi

Vivaldi is a very flexible browser that allows users to configure the browser for their specific needs and preferences. Specifically, Vivaldi allows each user to designate the location of the tab on the screen, to group and tile tabs, set the theme, search open tabs, set keyboard shortcuts, and perform other forms of customization.

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Vivaldi puts a high emphasis on privacy. It blocks sites and ads from tracking the user around the web, offers a built-in ad blocker, and uses end-to-end encryption to synchronize devices. Vivaldi offers a Private Window option, which does not store information about the web sites visited, cookies, or temporary files. Private Windows includes a separate default search engine to ensure privacy.

Vivaldi headquarters are in Oslo, Norway, with browser development teams located in Reykjavik, Iceland. Its home base in the U.S. is north of Boston at the Magnolia Innovation House near Gloucester. Every summer the whole team gathers here for a month of coding and relaxation.

7. Tor (The Onion Routing Project)

In the 1990s, the U.S. Naval Research Laboratory (NRL) looked at ways to create Internet connections that do not reveal who is talking to whom, even to someone monitoring the network. Researchers developed onion routing, which routes traffic through multiple routers that anonymously forward traffic, encrypting the data each step of the way. Routers only know addresses within one hop in either direction.

In 2002, the NRL deployed the Tor network and released its code under a free and open software license. The Tor Project, a 501(c)3 non-profit, continues to maintain and develop Tor. Currently, the U.S. government is the primary funder, with other governments and non-governmental organizations providing additional resources.

Tor has proved to be a valuable resource for activists and others in totalitarian regimes by providing a way to communicate anonymously and to access blocked web sites. Tor, however, was not an easy network for non-technical people to access. In the late 2000s, the Tor Browser made the Tor network more user-friendly, and its popularity increased.

Today, the Tor Browser is a modification of an Extended Support Release version of the Mozilla Firefox browser. The browser is portable, and users can use it from external media, which reduces the hazards of installation. Tor Browser removes the browsing history and cookies after every use. Tor is available for various operating systems including Windows, Linux, and MacOS, as well as for mobile Android and iOS devices. Tor is the browser of choice on the dark web.

D. Search engines

A search engine is a website through which users can search Internet content. Search engines discover and organize the Internet's content in order to offer the most relevant results to the searchers' requests. They use software robots (bots) that discover content by crawling the web. These bots, also known as crawlers, scan all sections, folders, subpages, and content – everything they can find on a website. Crawling finds hypertext links that

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refer to other websites. By parsing these links, the bots are able to find new sources to crawl.

Every time a web crawler visits a webpage, it makes a copy of the page and adds the page's URL to an index. Then the web crawler follows all the links on the page, repeating the process of copying, indexing, and then following the links. Because of this repetitive process, the crawler builds a huge index of webpages along the way. An internal scheduler assesses the relative importance of new and known URLs and determines when to crawl new URLs and how often to re-crawl known URLs. Figure 4 shows a flow diagram of this process.

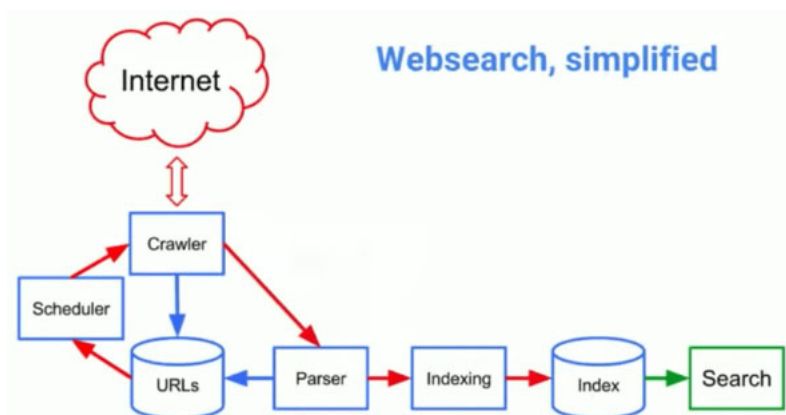


Figure 4: Search engine process¹⁵

When a search engine gets a user's request, the engine applies algorithms to determine which pages to display and in what order. Because of differences in algorithms among search engines, different search engines will rank the relevance of a web page to the searcher's request differently. The same web site may appear in a different position; others will not appear at all.

1. Google

Google is the most popular search engine. As Figure 5 shows, more than 90% of web searches happen on Google. Google crawls and re-crawls the web at a larger scale than any other search engine. This has allowed Google to build and maintain the largest and most up to date index. Google has developed language models that allow it to understand the true meaning behind even the most obscure or incorrect queries. Google looks at about two hundred factors to find and rank relevant content.

¹⁵ Image source: J. Hardwick, "How do search engines work and why should you care?" December 5, 2019, <https://ahrefs.com/blog/how-do-search-engines-work/>

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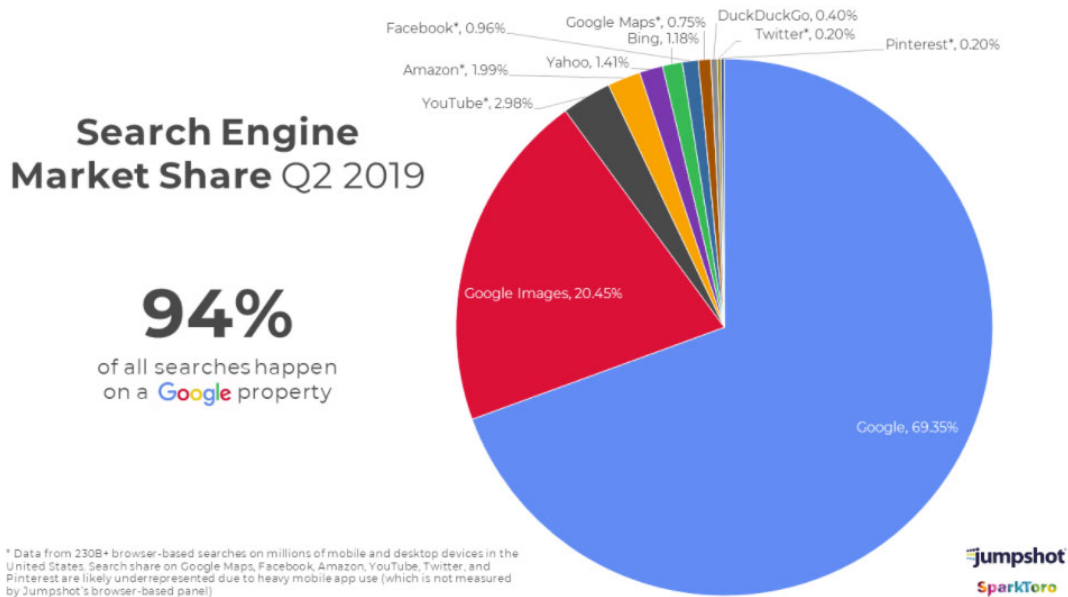


Figure 5: Search engine market share Q2 2019¹⁶

Google is constantly making updates to its algorithms and ranking signals, including the addition of artificial intelligence via RankBrain.¹⁷ This machine-learning algorithm let's Google infer the meaning of queries it had not seen before, an important feature since about 15% of the queries it processes every day are new. For this reason, the best way to structure a query on Google is simply to ask it as if you are asking another person.

Google provides the user with the ability to tailor the searches. On the home page, there is a settings button in the lower right hand corner. Clicking the button brings up a list of options. "Search settings" has some very useful options. "Results per page" allows the user to set a different number from the default of ten. Checking off the box for Google to open links in a new page makes tracing how you got to a particular site much easier. At the bottom of the Search Settings page, the user can set the region in which Google will focus the search. This is very helpful when researching a foreign company, product, or individual. Doing this pushes non-U.S. websites higher up in the search.

¹⁶ Image source, <https://www.towermarketing.net/blog/google-best-search-engine/>

¹⁷ Kristine Schachinger, "A complete guide to the Google RankBrain algorithm," December 14, 2017, <https://www.searchenginejournal.com/google-algorithm-history/rankbrain/>

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2. **Bing** bing

Bing, a Microsoft product, is the second most popular search engine. Bing does not have machine-learning algorithms on the level of Google, so it relies more heavily on conventional methods to understand content, such as keywords in the domain, page titles, and metadata. Even though Bing is the default search engine on Windows PCs, Bing only has a market penetration of just over 5%.

Bing prefers established content that either has been live for quite some time, or has gained a large amount of traffic. This preference causes it to rank domains such as .gov or .edu, higher, while Google considers commercial or popular websites to be just as valuable.

Bing incorporates social signals into its ranking algorithms. Pages that have earned a greater number of likes, shares, and retweets are more likely to rank highly on Bing. While this may be an important factor in consumer searches for restaurants, stores, and services, it has less relevance for other types of searches. Bing will delist a site if it identifies abusive tactics that aim to inflate the number and nature of inbound links, such as link buying, or participating in link schemes like link farms, link spamming, and link manipulation.¹⁸

3. **DuckDuckGo**

Although DuckDuckGo still has a relatively tiny segment of the search space, it is growing, primarily because of users' privacy concerns. DuckDuckGo claims that it never stores the personal information or search history of its users. It has a simple mantra, "no tracking, no ad targeting, just searching."

Although the search engine itself is powered by Google, DuckDuckGo uses its web crawler, DuckDuckBot, and up to 400 other sources to compile its search results, including other search engines like Bing, Yahoo, and Yandex, and crowdsourcing sites like Wikipedia.

4. **Yahoo!**

Although Yahoo was one of the first search engines, it now uses Bing's search engine. As a result, Yahoo! is more of a web portal than a search engine. The differences come from how Yahoo! ranks the pages and presents them to the user.

¹⁸ Bing Webmaster help and how to, <https://www.bing.com/webmaster/help/webmaster-guidelines-30fba23a>

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5. Yandex 

Yandex is the Google of Russia. It is very popular in many countries that used to be part of the Soviet Union. Yandex uses separate algorithms to rank sites within the .ru domain zone and those outside the domain. Yandex ranks sites that have been around longer above new web sites. It is highly tuned to the linguistic variances of the Russian language. Recently, Yandex began supporting searches in English.¹⁹

6. Baidu 

Baidu is the dominant search engine used in China. In China, it is similar in size and scale to Google in the U.S. Baidu has invested in machine learning to improve its ranking algorithms. Baidu prioritizes mobile web sites in the algorithms used to rank sites during searches. Therefore, the search results displayed for a mobile platform can vary significantly from those for desktop searches. Although Baidu is accessible worldwide, it is only available in the Chinese language.

¹⁹ <https://www.yandex.com>.

2. Search techniques and tools

Search engines are powerful tools for researchers. Although simply entering a question will frequently generate a number of useful web sites, there are much more powerful techniques that searchers can use to zero in on key sites and eliminate irrelevant search results. Since Google is the dominant search engine, this section discusses only search techniques for Google. Some techniques may work for other search engines, but we did not test compatibility.

A. Google search techniques and tools

As a search engine, Google limits queries to 32 words and follows certain rules. Except for a few special occasions, Google ignores case. Therefore, search queries for John Doe and john doe will yield the same results.

In addition, Google search algorithms often ignore small common words in the queries, called stop words, when they appear in lower case. The list of stop words includes the, and, where, how, a, an, and or.²⁰ One exception is for Boolean operators, discussed later.

1. Basic search techniques

The relatively simple and effective techniques described below, help users narrow and focus their searches. In the subsections below, an operator will appear in all capitals to distinguish it from text. However, for actual searches, the user does not need to capitalize the operator except for the noted case.

a. Exact match: “term1 term2”

Placing multiple words within quotation marks, returns only sites where these words appear next to each other. For example, a search for John Doe without quotation marks would return sites where any last name follows the first name John, and those where any first name precedes the last name Doe, names like John Deere and Jane Doe.

A word of caution with using quotation marks. Following up on the example used, John Doe may have a middle name, where it appears in full, or simply as an initial. In addition, names like William may also appear as Will or Bill. Without quotes, Google will return sites with the alternative names; with quotes, it will not.

²⁰ For a complete listing of stop words, see <https://www.likemind.media/seo-stop-words-guide-2020-including-list/>.

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Example: “John Doe”

b. Boolean operators: OR, AND

When Google encounters a string of search terms, the default Boolean operator is AND. The searcher can specify another Boolean operator, OR. This operator is useful when there are multiple expressions/spellings for the same term. The Boolean OR is case sensitive. Google will only recognize Boolean operators if they are capitalized. An alternative way to express OR is with the pipe character |.

Example: “John Doe” OR “Jonny Doe”

“John Doe” | “Jonny Doe”

c. Hyphen filter to exclude words: -term

The hyphen filter, or minus sign, helps eliminate words that appear in results unrelated to the intended search. This situation arises when a search term has two meanings. The term bass could mean a type of male singer or a type of fish. If the searcher wants results for the singer, adding -fish to the query would help limit the search to male singers. There is no space between the hyphen and the word.

Example: bass -fish

d. Plus filter to force Google to consider words: +term

Google does not always ignore stop words because sometimes stop words change the meaning of the search query. Google's algorithms are smart enough to consider the stop words and interpret the meaning of the query by looking at the words around the main keyword. In cases where Google does not consider a stop word that is important to narrow down a search, the user can force the query to consider it.

Example: +how

e. Synonym operator: ~word

The tilde “~” operator takes the word immediately following it and searches both for that specific word and for the word's synonyms. The presence of the operator also causes the Google search engine to look for alternative endings to the search word. Syntactically, there is no space between the tilde and the search word. Therefore, entering the search query ~inexpensive will also search for synonyms such as cheap, affordable, low cost, and alternative endings such as inexpensively.

Example: ~inexpensive

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f. Missing words: term1 * term2

Google will fill in one or more words between the search terms when the query includes the wild card operator “*”. For example, the search “cry * milk” can search for “cry over spilled milk.” Note that there are spaces between the operator and the words.

Example: cry * milk

g. Find pages with words within X of each other: word1 AROUND(X) word2

The around operator returns pages that contain the specified two words within a given number of words of each other. The term X is the maximum separation; the search will deliver pages with smaller separation too. This is a useful tool to flesh out incomplete information. Note that AROUND needs to be in capitals.

Example: cry AROUND(2) milk

h. Currency operators: \$ (US Dollars) and € (Euro)

The currency operator searches for prices. Placing the dollar or Euro sign before a number directs Google to search for prices. This operator works only with U.S. Dollars and Euros; it does not work with £ (British Pounds) or ¥ (Japanese Yen and Chinese yuan).

Example: breakfast under \$10

i. Numbers within a range: number1..number2

The range operator returns pages that contain numbers that fall within the specified range. It consists of two periods placed between two numbers. This is useful for identifying events within a certain date range, version numbers, or price. Note that the number could have a currency operator like a dollar sign.

Example: russian revolution 1800..2000

returns sites about the Russian revolution(s) between the years 1800 and 2000.

Example: recumbent bicycle \$250..\$1000

returns sites with recumbent bicycles priced between \$250 and \$1,000.

j. Convert equivalent units: term1 in term2

The IN operator converts the units of the search term. Examples include converting miles per hour to kilometers per hour, or temperature from Centigrade to Fahrenheit.

Example: 36 c in f

Converts the temperature 36 C to its equivalent in Fahrenheit.

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2. Advanced search techniques

Advanced techniques look at data that most users do not search, such as the metadata, and artifacts that web site complexity may have introduced. As entities change, revise, and update their web sites they may inadvertently leave references, links, and other artifacts that the entity may have intended the revised web site to contain. Advanced search techniques may reveal these website artifacts. In web parlance, using these techniques is called Google hacking or Google dorking. In 2013, Iranian hacker, Hamid Firoozi, used Google dorking to gain access to the Bowman Avenue Dam in Rye Brook, N.Y.²¹

The Google Hacking Database (GHDB)²² is a categorized index of Internet search engine queries designed to uncover interesting, and usually sensitive, information made publicly available on the Internet. The GHDB has almost 6,000 entries dating back to 2003.

The queries that use a colon as part of the operator, work best if the user does not insert a space between the colon and the subsequent query word. Although the syntax of some queries permits a space after the colon, the searches work equally well without a space. Adopting a habit of not using a space eliminates the need to remember which queries allow what.

a. Setting a date range: **before:yyyy-mm-dd after:yyyy-mm-dd**

The searcher can specify the desired date range for the search. The “before” operator will show results that Google indexed before the specified date. The “after” operator will show results that Google indexed after the specified date. These operators, when used together can also set a range of dates. Note that there is no space between the colon and the date.

Example: before:2020-04-01 after:2020-02-29

Provides search results for webpages indexed in March 2020.

b. Searching cached pages: **cache:name.com term**

Google caches as many web pages as possible during its crawl of the Internet. The CACHE operator allows a user to search these cached pages anonymously. When web site operators remove a page from their web site, it remains in the Google cache. From the user's perspective, there are two benefits to the search technique. First, in contrast to di-

²¹ R. Takala, “Iranian hacker allegedly used Google to hack dam,” *Washington Times*, March 28, 2016. <https://www.washingtonexaminer.com/iranian-hacker-allegedly-used-google-to-hack-dam>

²² <https://www.exploit-db.com/google-hacking-database>

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rectly visiting an active web site, accessing a cached page does not show in a user's browsing history. Second, this operator is particularly helpful in the event that a search returns the dreaded 404. Searching cached pages of that site can return pages before the link broke.

Example: cache:forbes.com gold

Returns cached forbes.com pages with the term gold.

c. File type operator: filetype:extension

Using a file type operator will limit pages returned to those that only have the specified extension. For example, a search expression with filetype:pdf will only return pages in the portable document format, pdf. Likewise, filetype:ppt will return Microsoft PowerPoint presentations. It is important to remember that newer PowerPoint documents may have the extension pptx, and so to capture all presentations, two searches are necessary, one for each extension. This also applies to Microsoft Word and Microsoft Excel files. Table 2 provides a list of extensions that the user can specify.

Example: filetype:doc

Returns webpages in the pre-2007 versions of Word.

Table 2: List of extensions

7z	Compressed file	odp	Open office presentation
bmp	Bitmap image	ods	Open office spreadsheet
doc	Microsoft word	odt	Open office text
docx	Microsoft word	pdf	Adobe acrobat
dwf	Autodesk	png	image
gif	Animated image	ppt	Microsoft PowerPoint
htm	Web page	pptx	Microsoft PowerPoint
html	Web page	rar	Compressed file
jpg	Image	rtf	Rich text format
jpeg	Image	xls	Excel spreadsheet
kml	Google earth	xlsx	Excel spreadsheet
kmz	Google earth		

d. Site operator: site:name.com term

The SITE operator will provide the results of a query only from a specific site; it limits the search to look only at that web domain. For example, the search of a particular name will usually yield only one or two pages of a particular site even though the name may

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appear more often. This is particularly useful when searching sites like newspapers and magazines, where the search term may appear multiple times, spanning many issues.

Example: site:forbes.com "john doe"

Returns only references to John Doe on forbes.com

A search can use the SITE operator to limit searches to specific domains like .com, .gov, .edu, .org, or .mil.

Example: iraq site:.gov

Returns only references to Iraq on .gov sites.

e. In title operator: intitle:term

Every web page has an official title. Webpage designers choose the words in the title so that search engines will index the page. Sometimes these words do not actually even appear on the page itself. Since the designer can put only a limited amount of text in the title, designers chose the words carefully. The INTITLE operator finds pages with specific words in the title.

Example: intitle:Alaska

Finds all pages that have the word Alaska in their title.

f. Include all specified words in title: allintitle:term1 term2

The ALLINTITLE search will produce results, which contain each term specified within the title.

Example: allintitle:alaska gold

Finds all pages that have the words Alaska and gold in their title.

g. Directory listings: intitle:index.of term

A powerful variation of the INTITLE operator can find the directory of the site. It takes advantage of the tendency of web designers to use "index of" in the title to denote directory listings. A refinement is to search for the key words "parent directory" found inside of a directory listing using **intitle:index.of "parent directory" site**. The result will be a page providing an index to all of the pages of a web site. See Figure 6 for an example of an index.

Example: intitle:index.of "parent directory" musser.net

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Name	Last modified	Size	Description
Parent Directory			-
ATT&CK-Stuff/	2020-03-13 22:52	-	
AnonOpSecPrivacy.html	2020-03-13 22:52	116K	
Basic.html	2020-03-13 22:52	45K	
Building_A_Lab.html	2020-03-13 22:52	44K	
CTFs_Wargames.html	2020-03-13 22:52	24K	
CandE.html	2020-03-13 22:52	62K	
Career.html	2020-03-13 22:52	78K	
Cars.html	2020-03-13 22:52	19K	
Cheats.html	2020-03-13 22:52	23K	

Figure 6: Example of parent directory index

h. Search only in text of page: `intext:term`

The INTEXT operator limits the search to only the text of the page. As indicated in the section on basic search techniques, putting a string of words in quotations for the search term will search for that string. This search operator is useful to finding pages that reference people and companies.

Example: `site:mit.edu intext:Slusarczuk`

Finds all pages on mit.edu with the name Slusarczuk

i. Multiple words in text: `allintext:term1 term2 term3`

The ALLINTEXT search operator effectively conducts multiple INTEXT searches of the text of the web page with one command.

3. Customizing Google with extensions

Google has taken a very basic, no-frills approach to displaying search results. While this lets new users immediately find the site useful, as users gain experience with Google, they can benefit significantly from customization using extensions. All of the extensions discussed below come from the Google Chrome Web Store. Be aware that a number of 3rd party web sites offer the same Google extensions by offering a limited number of uses over a specified time period for a fee. It is best to get the extensions directly from Google.

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a. WhenX

A common problem when performing a deep dive is that the insight that a particular site is useful comes only after performing a number of other searches. The difficulty becomes retracing ones steps though the digital ether. WhenX²³ provides both a timestamp when the user last visited a site, and the ability to make notes about a site that will appear in future searches. The time stamp appears to the right of the search entry (Figure 7). Hovering the cursor over the time stamp provides the exact time and date.

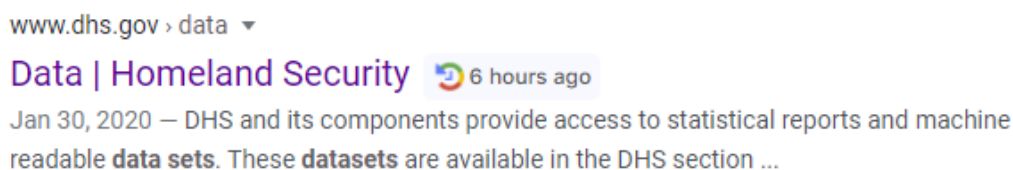


Figure 7: Time stamp that WhenX provides

The extension provides time stamps for sites the user visited before he or she installed WhenX. WhenX uses the local browser history, does not send the user history to any server, and does not leave the user's local machine.

4. Using image search on Google

Using the images search option in Google is a good way to check if the text you entered was sufficiently descriptive to produce the results for which you are looking. If the images are relevant to your search, you have tuned the search criteria well. Changing the search criteria slightly will let you see if you are narrowing in on the sought after results. This search approach is particularly useful for finding tables, figures, and graphs in technical papers.

One of the problems with an image search is that Pinterest, which is not helpful for most searches will often have many results. The Google filter Unpinterested!,²⁴ removes all Pinterest pages from your search results, both in image searches and regular searches. The filter is available for both Chrome and Firefox. A simple toggle, which appears in the "manage extensions" icon in the upper right of the screen enables and disables the filter. Essentially, what this extension does is automatically insert -site:pinterest to the search query.

²³ <https://chrome.google.com/webstore/detail/whenx-notes-timestamps-fo/dgafcid-lgmbcehokgdeghmfnbpbflhh>

²⁴ <https://chrome.google.com/webstore/detail/unpinterested/gefaihkenmchjmcpcbdiipoknfjpbfe?hl=en>

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B. Foreign search techniques

Most search engines normally do not display foreign websites up front in searches. They will be within the search results, but with searches returning millions of pages, unless they appear in the first ten pages of search results most users do not get to them. Certain techniques will help bring up foreign sites to the forefront of the results.

1. Region settings in search engines

Search engines use different mechanisms to set the default region for a search, like setting the region from which the user had logged in. The user can set an alternative region for the search engine.

a. Setting the region on Google

In the lower right hand corner of the Google.com search page, the user can select “settings.” Clicking on settings opens a page with several options. At the bottom of the page, the user can set the region for the search. The default is “current region,” the region from which the user had logged in. Alternatively, the user can select one of almost 200 other regions. Regions are not just countries, but include entities like the U.S. Virgin Islands.

b. Setting the region on Bing

In the upper right-hand corner of the main search page Bing shows three horizontal bars. Clicking brings up a drop down menu that includes the term “settings.” Clicking on settings brings up another drop down menu, which has the option “Country/Region.” Just below Country/Region, Bing identifies the current choice. Clicking Country/Region brings up a long list of options from which the user can select. Once the user selects a Country/Region it will be the one of choice for subsequent searches until the user changes it or clears the cookies.

One way the user can narrow the search in the U.S. is to set the location by Zip code. This option appears in the “Search” group of the settings.

c. Setting the region in DuckDuckGo

In the upper right-hand corner of the main search page DuckDuckGo shows three horizontal bars. Clicking brings up a sidebar with menu items that includes the term “all settings.” Clicking on all settings brings up page, which has the option “Region” at the top. A box on the right hand side identifies the current choice, which by default is set to “All regions.” Clicking the box brings up a long list of options from which the user can select.

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d. Setting the region in Yahoo Search

Setting the region in Yahoo Search is not as straightforward as in Google or Bing. The home page of Yahoo Search does not offer any settings among the five options at the bottom of the page. Yahoo's home page offers different options across the top of the page, but the user has to select "more. . ." and then scroll all the way to the bottom of the page to see "Choose your country." Selecting brings up a list of countries from which the user can select. Picking a country then opens Yahoo's home page for that country. At that point, the user can select "more. . ." which then offers "Search" as an option. Selecting "Search" brings up the Yahoo Search page for the region.

2. CORDIS

The European Commission requires all research projects that receive funding from the EU to make their results available publicly. The Community Research and Development Information Service (**CORDIS**)²⁵ is the primary repository for project fact sheets, reports, and deliverables. CORDIS maintains a web site where anyone can search for information about research projects. Although the website is available in six languages English, French, German, Italian, Spanish, and Polish, much of the scientific content is only in English.

CORDIS has 12 searchable databases, which users can access from a multilingual home page.²⁶ Searching a company name produces a list of publications that reference the company. Each entry identifies which of the twelve databases, like project, news, results, publication, programs, etc., contains the reference. The user has the option of filtering databases to limit the search to, the domain of the application, the field of science of a project, and which multi-year major program, called framework, funded the effort. The entry also identifies in what languages in addition to English the user can retrieve the entry.

C. Useful search sites

There is an abundance of data available on the Internet for free or for a fee. The challenge is finding data sets that are current, complete, and accurate. To be useful, data requires curation, which is time-consuming and expensive. Free sites may not have quality data. Sites that normally charge a fee, often offer limited free searches. Some fee-based sites offer a free trial period. Most however require the user to provide a credit card number, and after the free trial, the site converts to fee-based, charging the card.

²⁵ <https://cordis.europa.eu/en>

²⁶ <http://www.wbc-inco.net/glossary/11.html>

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1. Wiki sites

A wiki is a hypertext publication that users collaboratively edit and manage using a web browser. It is a site designed to let groups of people quickly capture and share ideas by creating simple web pages and linking them together. The term wiki derives from the Hawaiian word for quick.

A wiki allows collaborative editing of its content and structure by its users. Because the curators can remain anonymous and can publish without credentials, wiki sites may contain incorrect or biased information. Proponents of wikis contend that the ability of the community of users to edit makes the sites self-correcting – responsible users will edit out bad information. Virtually every wiki contains a “Recent Changes” page, which tracks the content and how it changed.²⁷

There is a wide variety of wiki sites that address a diverse range of interests and activities.²⁸

a. Wikipedia

The online encyclopedia project Wikipedia²⁹ is the most popular wiki-based website, and is one of the most widely viewed sites in the world. Although it is sometimes inaccurate, biased, or outdated, Wikipedia can be a good starting point for a search. A typical Wikipedia entry will provide a good summary of a company, its key personnel, locations, and products. A very useful resource of Wikipedia is the list of references at the bottom of the page.

b. Scholarpedia

In contrast to Wikipedia, Scholarpedia³⁰ is a peer-reviewed open-access encyclopedia, where communities of experts create and curate the content. Academics author encyclopedic articles on the subject areas within their expertise. Each article undergoes scholarly peer-review and, if accepted, the site publishes it. As the field advances and evolves, expert curators vet article revisions.

²⁷ The “history” tab will usually show who has edited the page. Typically, it will display usernames for editors who have registered with the wiki, and IP addresses for editors who have not registered.

²⁸ For a list of wiki sites, see https://en.wikipedia.org/wiki/List_of_wikis

²⁹ <https://www.wikipedia.org/>

³⁰ http://www.scholarpedia.org/article/Main_Page

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c. wikiHow

WikiHow³¹ is a website where users share information on how to perform a certain task. It has a number of hacking tips in the computers and electronics section.

2. Archives

Archives accumulate historical records and may include newspapers, newscasts, video, and other media. They provide researchers with material and content no longer readily available.

a. Wayback Machine

The Wayback Machine, also known as the Internet Archive³² is a digital archive of the Internet. The Internet Archive, a 501(c)(3) non-profit organization, created and maintains this resource. The project started in 1996, and went public 5 years later in 2001. When the project first opened to the public, the Archive consisted of over 10 billion web pages. Today, the Archive has over 458 billion web pages.

The Archive uses software web crawlers to access and download all publicly available web pages. It also accepts content from partners and contributors. The web crawls are huge efforts. The March 2011 crawl ran from March 9, 2011 to December 23, 2011, capturing 2.7 billion snapshots of 2.3 billion unique URLs from 29 million unique websites.³³

The Archive is a very simple tool to use. Simply enter the URL for the site into the search box, and the Archive returns a map of captured pages, as Figure 8 shows. The calendar bar at the top shows the relative number of captures for each month in a year. A more detailed calendar below expands the highlighted year with circled dates. Each circle indicates a day on which a crawler captured the page. The size of the circle indicates the number of page captures. Hovering the cursor over the circle pops up a small window with the times of the page captures. Clicking on the time opens the page.

³¹ <https://www.wikihow.com/wikiHow>About-wikiHow>

³² <https://archive.org/about/>

³³ Kalev Leetaru, "The Internet Archive turns 20: a behind the scenes look at archiving the web," *Forbes*, January 18, 2016. <https://www.forbes.com/sites/kalevleetaru/2016/01/18/the-internet-archive-turns-20-a-behind-the-scenes-look-at-archiving-the-web/#6efbc2a482e0>

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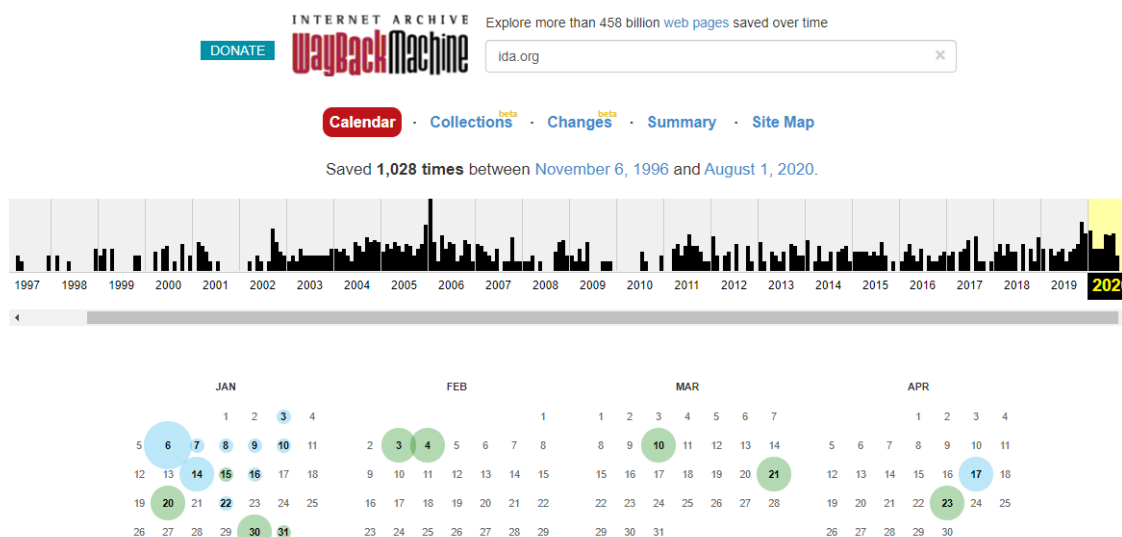


Figure 8: History of archived ida.org web pages

The Archive is a very useful research tool. One application is anonymity. Simply looking at the most recent image in the Archive, allows a researcher to see the content of a web page without leaving a browsing record.

Another application of the Archive is to see what the site owner chose to add or remove. This includes discontinued products, new products, or business areas. Along the same Similar to the site operator search, the Archive may reveal pages that the web site revealed inadvertently, and then took down.

The Archive can pull up the pages of websites that are no longer active – the 404. Along this line, the Archive offers a service that captures and saves a web site used by an author as an URL reference in a publication.³⁴ That way, when the web site disappears or changes, a reader of the publication can still access the intended citation.

b. News Link

News Link³⁵ provides links to media web sites including those for newspapers, magazines, radio, and television stations. It offers different types of search paths including by state, metro area, geographic region, frequency of publication, or by subject area, i.e. entertainment, family, religion, etc.

³⁴ Select “Web” at the top of the page to access this feature.

³⁵ <http://www.newslink.org/mag.html>

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c. Vanderbilt Television News Archive

The Vanderbilt Television News Archive³⁶ began recording news broadcasts on August 5, 1968. Its mission is to preserve, and provide access to, the news broadcasts of U.S. national television networks. The Archive works in partnership with the Motion Picture, Broadcasting, and Recorded Sound Division of the Library of Congress. It provides copies of the programs that it records to the Library of Congress for permanent preservation and they become part of the Library of Congress collection.

Because of copyright law, the Archive can only loan the material to users by copying the requested content onto USB drives for delivery to users. Although, the length of the loan is flexible, the default lending period is for 30 days, and the users must return the borrowed material to the Archive. There is a cost associated with this online service. Vanderbilt students, faculty and staff pay \$25 per half hour of content; users associated with an educational institution pay \$50 per half hour; and all other users pay \$100 per half hour.

d. Google news archive

Searches of Google news provides access to articles going back only about 30 days. The Google news archive,³⁷ however, contains a large number of digitized historic newspapers, and provides free access to many issues. Google photographed or scanned many of the older pages, so the image quality may be poor. Google discontinued the newspaper archive project in 2011. Although they stopped digitizing and adding new papers, previously digitized historical newspapers remain accessible. Regretfully, Google also removed their timeline and other search tools.

e. Chronicling America

Chronicling America³⁸ provides information about historic newspapers and provides access to select digitized newspaper pages. It includes newspapers printed between 1789 and 1963. It offers several different views of the data, all of which are publicly visible. Each view uses common Web protocols, and access is not restricted in any way. Together the views make up an extensive application-programming interface (API) which users can use to explore the data in different ways.

³⁶ <https://tvnews.vanderbilt.edu/about>

³⁷ <https://news.google.com/newspapers>

³⁸ <https://chroniclingamerica.loc.gov/about/>

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f. The National Digital Newspaper Program

The National Digital Newspaper Program (NDNP)³⁹ is a partnership between the National Endowment for the Humanities (NEH) and the Library of Congress. It is developing an Internet-based, searchable database of U.S. newspapers with descriptive information and select digitization of historic pages. An NEH award program funds the NDNP to include content from all U.S. states and territories eventually. This project is a work-in-progress, and uses the OpenSearch as the search tool.

3. U. S. Securities and Exchange Commission (SEC)

The SEC maintains a searchable database of corporate filings, EDGAR.⁴⁰ The SEC website has the annual report known as the 10-K, quarterly report 10-Q, current report 8-K, and proxy statements of all companies traded on U.S. exchanges. It has an advanced research tool that can access the full text of all electronic filings since 2000.⁴¹

10-K statements provide fiscal year financial statements and contain the descriptions of the business, properties, directors, and executive officers, and the security ownership of beneficial owners. Some libraries provide access to **ProQuest Historical Annual Reports**,⁴² which has compiled an archive of annual reports.

10Q statements provide quarterly financial statements, which contain a management discussion, information on legal proceedings, changes in securities, defaults upon senior securities, submission of matters to a vote of security holders, exhibits, and reports.

Form 8-K is the "current report" that notifies investors or security holders of the occurrence of any material events or corporate changes, which are of importance to them, and that the company has not reported previously. It provides more current information on certain specified events than would Forms 10-Q or 10-K.

A company issues Proxy Statements, 14-A, when it officially notifies designated classes of shareholders of matters that require a vote at upcoming shareholders meetings. Companies often solicit proxy votes for company officer elections. Proxy statements also contain executive compensation data.

³⁹ <https://www.loc.gov/ndnp/>

⁴⁰ <https://www.sec.gov/edgar/searchedgar/companysearch.html>

⁴¹ <https://www.sec.gov/edgar/search/>

⁴² https://about.proquest.com/products-services/pq_hist_annual_repts.html

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4. Public records

Public records searches used to be extremely tedious and time consuming. They required a physical trip to the various entities that were custodians of the records, and often the user had to request a document and wait for a clerk to retrieve it. **Search Systems**,⁴³ established in 1990, has located, analyzed, described, and organized links to over 70,000 databases by type and location. They help users find property, criminal, court, birth, death, marriage, divorce, licenses, deeds, mortgages, corporate, business registration, and many other public record resources quickly and easily. Search Systems provides some very basic information free, but getting results that are more detailed requires a paid membership with a monthly fee.

A state's vital records office keeps records of life's major events, including certificates of birth, death, marriage, and divorce. The information contained in these forms depends on state law, which varies significantly. Users access most information online and many of the states outsource the task of providing access to vital records to a commercial entity, with VitalChek⁴⁴ being one of the more commonly used services.

a. Birth

Birth certificates record the child's name, sex, date, place of birth, and the names of the parents, including the mother's maiden name. Some include additional details, such as the name of the hospital, birthplace of parents, occupation of the parents, marital status of the mother, the number of other children born to the mother, and the number this child is in the family.

b. Marriage

There are two official marriage records, the marriage license and the marriage certificate. The appropriate local authority, usually the county clerk's office issues a marriage license, which confirms that two people are legally qualified and allowed to marry. The parties obtain the license before the marriage ceremony itself.

The state issues the marriage certificate as proof that a marriage has occurred. The couple and their witnesses sign the marriage license, which the officiant files with the County clerk. California authorizes the confidential marriage certificate, which is not open to the public without a court order.

⁴³ <https://publicrecords.searchsystems.net/>

⁴⁴ <https://www.vitalchek.com/>

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c. Divorce

For the most part, divorce records are public information and are generally available to anyone, but some states limit who can access the records. Since the court system handles divorces at the local level, it is necessary to know the jurisdiction where the divorce took place. Courts can seal divorce records to protect the identity of children, to protect victims of abuse, or at the parties' request.

d. Death

The Social Security Death Index,⁴⁵ also known as the Death Master File, is a government database that includes the name, birthdate, date of death, and Social Security number of Americans who have died since 1936. To gain limited access to the Death Master File, members of the financial community, insurance companies, security firms and state and local governments must file a Certification Form attesting that they are authorized to have access, and will use the database to prevent identity fraud.⁴⁶ Genealogy researchers can purchase information through commercial sites like Ancestry.com, use the database to build family trees. The entire database is available from the National Technical Information Service⁴⁷ for an annual fee of \$2,930.

5. Private databases

The private database space is rather crowded, with companies trying to differentiate by packaging information so that it targets specific user groups. Such user groups include sales and marketing teams, business development professionals, investors, competitive intelligence gatherers, and others. The database companies continuously adjust and refine their platforms to zero in on the best strategy to capture market share. As a result, the information about these databases that follows may change.

With all the data out there, the challenge is not finding data, but finding data that are complete, current, and accurate. A good aid for evaluating the quality of information sources is **Finances Online**.⁴⁸ It reviews and ranks business intelligence software providers.

⁴⁵ https://www.ssa.gov/dataexchange/request_dmf.html

⁴⁶ <https://ladmf.ntis.gov/docs/subscribercertificationform-FM161.pdf>

⁴⁷ <https://dmf.ntis.gov/>

⁴⁸ <https://business-intelligence.financesonline.com/>

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a. The financial data industry leaders

Four large providers dominate the financial data industry, Bloomberg with 33.4% market share, Eikon with 23.1%, Capital IQ with 5.6%, and FactSet with 4.2%.⁴⁹

One of the first providers of financial information about companies is the **Bloomberg Terminal**, founded in 1981.⁵⁰ . Because its origins predate the wide use of the personal computer, which also came out in 1981, it initially used its own, special terminal, which gave it its name. Today, its software will run on any PC system. This very powerful tool is rather expensive, with subscriptions costing \$20,000 to \$24,000 per year, depending on the number of seats licensed.

Eikon,⁵¹ a Thomson Reuters company, provides company and economic data, news, and analytics. It leverages the analysis and commentary of 2,500 Reuter's journalists worldwide. Eikon offers many of the same financial data as Bloomberg, but users generally consider it the lesser option in terms of data breadth. Eikon costs \$22,000 per year, but a stripped down version can cost as little as \$3,600 per year. It offers a free trial.

The **S&P Capital IQ**⁵² platform is a source of financial data, analytics, and research. This web-based platform provides information on companies, markets, and financial professionals worldwide, as well as tools for analysis. It is fee-based, and does not offer any limited or free capabilities. Capital IQ offers a \$50 reward to clients who find a verified mistake or omission in their platform.

FactSet⁵³ provides details on millions of private companies, including SEC filers, private companies with public debt, companies involved in merger and acquisition (M&A) transactions, private equity, and venture-capital-backed companies. It has details on financing rounds, securities invested and investment date, in-depth analysis of the deal with links to sources, board seats, and percent held. Entity maps provide links to subsidiaries and parents of private companies. The private company data includes business descriptions, company contacts, industry data, management and board information, financials, and transactions via M&A. A FactSet subscription costs \$12,000 per year

⁴⁹ <https://www.wallstreetprep.com/knowledge/bloomberg-vs-capital-iq-vs-factset-vs-thomson-reuters-eikon/>

⁵⁰ <https://www.bloomberg.com/professional/download/fee-schedule/>

⁵¹ <https://solutions.refinitiv.com/eikon-trading-software/>

⁵² <https://www.spglobal.com/marketintelligence/en/solutions/sp-capital-iq-platform>

⁵³ <https://www.factset.com/solutions/business-needs/data-solutions/core-company-data#private-company-data>

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b. Other financial web sites

Crunchbase⁵⁴ focuses on investor and funding data. It provides limited information free and offers paid subscriptions with enhanced access.

The limited free version of **D&B Hoover's**⁵⁵ offers concise descriptions of thousands of companies based in the United States and abroad. The capsules include the name, address, phone number, and website; ranking in lists of largest publicly traded or privately held companies; brief overview of its operations; and top competitors. Paid subscriptions give users access to additional information, including narrative profiles, more details on products and subsidiaries, and biographical information about top executives and directors.

Mergent Online,⁵⁶ a FTSE Russell company, provides information on financials, descriptions, history, property, subsidiaries, officers, and directors. Costing \$2,500 per year, it covers U.S. and non-U.S. public and private companies.

Bureau van Dijk, a Moody's Analytics Company, offers **Orbis**,⁵⁷ which consolidates data from more than 170 separate providers, and hundreds of its own sources. Orbis has information on over 375 million companies and entities worldwide. Searches return information in a standardized format that makes it easy to use.

Mint Global,⁵⁸ provides the Orbis database on a simpler interface designed to reside on the desktops of time-pressured users who do not need the advanced features offered by Bureau van Dijk. Mint Global has five modules: companies, news, market research, executives, and original documents. It is a good resource for research on privately held companies. Mint Global is fee-based, but offers free trials.

NetAdvantage⁵⁹ provides access to Standard & Poor's company profiles, financials, stock reports, and analyses.

Owler⁶⁰ is a community-based business information and insights platform that provides company data and real-time news updates on companies. The information includes competitors, products or services, customers, financials, press reports, links, and social media statistics. Owler obtains its information from two sources. Owler's employees hand-curate information from sources across the web. Owler also crowdsources information

⁵⁴ <https://www.crunchbase.com/>

⁵⁵ <https://www.dnb.com/business-directory.html>

⁵⁶ <https://www.mergentonline.com/>

⁵⁷ <https://www.bvdinfo.com/en-us/our-products/data/international/orbis>

⁵⁸ <https://www.bvdinfo.com/en-us/our-products/data/international/mint-global#secondaryMenuAnchor2>

⁵⁹ <https://www.capitaliq.com/>

⁶⁰ <https://www.owler.com/feed>

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from its more than 3.5 million members. To attract members, Owler initially offered a free plan with generous access.⁶¹ On October 1, 2020, Owler began converting the legacy free accounts to the Owler Basic plan. The Basic plan is still free, but allows much more limited access to financial information than the legacy free accounts.

Prequin⁶² focuses on alternative asset classes, covering private equity, venture capital, hedge funds, private debt, real estate, infrastructure, natural resources, and secondary markets. Since alternative investments can be opaque to many investors, Prequin has a significant focus on educating the investment community. They have created the Prequin Academy,⁶³ a free online resource for early-career professionals, students, and those looking to learn more about the alternative assets industry. Prequin often partners with universities and academics conducting research on alternative assets.

PrivCo⁶⁴ focuses on private companies. Although it offers limited information free, its full capabilities are fee-based with monthly subscription costing \$116.

c. Small investor focused sites

Several popular websites have financial sections. On Yahoo, clicking on Finance at the top of the page takes the user to **Yahoo Finance**.⁶⁵ On the Finance page, the user can enter a company name or stock symbol in the search box, which takes the user to a summary page that has key information on the company and its financial health. Just below the share price, a user can select links to more information about the company.

Google also has a finance page, **Google Finance**.⁶⁶ Like Yahoo, a user can insert a company name or stock symbol in the search box at the top of the page. Google provides a page with information on the company. Unlike Yahoo's page, Google Finance does not offer the user a way to dive deeper to obtain additional information beyond that presented on the summary page.

Seeking Alpha⁶⁷ is a very useful financial web site. It offers crowd-sourced content of financial information. Although crowd-sourced information can be biased and inaccurate, the varied perspectives can be helpful to the user. Like Yahoo and Google, entering a

⁶¹ <https://corp.owler.com/classic>

⁶² <https://www.prequin.com/about/who-we-are>

⁶³ <https://www.prequin.com/academy>

⁶⁴ <https://www.privco.com/>

⁶⁵ <https://finance.yahoo.com/>

⁶⁶ <https://finance.google.com/finance?tab=we>

⁶⁷ <https://seekingalpha.com/>

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company name or symbol in the search box returns a page that provides information about the company.

Seeking Alpha's useful contribution, however, is the Transcripts tab on the top of the summary page for a company. That link provides transcripts of the company's earnings calls and investment house conferences. In addition to the company's presentation, it provides the transcripts of the analysts' questions and the company's responses. Regretfully, only the most recent transcript is available free. The older ones are behind a pay wall. Seeking Alpha's fee for access to all articles and transcripts is \$19.99 per month if the user prepays for a full year, or \$29.99 per month if paid monthly. The monthly option is a possible option for users doing a one-time search.

A useful service that Seeking Alpha offers is the portfolio. A user can add companies to their portfolio, and Seeking Alpha will send the user an email with links as new articles on the company become available. A user can set up multiple portfolios.

Companies use footnotes in their annual and quarterly reports to describe in detail the practices and reporting policies of the company's accounting methods and disclose additional information that the statements themselves do not show. **Footnoted**⁶⁸ is an information service that uses proprietary search techniques to find signs of potential problems buried deep in SEC filing footnotes.

d. Data bases tailored for government users

Reference Solutions⁶⁹ is a division of Data Axle that targets the government user.⁷⁰ It is on the General Services Administration (GSA) Schedule, and is part of the Federal Library and Information Network (FEDLINK). Reference Solutions provides database products that include state business directories, an American big business directory, American manufacturers directory, and others. Products are available in print, CD-ROM, or via the Internet.

Reference Solutions compiles its data from Yellow Page and Business White Page telephone directories; corporate annual reports and other SEC information; professional and specialty directories; federal, state, provincial, and municipal governments; business magazines, trade publications, newsletters, newspapers, industry directories, and Postal Service change of address updates.

⁶⁸ <https://www.footnoted.com/>

⁶⁹ <https://www.bloomberg.com/professional/download/fee-schedule/>

⁷⁰ <https://www.referenceusagov.com/Static/Home>

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e. Academic databases and search engines

Wikiwand⁷¹ provides an extensive list of academic databases and search engines for finding and accessing articles in academic journals, institutional repositories, archives, or other collections of scientific articles. It provides links to the sites, information about the disciplines covered, whether the articles are available at no cost, and the provider.

Google Scholar⁷² limits searches to peer-reviewed online academic journals, books, conference papers, theses and dissertations, preprints, abstracts, technical reports, and other scholarly literature. A toggle on the search page allows the user to select between articles and case law. Once a user submits the query, Google Scholar allows the user to refine the search further. The user can specify the date range, as well as include or omit patents and citations. The user can also elect to sort the results of the search by relevance or by date.

Google Books⁷³ performs full text searches of books. If the book is out of copyright, or the publisher has given Google permission, the user will be able to see a preview of the book, and in some cases the entire text. If it is in the public domain, you are free to download a portable document format (PDF) copy.

Scopus⁷⁴ is a fee-based academic abstract and citation service used by many academic libraries to search books, research and scientific journals, trade journals and patent databases. Elsevier, one of the largest international publishers of scientific journals, owns Scopus. Every year, Scopus reviews all of the journals that it covers to ensure each publication maintains high quality standards.

Microsoft Academic,⁷⁵ developed by Microsoft Research, is a free, public web search engine for academic publications and literature. The search engine uses semantic search technologies, it finds the best matches for the user's meaning or intent, and does not just match keywords. It indexes over 220 million publications, 88 million of which are journal articles. Preliminary reviews suggest the new Microsoft Academic Search is a competitor to Google Scholar and Scopus for academic research purposes.

Microsoft Academic offers more functionality than Google Scholar does. At the left margin, bar graphs present the search results partitioned into subcategories (Figure 9). In addition to setting the time span for the search to covered, by checking a box, users can

⁷¹ https://www.wikiwand.com/en/List_of_academic_databases_and_search_engines

⁷² <https://scholar.google.com/>

⁷³ <https://books.google.com/>

⁷⁴ <https://www.scopus.com/search/form.uri?display=basic>

⁷⁵ <https://academic.microsoft.com/home>

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filter the search results based on eight subcategories: top topics, publication types, top authors, top journals, top institutions, top conferences, top Medical Subject Headings (MeSH), and top MeSH qualifiers.

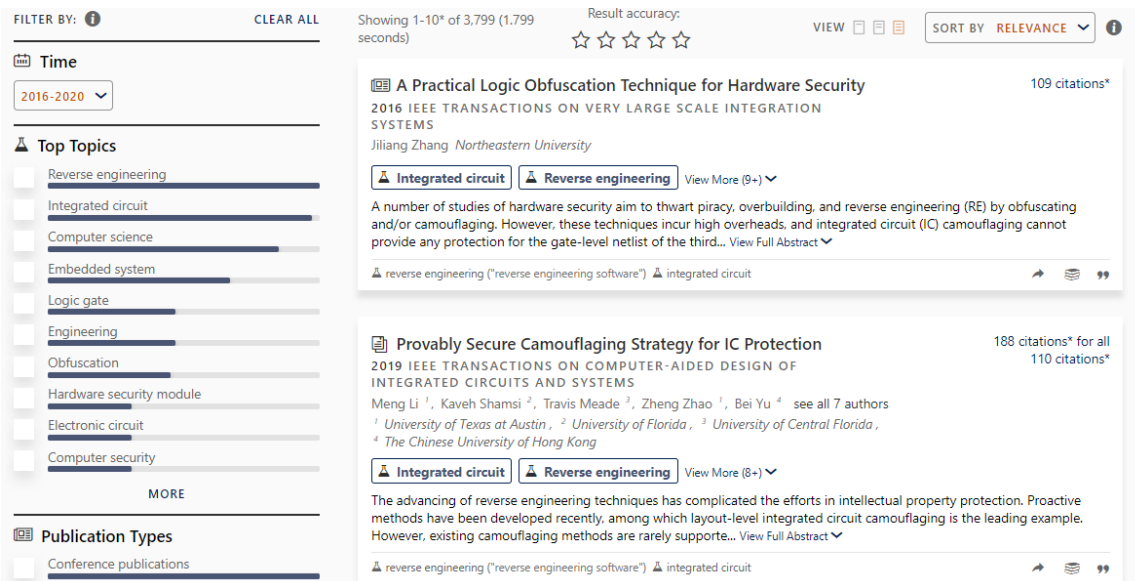


Figure 9: Filters available for searches on Microsoft Academic

6. Social policy sites

Social policy sites are *not* social media sites. A number of non-profit community, environmental, and labor activist groups publish and curate sites with guidance on how to gather information about corporations.⁷⁶ One of the benefits of this class of data sites is that most do not require payment or will waive payment to other non-profit organizations and reporters.

The web site **OpenCorporates**⁷⁷ is a public benefit corporation funded by a trust. Like most web sites that provide data, it has a teaser section that is accessible free, and several levels of paid subscription services starting at 99 British pounds per year. They also offer no cost accounts with full access to non-government organizations (NGO) and journalists.

The paid version provides information on all the branches and subsidiaries of a company, including directors, officers, beneficial owners, nationalities, and addresses.⁷⁸ The

⁷⁶ <https://www.corp-research.org/ddresearchguide>

⁷⁷ <https://opencorporates.com/>

⁷⁸ This video shows the use of OpenCorporates to investigate money laundering.
<https://www.youtube.com/watch?v=gub5Km4sA6c>

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free version provides more limited data set access, and does not allow for data filtering or downloading information as CSV or XML files. In addition to current data, it provides inactive historical information.

The **Corporate Research Project**⁷⁹ assists community, environmental, and labor organizations in researching companies and industries. Its focus is on identifying information that activists can use to advance corporate accountability campaigns. They publish a very helpful guide, “Dirt Diggers Digest Guide to Strategic Corporate Research,”⁸⁰ which identifies data sources for corporate research and provides guidance on how to use them.

Strategic Corporate Research⁸¹ provides guidance and resources to community and union activists for conducting corporate research. Appendix B in this report has Strategic Corporate Research’s outline of a research report and the 24-question model for conducting searches. The web site has a page with links for each of the numbered boxes on the question model for U.S. public corporations,⁸² U.S. private corporations,⁸³ and U.S. non-profit organizations.⁸⁴ It has similar charts for non-profit and public sector entities.⁸⁵ The Strategic Corporate Research web site provides similar coverage for Canadian and United Kingdom entities.

The **Public Accountability Initiative**⁸⁶ (PAI) is a nonprofit public interest research organization focused on corporate and government accountability. They specialize in researching and mapping power networks of wealthy and powerful people, organizations, and their relationships. Figure 10 shows their target population.

79 <https://www.corp-research.org/home-page>

80 <https://www.corp-research.org/dddresearchguide>

81 <http://strategiccorporateresearch.org/>

82 <http://strategiccorporateresearch.org/united-states/u-s-private-sector-publicly-traded-firms/>

83 <http://strategiccorporateresearch.org/united-states/u-s-privately-held-firms/>

84 <http://strategiccorporateresearch.org/united-states/u-s-not-for-profit/>

85 <http://strategiccorporateresearch.org/resources/>

86 <https://public-accountability.org/about/>

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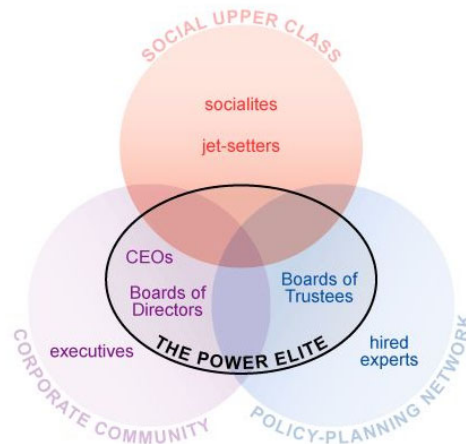


Figure 10: Public Accountability Initiative's research target area

PAI conducts training sessions and workshops for researchers, activists, and journalists on how to research power networks, and particularly corporate power. They built and maintain **LittleSis**,⁸⁷ a database and research platform that tracks information on powerful people and organizations. They picked the name to be the opposite of Big Brother.

7. Job search sites

Since job search sites want to attract job seekers, the information that they provide about companies is free. The job description/qualifications listed for job opportunities can provide insights into the technical and business areas that a company is pursuing. This is particularly true for companies entering new business sectors where they do not have significant resident talent.

The job-hunting site **Zippia**⁸⁸ provides job seekers with an overview of, and insights into a prospective employer. In addition to the expected information about the size, location, business area, and revenues of a prospective employer, Zippia provides insights like salary ranges, worker demographics, and the colleges and universities attended by employees, as well as their majors and political affiliation.

Glassdoor⁸⁹ provides information on over 600,000 companies worldwide. It also provides applicant and employee reviews, to which the company can respond and comment. This provides a balanced view, eliminates trolls, and mitigates biased reviews. Glassdoor

⁸⁷ <https://littlesis.org/>

⁸⁸ <https://www.zippia.com/company/>

⁸⁹ <https://www.glassdoor.com/index.htm>

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requires users to provide some minimal information about themselves to access the material available at the site.

8. On line libraries

There are a number of on-line libraries, but many focus on the arts and literature, and not data that would support open source searches on corporations and people.

a. U.S. Library of Congress

The U.S. Library of Congress has put together a guide for researching corporations.⁹⁰ The site is a very rich resource that groups research into categories: basic information, U.S. private companies, U.S. public companies, peer group/competitor comparison, searching for the news, and non-U.S. companies. Each category provides information about tools that the Library makes available to users. It includes tools like Crunchbase that require paid subscriptions. Using these tools, however, requires the user to be on-site at the Library.

b. Internet Archive Open Library

The Internet Archive is a non-profit library of millions of free books, movies, software, music, websites, and more. It groups its collection by topics. It began digitizing books in 2005 and currently scans 1,000 books per day at 28 locations around the world. Books published prior to 1923 are available for download. Because of copyright laws, however, users can only borrow hundreds of thousands of modern books through their Open Library site.⁹¹

The Internet Archive library collection occupies more than 90 Petabytes of server space that store two copies of 28 million books and texts, 14 million audio recordings, 6 million videos, 3.5 million images, and 580,000 software programs. Like most libraries, it respects the privacy of users, and does not keep their IP addresses.

c. ibiblio

ibiblio⁹² one of the largest free on-line information databases. It is a digital library hosted through the collaboration of the School of Information and Library Science and Information Technology Services at the University of North Carolina at Chapel Hill. One

⁹⁰ <https://guides.loc.gov/company-research>

⁹¹ <https://openlibrary.org/>

⁹² <https://www.ibiblio.org/>

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of its very useful services is distributing Linux software and acting as a software mirror for open-source software.

d. Google Books

Google Books⁹³ search is just like their web search except that it searches book contents. If Google has received permission from the publisher, users can preview pages from it. If the book is a book is out of copyright or in the public domain, users can download the contents in PDF form. Alternatively, the users can select “Buy this book” and buy an eBook version.

⁹³ <https://books.google.com/?hl=en&tab=wp>

3. Publicly available due diligence supplier assessment tools and processes

This chapter builds on the foundation of the general web-based techniques and tools described in Chapter 2. The focus of Chapter 3 is the web-based services, tools, and techniques that enable the discovery of the PAI directly relevant to a SCRM assessment. It provides links to databases and websites that provide specific information on companies and people associated with them.

A. Vendor profile characteristics

The first step of a due diligence analysis, is to look at the company, its key people, and facilities. Key data parameters are:

- Entity type – corporation, partnership, etc.
- Accurate name – other names, DBA, etc.
- Location of headquarters, manufacturing, research, and subsidiaries – city and country
- Ownership – founders, investors, etc., and their nationalities
- Leadership – directors, officers, shareholders, and their nationalities
- Interactions with the government
- Corporate cybersecurity maturity

The subsections that follow discuss each of these key data parameters in the order listed above.

1. Entity type

The law recognizes a number of different ways that individuals or groups of individuals can form entities to conduct business. The main differences are in allocation of control,

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liability, and taxes.⁹⁴ From the due diligence perspective, the various filing and licensing requirements may provide information on the entity and its people.

One helpful detail is the suffix that the entity uses after its name to designate its status, like Corp., LLC, and Inc. The states have different requirements for using these suffixes.⁹⁵ In addition, different countries use different suffixes, so the suffix may help identify the nationality of an entity.⁹⁶ For example, GmbH is the abbreviation for Gesellschaft mit beschränkter Haftung, which translates to “Company with Limited Liability” and companies in Austria, Germany, and Switzerland use that suffix.

a. Sole proprietorship

Entities conducting business under their own or a trade name are a sole proprietorship. Generally, there is no state-level requirement to register the activity, though some local jurisdictions may require a business license and for certain activities zoning clearances.⁹⁷ The business assets and liabilities are not separate from personal ones, and the proprietor may be liable for all debts of the proprietorship. A sole proprietorship may have employees but needs to obtain a tax identification number (EIN), and comply with Internal Revenue Service withholding and filing requirements.

b. Partnerships

Partnerships are the simplest structure for two or more people to own a business together. There are two common kinds of partnerships: limited partnerships (LP) and limited liability partnerships (LLP). Limited partnerships have a general partner with unlimited liability, while all other partners have limited liability. Control is allocated in the partnership documents.

Limited liability partnerships are similar to limited partnerships, but every owner has limited liability. Professionals like doctors and lawyers frequently use limited liability partnerships.

⁹⁴ The Small Business Administration has a good web site describing the various entity structures available to run a business. <https://www.sba.gov/business-guide/launch-your-business/choose-business-structure>

⁹⁵ Company Suffix Requirements by State, <https://www.swyftfilings.com/learning-center/company-suffix-requirements-by-state>; see also, <https://www.harborcompliance.com/information/company-suffixes>

⁹⁶ <https://www.corporateinformation.com/Company-Extensions-Security-Identifiers.aspx>

⁹⁷ Nolo Press provides information for sole proprietorships in each state. <https://www.nolo.com/legal-encyclopedia/50-state-guide-establishing-sole-proprietorship.html>

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c. Limited liability corporations (LLC)

The limited liability corporation is a hybrid entity that takes advantage of benefits that both partnerships and corporations provide. It provides liability protection to its owners. The LLC also minimizes ongoing formalities. Unlike corporations, which must hold annual meetings of directors and shareholders, and keep detailed documents and records for all corporate meetings and major business decisions, LLCs do not face strict ongoing meeting and documentation requirements. Profits and losses pass through to the owners for inclusion on their personal tax returns.

d. C corporation

A C corporation is a legal entity that is separate from its owners. It offers the strongest protections from personal liability, but is more expensive to form than other entities and requires more record-keeping, reporting, and formal processes.

The three most popular states for incorporation are Delaware, Nevada, and Wyoming. All three states have registration requirements and tax structures that are favorable to corporations.⁹⁸ Delaware and Nevada offer significant privacy to corporations. In Delaware, a corporation does not need to disclose key details about its officers and directors. In Nevada, they do not have to list owner names in order to incorporate. Investors, and other interested parties can remain anonymous. An attorney can handle all of the details, and be the person of record. Delaware,⁹⁹ Nevada,¹⁰⁰ and Wyoming¹⁰¹ have web sites where users can search for information on entities incorporated in those states.

A corporation may be privately held, or publicly traded. Stock traded on exchanges or over-the-counter markets distributes a public company's ownership amongst the general public shareholders. Publicly traded companies are subject to rules of the exchanges where their shares trade and to the securities laws of their country.

e. S corporation

An S corporation is a special type of corporation that provides owners the protection from liability, but allows profits, and some losses, to pass through directly to owners' personal income without being subject to corporate tax rates.

⁹⁸ <https://www.legalnature.com/guides/top-states-for-incorporation-delaware-nevada-and-wyoming-explained>

⁹⁹ <https://icis.corp.delaware.gov/Ecorp/EntitySearch/NameSearch.aspx>

¹⁰⁰ <https://esos.nv.gov/EntitySearch/OnlineEntitySearch>

¹⁰¹ <https://wyobiz.wyo.gov/Business/FilingSearch.aspx>

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f. B corporation

Benefit corporations are a relatively new type of business entity. Maryland was the first state to implement B corps in 2010. Today, 36 states provide for B corps.¹⁰² While a typical corporation maximizes shareholder value, benefit corporations produce some sort of social benefit in addition to a financial profit. Although no state requires a B corporation to be certified, Standards Analysts at the non-profit **B Lab**¹⁰³ certify B corps. B corps can be privately held or public entities.

g. Close corporation

Close or closely held corporations have a statutorily limited number of shareholders, usually less than 35. The limitation on shareholders restricts them to being privately held. Bylaws and shareholder agreements set the reporting requirements, so close corporations usually keep reporting to the minimum.

h. Nonprofit corporations

The purpose of nonprofit corporations is to do charity, education, religious, literary, or scientific work. Because of the public good nature of their work, nonprofits can file with the Internal Revenue Service to get tax-exempt status, which states also recognize for state tax purposes. Nonprofits are often called 501(c)(3) corporations, which is the section of the Internal Revenue Code that gives them their tax-exempt status. The website **GuideStar**¹⁰⁴ provides information on over 650,000 nonprofit corporations.

The IRS requires tax-exempt organizations, nonexempt charitable trusts, and section 527 political organizations to file Form 990.¹⁰⁵ It also requires private foundations to file a Form 990PF. Both filings are public documents. **Candid 990 Finder**¹⁰⁶ determines if a firm is a registered 501(c)(3).

¹⁰² <https://www.northwestregisteredagent.com/benefit-corporation.html>

¹⁰³ <https://bcorporation.net/about-b-lab>

¹⁰⁴ <https://www.guidestar.org/>

¹⁰⁵ <https://www.irs.gov/pub/irs-pdf/f990.pdf>

¹⁰⁶ <https://candid.org/research-and-verify-nonprofits/990-finder>

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i. Cooperatives

A cooperative, also known as co-op, is a form of corporation organized for the benefit of its employees or patrons. The cooperative distributes its profits to its members. There are five different types of cooperatives.¹⁰⁷

- Consumer: owned by consumers who buy goods or services from their cooperative;
- Producer: owned by producers of commodities or crafts who have joined forces to process and market their products;
- Worker: owned and democratically governed by employees who are co-op members;
- Purchasing: owned by independent businesses or municipalities to improve their purchasing power;
- Hybrid: a combination of co-op types, where people with common interests band together.

What consumers often identify as brands are actually cooperatives, for example, Ocean Spray, Land O'Lakes, and ACE Hardware. Cooperatives can be financial, e.g., Navy Federal, or utilities, e.g., Old Dominion Electric. The legal requirements for forming a cooperative corporation vary from state to state.¹⁰⁸

j. DBA – doing business as

A DBA, also known as fictitious business name, is a name used for business purposes that is different from the personal name of a sole proprietor or from the officially registered name of a business entity, such as a corporation, limited liability company, or limited partnership. Entities will often use a DBA when entering a new line of business with which their usual name was not compatible. For example, if Acme Hardware were to open a store that focused on plumbing, they may choose a DBA of Acme Plumbing. Registering the DBA would permit them to accept payments made out to the fictitious name.

Registration requirements vary by jurisdiction. Registrations can be at a local level, like the city or county where the business is located, or at the state level. Even though DBA

¹⁰⁷ <https://www.iwdc.coop/why-a-coop/five-types-of-cooperatives-1>

¹⁰⁸ The National Cooperative Business Association provides a link to the U.S. Department of Agriculture's State Cooperative Statute Library spreadsheet with a provision-by-provision description of state laws, with different spreadsheet pages on subjects such as formation, membership, bylaws, etc. The Association Formation tab, Column I has state filing requirements. <https://nbaclusa.coop/resources/state-cooperative-statute-library/>

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registrations are a public record, finding in which jurisdiction the entity registered complicates researching DBAs.

k. Holding company

A holding company is a business entity, usually a corporation or limited liability corporation, which owns the outstanding stock of other companies. It does not manufacture anything, sell any products or services, or conduct any other business operations. Holding companies often hold subsidiaries and assets, such as intellectual property or trade secrets. Since a creditor of a subsidiary in a holding company cannot reach the assets of the holding company or any other subsidiaries, it lowers the entity's risk in the event of litigation.

2. Accurate name

Publicly traded companies are usually more transparent than privately held entities. In addition to information that they must disclose in accordance with the securities laws of their country, they tend to provide more information to the general public. Many will have a tab at their website entitled "Investors." Pages under this tab often will provide links to corporate presentations, documents filed with the SEC, and other information. See Figure 11.

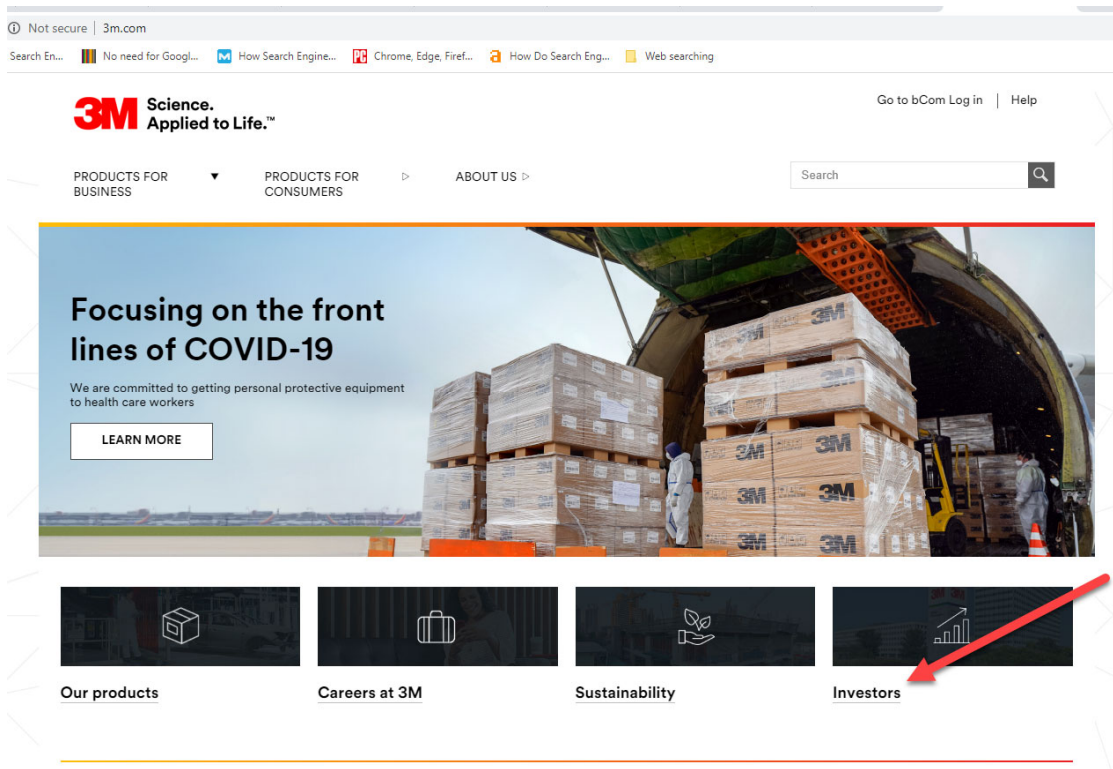


Figure 11: An investors tab on a corporate web site

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a. Entities that register

Reporting and filing requirements for companies differ from country to country and sometimes from state to state, or region to region. They also vary depending on the size and legal form of the company. Wikipedia provides links to over 200 countries' registry sites.¹⁰⁹ The anti-money laundering and countering the financing of terrorism site publishes links to U.S. and international company registers.¹¹⁰ Information on corporate registries in some major regions follows.

1) United States

In the United States, the states' Secretary of State is responsible for registering corporations, limited liability companies, and partnerships; handling business mergers and acquisitions; and processing the articles of dissolution in the event that a business closes down. A number of web sites provide links to the Secretary of State sites free.¹¹¹ Others charge a fee, but provide limited free searches.¹¹²

2) Canada

The Canadian Securities Administrator developed the Administrator's System for Electronic Document Analysis and Retrieval (**SEDAR**)¹¹³ to facilitate the electronic filing of securities information. At its website, investors and other authorized users can find and retrieve issuer profiles and securities filings. The web site update rate is every fifteen minutes, on weekdays from 7 am to 11 pm ET with new filings and other information. There is no fee for using this service.

The format and names of Canadian filings are different from those that the SEC uses on EDGAR, but the content is similar. For example, the counterpart to the 10-K is the Annual Information Form and the counterpart to the proxy statement is the Management Information Circular.

¹⁰⁹ https://en.wikipedia.org/wiki/List_of_company_registers

¹¹⁰ <https://aml-cft.net/library/company-registers/>

¹¹¹ A convenient directory of contact information for each state is available at <https://www.thebalanc-emb.com/secretary-of-state-websites-1201005> . These web sites also provide links for researching companies incorporated in each state:
<https://www.e-secretaryofstate.com/>
<https://www.llcuniversity.com/50-secretary-of-state-sos-business-entity-search/>

¹¹² <https://corporation.directory/secstates>

¹¹³ https://www.sedar.com/homepage_en.htm

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Canada's Business Registries¹¹⁴ provides information from the official registries of Alberta, British Columbia, Corporations Canada, Manitoba, Ontario, Quebec, and Saskatchewan. The site provides the legal name, status, location, the province or territory where the business is registered, and a direct link to the official registry source. There is no fee for this service.

3) United Kingdom

Companies House¹¹⁵ is the United Kingdom's registrar of companies and is an executive agency and trading fund of Her Majesty's Government. It incorporates and dissolves limited companies and registers company information. Companies House maintains a searchable database¹¹⁶ that provides information on corporate officers, their role, nationality, country of residence, and contact address for those entities. All registered limited companies, including subsidiaries, small, and inactive companies, must file annual financial statements in addition to annual company returns. Companies House maintains scanned images of all filed documents. The service is free.

4) European Union (EU)

Corporations register with the individual EU member states. Links to each country's registry site, represented as country flags and name abbreviations, are located at the right margin of a common web page.¹¹⁷ Another link lets the user check off the countries to search.¹¹⁸ The individual country sites provide access to different information. Some country websites provide only the basic details like name address, company registry number, while others contain copies of corporate documents. Some like Germany charge a fee for printing documents. Because the official language of the EU is English, all sites are in English.

5) Switzerland

The canton of St. Gallen maintains a database of people and companies in Switzerland.¹¹⁹ The site provides an option to view its pages in English.

¹¹⁴ <https://beta.canadasbusinessregistries.ca/about>

¹¹⁵ <https://www.gov.uk/government/organisations/companies-house/about>

¹¹⁶ <https://beta.companieshouse.gov.uk/>

¹¹⁷ https://e-justice.europa.eu/content_business_registers_in_member_states-106-en.do

¹¹⁸ https://e-justice.europa.eu/content_find_a_company-489-en.do?m=1.

¹¹⁹ <https://www.sg.ch/content/sgch/recht/handelsregister-notariate/handelsregister/personen--und-firmensuche.html>

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6) China

The Administration for Industry and Commerce (AIC) is a national organization with local departments in every administrative region in China. It has jurisdiction over industry and commerce throughout the region, with offices usually in each province and major city. The AICs provide official registration records for all companies in their jurisdiction to China's National Enterprise Credit Information Publicity System,¹²⁰ which makes the company registration records available online. The company China Checkup has provided a list of AIC websites,¹²¹ but these websites are in Chinese. China Checkup provides China company verification reports for \$129 to \$399, depending on the level of detail required.¹²²

7) Hong Kong

Cyber Search Centre¹²³ (CSC) maintains a database of registered companies and image records of documents that the Registrar of Companies registered and keeps. A free search provides company name, filed document index, registered charges, and disqualification orders. A user can download images of documents and obtain more detailed services for an annual fee of HK 500 (US\$ 64.48).

8) Rest of world

The United Kingdom has developed a website that contains links to the registries of some countries.¹²⁴

3. Location of headquarters, manufacturing, research, and subsidiaries

U.S. public companies must provide a list of their subsidiaries in Exhibit 21 of their 10-K filing. The website **Croctail**¹²⁵ contains a search engine for these lists. It provides an interface for browsing information for about several hundred thousand U.S. publicly traded corporations and their foreign subsidiaries. They have parsed information from company filings with the U.S. SEC since 2003.

Because Croctail compiles this information from corporate annual reports, which companies file only once a year, the information may not always be the most current. Corporations do not all file on the same date, but file based on their corporate year. That means

¹²⁰ <http://www.gsxt.gov.cn/index.html>

¹²¹ <https://www.chinacheckup.com/blogs/articles/chinese-aic-websites-list>

¹²² <https://www.chinacheckup.com/pages/china-company-verification-reports>

¹²³ <https://www.cr.gov.hk/en/publications/docs/10-e.pdf>

¹²⁴ <https://www.gov.uk/government/publications/overseas-registries/overseas-registries>

¹²⁵ http://croctail.corpwatch.org/#cw_1688,cw_1688,2019

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that on a particular date, the currency of the reports for different companies may vary by up to a year. Furthermore, since there is no standard format for Exhibit 21, and Croctail uses an automated parser to gather the data, they assert that it is only 90% correct. They strongly advise users to verify the information by checking the actual Exhibit 21 in a company's annual report before relying on it.

Croctail is a product of Corpwatch,¹²⁶ a not-for-profit that works to promote environmental, social and human rights at the local, national, and global levels by holding multinational corporations accountable for their actions. Corpwatch does not charge a fee for Croctail, but asks for donations from users.

The fact that a company trades publicly does not necessarily mean it is an ultimate parent. It is not uncommon for large companies to make a public offering of stock in a subsidiary while retaining a majority of the shares. Private equity firms may do the same.

Uniworld Online¹²⁷ has merged its two corporate directories of multinational companies: *American Firms Operating in Foreign Countries* and *Foreign Firms Operating in the United States* into one searchable database. It provides insights into "who operates where" and "who owns whom."

Public companies report the location and type of property in Part I, Item 2, in the annually filed 10-K report. The level of detail varies from company to company, but it is a good starting point.

A number of web sites provide the locations of corporate headquarters. **Corporate Office Headquarters**¹²⁸ provides an alphabetic list of companies. **Ranker**¹²⁹ provides headquarters by states, but does not include all states, i.e. Maryland and New York do not appear on their list. In addition, the state list is not alphabetical, so using the list requires hunting for the correct link.

Powrbot¹³⁰ offers up to 50 free searches per month. A user completes a short registration form, which only requests an email and password, and then simply uploads a comma-separated values (CSV) file¹³¹ with one company name per line. Powrbot responds with an Excel file with the companies searched in the rows and information about them in

¹²⁶ <https://corpwatch.org/>

¹²⁷ <https://uniworldonline.com/>

¹²⁸ <http://www.corporate-office-headquarters.com/>

¹²⁹ <https://www.ranker.com/fact-lists/companies/directory-of-company-headquarters-for-every-state>

¹³⁰ <https://powrbot.com/>

¹³¹ Excel allows users to save a file in comma-separated values - CSV format. The user must actively select CSV from the "Save as Type" box.

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columns. Information includes the company website, company description, industry, CEO, year founded, number of employees, location of headquarters, exchange where it trades, and a financial summary. Paid subscriptions allow for more searches with unused search credits rolling over to the next month.

LexisNexis has a **Corporate Affiliations**¹³² database that provides the names of parent and subsidiaries along with a detailed corporate hierarchy and family tree. LexisNexis verifies the accuracy of its information with the companies.

4. Ownership – founders, investors, etc. and their nationalities

The true owner of a company may not be apparent. As merger and acquisitions take place, ownership may change. The new parent company, however, may wish to retain the brand name recognition, goodwill, and the associated value of the entity that it buys. Therefore, they do not simply absorb the assets under their own name.

The true owner of an entity may choose to hide behind multiple layers of ownership. This is particularly true if the company conducts legally shady activities like money laundering. As a result, countries have developed databases that allow investigators to drill down to the ultimate owner.

a. Shareholders

Entities that have an ownership interest in a company are the shareholders. The ownership interest may arise from invested money in the corporation, or sweat equity as in the case of the founders.¹³³ Shares represent an apportioned ownership interest in the corporation, and a single share can represent anywhere from a minute fraction of one percent to 100 percent ownership interest in the corporation.

The corporate bylaws set the classes and rights of the shareholders. The two most popular classes of stock are common and preferred, sometimes referred to as Class A and Class B.¹³⁴ Most of the differences between the classes come down to dividends, voting rights, and distribution rights in the event of dissolution of the enterprise. Preferred stock's dividends are fixed and do not depend on company profits like those of common shares. If

¹³² <http://www.corporateaffiliations.com/>

¹³³ The term sweat equity encompasses all the things that founders bring to venture, including ideas, intellectual property, prototypes, time involved in organizing, raising financing, and promoting the business,

¹³⁴ This nomenclature should not be confused with Series of stock usually found in start-up privately held companies. The first round of financing is the Series A round. Subsequent rounds are named with sequential letters, i.e., Series B, Series C, etc.

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the company does not have sufficient profits to pay all of the preferred dividend obligations, they defer and cumulate. They are first to be paid when the company has profits. Preferred shareholders are also the first in line in the event of liquidation. In this respect, preferred shares are similar to bonds.

Common stock comes with one vote per share on matters put before the shareholders. Preferred stock, on the other hand, has no voting rights. Recently, a new class of stock has begun to emerge – the F-Class. Promoted by the Founder Institute, F-Class stockholders get super voting privileges, usually 10 votes per share.¹³⁵ This class of stock is reserved for the founders of a company, and allows them increased control over company direction and defenses for hostile takeovers.

Being a shareholder usually does not confer any additional insights into the company or its technology. In high-tech, privately held startups, however, major investors usually get significant insight into the details of the proprietary technology as part of their due diligence. This can be a sensitive issue in the event of major foreign investors, which can subject the transaction to scrutiny by the Committee on Foreign Investment in the United States (CFIUS).¹³⁶

b. Private equity

Private equity consists of funds that invest into companies that do not yet trade publicly. The fund managers take money from institutions like pension funds, universities, and high net-worth individuals, and invest them in privately held companies.

Preqin¹³⁷ provides private equity coverage that includes details on investors, funds, fund performance, fund terms, portfolio companies, deals and exits, service providers, among other data. Outside of the demo, Preqin requires a paid subscription. It provides data to academics at discounted rates to support their research.

PitchBook Data,¹³⁸ a subsidiary of Morningstar, provides data, research, and technology that cover the private capital markets, including venture capital, private equity, and merger and acquisition transactions. PitchBook uses 650,000 web crawlers to scan the Internet and capture financial information from news articles, regulatory filings, websites,

¹³⁵ See, <https://fi.co/information/agreements#>

¹³⁶ <https://home.treasury.gov/policy-issues/international/the-committee-on-foreign-investment-in-the-united-states-cfius>

¹³⁷ <https://www.preqin.com/>

¹³⁸ <https://pitchbook.com/>

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and press releases. Natural language processing and machine learning technology organize and filter the data. PitchBook employs analysts to further process and verify the data.

c. Venture Capital

Venture capital (VC) is a form of private equity financing for startups, early-stage, and emerging companies. The VC takes the investment of limited partners and spreads it across multiple ventures. The VC focuses on companies that have a high growth potential or that have already demonstrated high growth but still need capital. VC investment takes place in stages, usually designated by a letter. Series A is a first round of investment, followed by the B, C, and beyond. A typical round will have a lead VC investor, and several other investors to spread the risk. A term sheet is the nonbinding agreement that outlines the basic terms and conditions of each round. In 2020, VC investment in the U.S. exceeded \$156 B, a 20% increase over the \$130B invested in 2019.

Figure 12 shows the structure of a typical VC investment. General partners at the VC firm manage a VC fund, which is a limited partnership. A typical VC firm will manage several funds at the same time. The limited partners, which can be high net worth individuals, pension funds, insurance companies, family trusts, endowments, sovereign wealth funds, and foundations, contribute money to the VC fund. The VC fund invests this money in multiple companies at various stages of maturity.

The fund pays the general partners a 2% annual management fee. When a fund exits the investment through a liquidity event like an initial public offering (IPO) or a corporate buyout, they pay the limited partners first until they recover their invested capital. Once the limited partners recover all of their invested capital, the general partners get 20% of the remaining distributions, known as the carried interest. The fund distributes the rest to the general partners based on their investment. A typical VC fund lasts about 10 years from the first investment to the last liquidity event.

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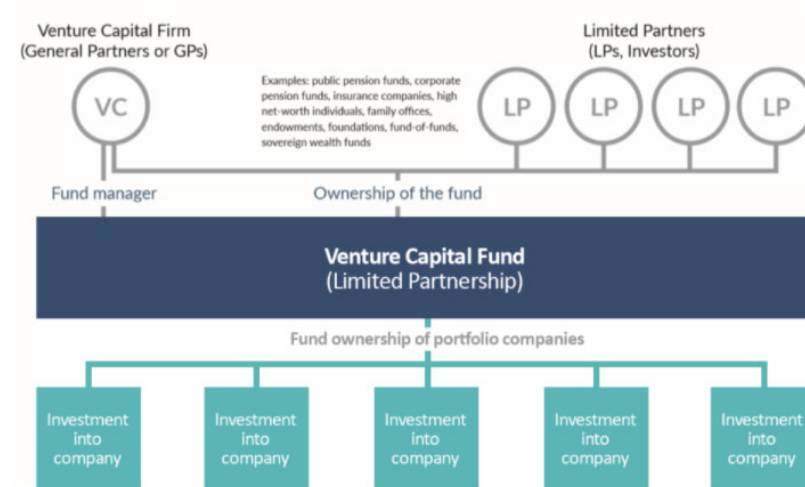


Figure 12: VC fund structure¹³⁹

The VC usually gets a significant equity stake in return for its investment. The equity that the VC gets comes with liquidation preference, which has 100% preference over common shares held by management and employees. The VC also usually gets downside protection in the form of anti-dilution clauses, or ratchets. Such clauses protect the VC from equity dilution if subsequent rounds of financing take place at lower values.

During the meetings preceding the closing of a financing round, companies will share considerable information about their technology to convince the VC to invest. Often the lead VC will have a seat on the Board, and gets updates on the progress of the technology development. VC's often take an active role in the companies that they invest in by providing guidance, connections, identifying key talent, and deal making with key customers.

The National Venture Capital Association (NVCA) is the VC community's trade association.¹⁴⁰ At its website, the NVCA provides a list of members with links to their websites.¹⁴¹ Every quarter it produces a report, the Venture Monitor, that provides a complete look at venture capital activity, reporting on fundraising, investments, exits, and other relevant industry analysis.¹⁴²

¹³⁹ Image source: <https://nvca.org/about-us/what-is-vc/#toggle-id-2>

¹⁴⁰ <https://nvca.org/about-us/>

¹⁴¹ <https://nvca.org/about-us/members/>

¹⁴² <https://nvca.org/research/pitchbook-nvca-venture-monitor/>

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Other websites also provide links to VC funds. **Fundz**¹⁴³ provides links to U.S. and Canadian VCs. **Golden**¹⁴⁴ lists over 8,200 VC firms worldwide, along with links to their web sites, and in some cases information about key people.

d. Beneficial ownership

A beneficial owner is the natural person who ultimately owns or controls a legal entity or arrangement, such as a company, a trust, or a foundation. Countries have recently started to promote legislation that would centralize data on beneficial ownership. These efforts are a part of the overall fight on terrorism and money laundering.

The European Union's Fifth Anti-Money Laundering Directive requires all Member States to set up a centralized register of the ultimate or so-called beneficial, owners of companies and to make this information available to the public. As of March 2020 only five EU countries, Bulgaria, Denmark, Latvia, Luxembourg, and Slovenia, and the UK have set up free public registers.¹⁴⁵

The U.S. House of Representatives passed the Corporate Transparency Act of 2019 on October 22, 2019.¹⁴⁶ The bill has yet to clear the Senate. If enacted, the bill would require companies to disclose beneficial owners and update the information annually. The U.S. Department of the Treasury, Financial Crimes Enforcement Network (FinCEN) will maintain the database. The legislation requires strictly controlled and limited access to this database to law enforcement agencies, U.S. federal agencies, and financial institutions with the purpose of complying with the U.S. Bank Secrecy Act.

Open Ownership¹⁴⁷ is a non-profit that maintains a searchable database of company beneficial ownership. The database, updated monthly, is available as a free download under the Open Data Commons Attribution License. The search results adhere to an open ledger format, in accordance to the Beneficial Ownership Data Standard (BODS).¹⁴⁸ The metadata

¹⁴³ <https://www.fundz.net/venture-capital-firms>

¹⁴⁴ <https://golden.com/list-of-venture-capital-firms/>

¹⁴⁵ "Patchy progress in setting up beneficial ownership registers in the EU," *Global Witness*, March 20, 2020, <https://www.globalwitness.org/en/campaigns/corruption-and-money-laundering/anonymous-company-owners/5aml-d-patchy-progress/>. A downloadable annex at this site lists the status of the register for each country and provides links to each country's register web site.

¹⁴⁶ "U.S. House passes bill that would require disclosure of beneficial owners of U.S. corporations and limited liability companies," *The National Law Review*, October 29, 2019. <https://www.natlawreview.com/article/us-house-passes-bill-would-require-disclosure-beneficial-owners-us-corporations-and>

¹⁴⁷ <https://register.openownership.org/>

¹⁴⁸ <http://standard.openownership.org/en/0.2.0/>

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include the history and provenance of source. Historical information about companies is important since it can help uncover links that are not immediately evident from viewing current information only.

The **Law Library of the Congress** has published a guide for researching ownership information for selected countries.¹⁴⁹

5. Leadership – directors and officers

a. Corporate structure

A typical corporation's structure consists of three main groups: directors, officers, and shareholders. The directors oversee the affairs of the organization and protect the interests of the shareholders; the officers handle the day-to-day operations of the business; the shareholders seek a return on their investment and vote on company matters in specific situations.

1) Board of directors

As its name suggests, the board of directors directs the corporation's affairs and sets its business path. The board of directors also has ultimate legal responsibility for the actions of the corporation, its subsidiaries, the officers, employees, and agents. A corporate director's duties and responsibilities typically include:

- Acting on behalf of the corporation and its best interests;
- Acting with loyalty to the corporation and its shareholders;
- Participating in regular meetings of the board of directors;
- Approving certain corporate activities and transactions as set by law and the corporation's bylaws. Such actions include contracts and agreements, election of new corporate officers, asset purchases and sales, approval of new corporate policies, property leases and others;
- Amending the corporation's bylaws or articles of incorporation.

Corporate directors have a high degree of visibility into the business activities, technology, and proprietary information of a company. In smaller startups, large equity investors will often require a seat on the Board as a condition of investment.

¹⁴⁹ <https://www.loc.gov/law/help/beneficial-ownership/disclosure-beneficial-ownership.pdf>

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2) Corporate officers¹⁵⁰

The corporation's officers oversee the business's daily operations. In their different roles, they have the legal authority to act on the corporation's behalf in almost all business-related activities. The corporation's board of directors usually appoints the officers. A typical corporation has the following officers.

Chief Executive Officer (CEO) or President. The CEO has ultimate responsibility for the corporation's activities, and signs off on contracts and other legally binding actions on behalf of the corporation. The CEO reports to the corporation's board of directors.

Chief Operating Officer (COO). The COO manages the corporation's day-to-day affairs, and usually reports directly to the CEO.

Chief Financial Officer (CFO) or Treasurer. The CFO is directly or indirectly responsible for almost all of the corporation's financial matters.

Secretary. The corporation's Secretary is in charge of maintaining and keeping corporation's records, documents, and minutes from shareholder meetings.

b. Sources of information on individuals

Getting current data on corporate leadership is important. Thirty five percent of business executives assume another business title within a span of 12 months. **The Official Board¹⁵¹** provides detailed corporate organizational charts for over 80,000 companies that have an annual revenue over \$100 M. As with most sites, it offers limited use for free and different levels of paid subscription access.

The U.S. Citizenship and Immigration Services (USCIS) have a Genealogy Program to help people doing genealogy research.¹⁵² There is no easy way to access information remotely, and researchers must submit a request or an index search, along with a fee. There is also a web page for researching individuals.¹⁵³ There is no information on the USCIS regarding access for government employees.

True People Search¹⁵⁴ provides very detailed information on people. Searches return address history, phone numbers, relatives, associates, email addresses, and more

¹⁵⁰ Findlaw, "Corporate structure: from directors to shareholders, July 22, 2019. <https://smallbusiness.findlaw.com/incorporation-and-legal-structures/corporate-structure-directors-to-shareholders.html>

¹⁵¹ <https://www.theofficialboard.com/info/about-us>

¹⁵² <https://www.uscis.gov/records/genealogy>

¹⁵³ <https://www.uscis.gov/history-and-genealogy/research/researching-individuals>

¹⁵⁴ <https://www.truepeoplesearch.com/>

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without having to set up an account or pay a fee. It requires minimal input information to conduct a search. Users simply provide a name, phone number, or address for the search. Getting additional information requires users to provide an email.

Westlaw People Map¹⁵⁵ is a service aimed at law firms that locates people and finds information about their connections and assets.

Marquis Who's Who¹⁵⁶ has published biographical data since 1899. It is the standard for reliable and comprehensive biographical data. Marquis Who's Who publications cover leaders and achievers from the United States and around the world, from every significant field. It has over 1.6 million biographies and is the largest database of its kind. It is available to institutions on an annual subscription basis. Many libraries provide access to Marquis Who's Who.

LittleSis¹⁵⁷ is an involuntary Facebook of the wealthiest 1%. It is a project of the not-for-profit Public Accountability Initiative.¹⁵⁸ Its objective is to bring transparency to influential social networks by tracking the key relationships of politicians, business leaders, lobbyists, financiers, and their affiliated institutions. It has a mapping tool, **Oligrapher**,¹⁵⁹ for visualizing networks of influence.

Linked In¹⁶⁰ is a networking site for professionals with more than 700 million users in more than 200 countries and territories worldwide. Linked In includes employers posting jobs and job seekers posting their curriculum vitae (CV).

The growing popularity of researching the family tree has spawned a number of web sites and services like **Ancestry**¹⁶¹ and **Genealogy**¹⁶² that help people identify ancestors and their nationalities.

6. Interactions with government entities

Business entities can interact with different levels of government in many different ways. In addition to contracts for goods and services, the interaction can be through the courts, lobbying, political campaign contributions, subsidies, taxes, licensing, laws, and

¹⁵⁵ <https://legal.thomsonreuters.com/en/products/people-map#>

¹⁵⁶ <https://marquiswhoswho.com/>

¹⁵⁷ <https://littlesis.org/>

¹⁵⁸ <https://public-accountability.org/>

¹⁵⁹ <https://littlesis.org/oligrapher>

¹⁶⁰ <https://www.linkedin.com/>

¹⁶¹ <https://www.ancestry.com/>

¹⁶² <https://www.genealogy.com/>

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regulations. Government entities can be at the city, county, state, Federal, and international levels.

a. North American Industry Classification System (NAICS)

Federal statistical agencies use the North American Industry Classification System (NAICS)¹⁶³ to classify business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. The Office of Management and Budget (OMB) developed NAICS, and in 1997, it replaced the Standard Industrial Classification (SIC) system. The development was a joint effort of the U.S. Economic Classification Policy Committee (ECPC), Statistics Canada, and Mexico's Instituto Nacional de Estadística y Geografía. Making it a joint effort allows for consistency in business statistics among the North American countries.

The ECPC reviews and maintains the NAICS. It solicits and considers proposals for revisions from the public and submits recommendations to OMB. After reviewing public comments, and consulting with the ECPC, the OMB makes the ultimate decision on changes. Every five years the NAICS incorporates these changes and publishes the revised NAICS. The next revision will publish in 2022. The 2017 NAICS Manual is available for download at no cost.¹⁶⁴

b. OPEN Government Data Act

The Office of Management and Budget, the Office of Government Information Services of the National Archives, and the General Services Administration provide an online repository of guidance and tools to implement the OPEN Government Data Act and the Federal Data Strategy.¹⁶⁵ It is the central repository for Federal Enterprise Data resources including tools, case studies, playbooks, and guidance on how to manage and use Federal data. Federal agencies publish their information online as open data, using standardized, machine-readable data formats, with their metadata included in the Data.gov catalog.

c. Court proceedings

Frequent litigation can indicate a company's posture relative to laws and regulations. In addition, in litigation, a company may have to reveal information that it would prefer to keep private. Court proceedings may document this information, but they also have the option to seal it.

¹⁶³ <https://www.census.gov/eos/www/naics/>

¹⁶⁴ https://www.census.gov/eos/www/naics/2017NAICS/2017_NAICS_Manual.pdf

¹⁶⁵ <https://resources.data.gov/about/about-this-repository/>

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The website **Justia**¹⁶⁶ provides free basic searches of federal dockets going back to 2004. The **Public Access to Court Electronic Records**,¹⁶⁷ (PACER) run by the Administrative Office of the U.S. Courts is a fee-based system that provides detailed dockets of federal district, appellate, and bankruptcy courts. To use the system the user must open an account and pay a modest fee based on usage.¹⁶⁸ In addition to providing access to individual courts, PACER provides access to a Case Locator, which allows the user to search all federal court dockets at once for cases in which a specific company or individual is a party.

Violation Tracker¹⁶⁹ is database of corporate misconduct. It includes banking, consumer protection, false claims, environmental, wage, hour, safety, discrimination, price-fixing, and other cases resolved by federal regulatory agencies and the Justice Department, state Attorney Generals, and state regulatory agencies. It contains over 444,000 civil and criminal cases from more than 250 agencies. They also cover selected types of class action lawsuits.

d. Bankruptcies

Bankruptcy is a legal proceeding that individuals and businesses undertake to become free of their debts, while simultaneously providing creditors an opportunity for partial or complete repayment. The U.S. Bankruptcy Code sets the rules, and filings fall under one of several chapters of the code. The specific bankruptcy proceedings bear the name of the chapter they follow. In addition to those discussed below, there are other less commonly used chapters.

Bankruptcies can provide insights into an individual's or company's business acumen. Filed documents and court proceedings may contain information not available elsewhere. The **UCLA-LoPucki Bankruptcy Research Database**¹⁷⁰ contains data on cases involving large publicly traded companies. It provides several tools and databases for researchers covering bankruptcies since October 1, 1979.

¹⁶⁶ <https://dockets.justia.com/>

¹⁶⁷ <https://pacer.uscourts.gov/>

¹⁶⁸ PACER charges \$0.10 per page accessed, with a maximum of \$3.00 per document. Audio mp3 files cost \$2.40 each.

¹⁶⁹ <https://www.goodjobsfirst.org/violation-tracker>

¹⁷⁰ <https://lopucki.law.ucla.edu/>

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1) Chapter 7 Bankruptcy

Individuals and in some cases businesses, that have few or no assets, typically file Chapter 7 bankruptcy.¹⁷¹ It allows them to dispose of their unsecured debts, such as credit card balances and medical bills. They may keep exempt property, such as household goods, clothing, tools for their trade, and a personal vehicle worth up to a certain value. They must liquidate nonexempt assets, such as family heirlooms, high value collections, second homes, stocks, and bonds to repay some or all of their unsecured debts. People who have no valuable assets and only exempt property may end up repaying none of their unsecured debt.

2) Chapter 11 Bankruptcy

Businesses often file Chapter 11 bankruptcy,¹⁷² with the goal of reorganizing and remaining in business. Filing Chapter 11 bankruptcy allows a company to create plans for profitability, to cut costs, and find new ways to increase revenue. Their preferred stockholders, if any, may still receive payments, though common stockholders will not. Chapter 11 bankruptcy allows the business to continue conducting its business activities without interruption, while it works on a debt repayment plan under the court's supervision. In rare cases, individuals can also file Chapter 11 bankruptcy.

3) Chapter 13 Bankruptcy

Individuals who make too much money to qualify for Chapter 7 bankruptcy may file under Chapter 13.¹⁷³ It allows individuals as well as businesses that have consistent income to create a manageable debt repayment plans. Typically, the repayment plans consist of installments over the course of three to five years. In exchange for repaying their creditors, the courts allow debtors to keep all of their property, including otherwise nonexempt property.

e. Administrative actions

The Consumer Product Safety Commission has an **archive of product recalls and other commission actions**¹⁷⁴ as well as a website called **Safer Products**¹⁷⁵ that contains

¹⁷¹ 11 U.S.C. 7 Sections 701 to 784.

¹⁷² 11 U.S.C. 7 Sections 1101 to 1195

¹⁷³ 11 U.S.C. 7 sections 1301 to 1308, and 1321 to 1330

¹⁷⁴ <https://www.cpsc.gov/Recalls/>

¹⁷⁵ <https://www.saferproducts.gov/>

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complaints and hazard warnings submitted by consumers. The Food and Drug Administration has an **archive of safety alerts and product recalls**.¹⁷⁶ The National Highway Traffic Safety Administration has an **archive of motor vehicle recalls**,¹⁷⁷ investigations, and complaints. There is also a federal site called Recalls.gov¹⁷⁸ that has data from various agencies in one place. It provides tabs for consumer products, motor vehicles, boats, food, medicine, cosmetics, and environmental products.

f. Subsidies

Subsidy Tracker¹⁷⁹ compiles economic development and other forms of government financial assistance to business on the federal and state/local basis. It draws data from hundreds of online sources, and supplements them with open records requests for information not posted by government agencies.

g. Lobbying activities

Companies often lobby the government in order to get favorable treatment on issues like taxes and regulations. These activities can sometimes provide an insight on corporate directions and business priorities. The Lobbying Disclosure Act of 1995¹⁸⁰ (LDA) as amended by the Honest Leadership and Open Government Act of 2007¹⁸¹ require senior government officials and politicians¹⁸² to disclose items or services above certain threshold values that they receive.

The LDA requires employed lobbyists, as well as registered lobbying firms, organizations, and self-employed lobbyists to file a Registration LD-1, Quarterly Activity Reports LD-2, and Contributions Reports LD-203. All reports filed under the LDA are available to the public over the Internet. The United States Senate Office of Public Records maintains the **Lobbying Disclosure Act Database**.¹⁸³ The Office of the Clerk in the U.S. House of

¹⁷⁶ <https://www.fda.gov/safety/recalls-market-withdrawals-safety-alerts>

¹⁷⁷ <https://www.nhtsa.gov/recalls>

¹⁷⁸ <https://recalls.gov/>

¹⁷⁹ <https://www.goodjobsfirst.org/subsidy-tracker>

¹⁸⁰ <https://lobbyingdisclosure.house.gov/lda.html>

¹⁸¹ <https://transition.fec.gov/law/feca/s1legislation.pdf>

¹⁸² <https://www.venable.com/-/media/files/publications/2017/01/what-is-lobbying-under-the-lda/files/what-is-lobbying-under-the-lda/fileattachment/whatislobbyingunderthelda.pdf>

¹⁸³ <https://soprweb.senate.gov/index.cfm?event=selectfields>

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Representatives maintains a similar database.¹⁸⁴ Users can search these databases for the lobbying activities of individuals and companies.

h. Campaign contributions

Laws prohibit corporations from donating to political candidates or campaigns. Corporations can bypass this restriction, however, with individual contributions by company executives,¹⁸⁵ contributions through company Political Action Committees (PAC), as well as spending through Super PACs, 501(c)3 "dark money" entities, and 527 groups.¹⁸⁶ The Federal Election Committee maintains a database on its website,¹⁸⁷ which tracks contributions and has the images of the original documents. The Internal Revenue Service posts filings by 527 groups¹⁸⁸ that users can search.

i. U.S. government contracts

The OMB maintains a searchable website, **USASpending**,¹⁸⁹ of contracts, grants, loans, and other funding awarded to entities. The website is accessible at no cost, and returns the name of the entity receiving the award, the amount of the award, and other information about the award.

The beta **SAM.gov** website¹⁹⁰ allows searches for awarded Federal contracts that have an estimated value of \$3,500 or more. Using SAM.gov requires the user to create an account.

The Federal Government tracks and makes public negative information about a contractor's performance at the Federal Awardee Performance and Integrity Information System (**FAPIIS**)¹⁹¹ website. Users can search the database for administrative agreements,

¹⁸⁴ <https://lobbyingdisclosure.house.gov/>

¹⁸⁵ Campaign finance laws prohibit a company from reimbursing an employee for political contributions.

¹⁸⁶ A 527 organization or 527 group is a type of U.S. tax-exempt organization organized under Section 527 of the U.S. Internal Revenue Code (26 U.S.C. § 527). A 527 group is created primarily to influence the selection, nomination, election, appointment, or defeat of candidates to federal, state, or local public office.

¹⁸⁷ <https://www.fec.gov/data/>

¹⁸⁸ <https://forms.irs.gov/app/pod/basicSearch/search?execution=e1s1&format=>

¹⁸⁹ <https://www.usaspending.gov/search>

¹⁹⁰ <https://beta.sam.gov/>

¹⁹¹ <https://www.fapiis.gov/fapiis/index.action>

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defective pricing, DoD determination of contractor fault, non-responsibility determinations, recipient not-qualified determinations, terminations for cause, terminations for default, terminations for material failure to comply, and suspension/debarment information.

The **Federal Contractor Misconduct**¹⁹² site is a private database that allows search by company for misconduct, including contract fraud and other violations. The Project On Government Oversight (POGO),¹⁹³ a nonpartisan independent watchdog that investigates and exposes waste, corruption, abuse of power, maintains this database.

j. Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards

For profit, U.S.-owned and operated entities with less than 500 employees qualify for Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) awards.¹⁹⁴ SBIRs and STTRs consist of three phases. The objective of Phase I is to establish the technical merit, feasibility, and commercial potential of the proposed efforts. Typical Phase I awards are \$50,000 to \$250,000 and cover a six-month effort for SBIRs and one year for STTRs.

Phase II is for the entity to continue the R&D efforts initiated in Phase I. The results achieved in Phase I, the scientific and technical merit, and commercial potential of the project determine if the recipient qualifies for a Phase II award. Only Phase I awardees are eligible for Phase II awards. SBIR/STTR Phase II awards are up to \$750,000 and last for up to two years.

Phase III is where the small business pursues the commercialization of the results developed with the Phase I and Phase II activities. The SBIR/STTR programs do not fund Phase III. At some Federal agencies, Phase III may involve follow-on non-SBIR/STTR-funded R&D or production contracts for products, processes, or services for the U.S. Government.

Entering a company's name into the search box on the **SBIR/STTR web site**¹⁹⁵ (upper right hand corner) returns detailed information on the SBIR and STTR awards that the company has received. It provides summary information on the amount of funding, the year, phase, and funding department for awards. The user can get additional details on each

¹⁹² <https://www.contractormisconduct.org/>

¹⁹³ <https://www.pogo.org/about/>

¹⁹⁴ <https://www.sbir.gov/#>

¹⁹⁵ <https://www.sbir.gov/#>

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award by clicking on the award title. The search returns all of the awards that the company has received and that can span many decades.

7. Corporate cybersecurity maturity (clearances, contracts, breaches)

In today's data-driven society, many companies, organizations, individuals, and governmental organizations have been victims of cybersecurity attacks and breaches. The **Privacy Rights Clearinghouse**,¹⁹⁶ a 501(c)(3) nonprofit organization, maintains a database of breaches going back to 2005.¹⁹⁷ The database contains over 9,000 records, and users can download it in Excel CSV format. There is no fee for accessing this database.

Information is Beautiful¹⁹⁸ provides data on breaches greater than 30,000 records in a visual graphic that shows the size and sensitivity of data lost. Users can also download the data set in Excel CSV format; the button is in the lower right-hand corner of the page.

B. Vendor PRODUCTS characteristics

The degree of value-added that the ultimate seller makes to the product can vary significantly. A company's involvement can range from performing every step of the manufacturing process, to performing only some of the steps, like writing the software code that interfaces with the user, or to simply putting its name and logo on a product that another company manufactured. A product's path through the manufacturing process may reveal vulnerabilities or opportunities for compromise.

With today's globalized manufacturing ecosystem, a product may visit many countries in the course of its manufacture. Knowing where a product has been, and who had the opportunity to touch it, are an important part of supply chain assessment.

Therefore, the next step of a due diligence analysis, is to consider the key data parameters related to product manufacturing or that provide insight into vulnerabilities or opportunities for compromise. Those key product-related data parameters are:

- Product suppliers
- Supply chain
- Branding and labeling
- Installation guides and manuals

¹⁹⁶ <https://privacyrights.org/>

¹⁹⁷ <https://privacyrights.org/data-breaches>

¹⁹⁸ <https://www.informationisbeautiful.net/visualizations/worlds-biggest-data-breaches-hacks/>

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- Component list or bill-of-materials
- Evaluations and reviews
- Proprietary technology
- Cybersecurity risk

The subsections that follow discuss each of these key data parameters in the order listed above.

1. Product suppliers

Finding a company's actual suppliers can be difficult. Many companies do not want to reveal this information to their competitors. The globalization of supply chains that has taken place over the last two decades has made tracing a product's path more difficult.

a. Trade journals

Suppliers, on the other hand, like to publicize their customers to bolster their reputation as a quality supplier. Often, they will place announcements of new contracts in the trade journal for their market segment. Trade journals are rather obscure, and articles appearing in them will come up buried deeply in a typical Google search. It helps to know the particular industry journal name to include it in the search terms.

Part IV of the **Dirt Diggers Digest Guide to Strategic Corporate Research** from the Corporate Research Project provides information sources for major industry segments at no cost to the user.¹⁹⁹ For each industry segment, the guide lists directories and data sources, trade associations, trade publications, labor unions, watchdog groups, regulatory agencies, and access to disclosure forms.

WebWire²⁰⁰ maintains a comprehensive database of trade publications grouped by industry. It lists both U.S. and international publications. Its business model is to charge companies for disseminating information and driving readers to a company's website. It does not charge for accessing its trade journal list.

b. Trade associations and trade shows

Trade associations provide a mechanism for competitors in industry to share information and collaborate without triggering antitrust violations. Trade associations publish industry reports and statistics, organize trade shows, and engage with government officials.

¹⁹⁹ <https://www.corp-research.org/dddresearchguide4#4>

²⁰⁰ <https://www.webwire.com/IndustryList.asp>

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A number of web sites list trade associations grouped by industry sectors that users can search for free.²⁰¹ The website **growology**²⁰² breaks down the industry grouping into more detailed subgroups. The **Directory of Associations**²⁰³ allows users to search its database for free, or download the entire database of over 35,000 associations for \$299.

2. Product supply chain – import/export data

Import/export data can be the source of much useful information on the product supply chain.

a. Incoterms

Import/export transactions come with their own special terminology. The Incoterms® are a set of 11 individual rules issued and copyrighted by the International Chamber of Commerce (ICC) that define the responsibilities of sellers and buyers for the sale of goods in international transactions. Each Incoterms rule clarifies the tasks, costs, and risks borne by buyers and sellers in these transactions.

The updated Incoterms® 2020 rules are grouped into two categories that relate to the particular mode of transport. Of the 11 rules, there are seven for any mode of transport category and four for sea or land, or inland waterway transport category.

The seven Incoterms® 2020 rules for any mode(s) of transport are:²⁰⁴

- EXW - Ex Works (insert place of delivery)
- FCA - Free Carrier (Insert named place of delivery)
- CPT - Carriage Paid to (insert place of destination)
- CIP - Carriage and Insurance Paid To (insert place of destination)
- DAP - Delivered at Place (insert named place of destination)
- DPU - Delivered at Place Unloaded (insert of place of destination)
- DDP - Delivered Duty Paid (Insert place of destination).

The four Incoterms® 2020 rules for sea and inland waterway transport are:

²⁰¹ <https://www.marketing-mentor.com/pages/trade-list>
<https://planningshop.com/associations/>
<https://jobstars.com/professional-associations-organizations/>

²⁰² <https://growology.com/industry-trade-associations/>

²⁰³ <https://directoryofassociations.com/>

²⁰⁴ <https://www.trade.gov/know-your-incoterms>

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- FAS - Free Alongside Ship (insert name of port of loading)
- FOB - Free on Board (insert named port of loading)
- CFR - Cost and Freight (insert named port of destination)
- CIF - Cost Insurance and Freight (insert named port of destination)

We include them here, since a researcher is likely to encounter these terms, and their use and meaning helps put the details of a transactions in context. For a more detailed discussion of shipping terminology, see Appendix C.

b. Harmonized system codes (HS)

The Harmonized System²⁰⁵ is a standardized numerical method of classifying traded products. Customs authorities around the world use it to identify products when assessing duties and taxes and for gathering statistics. The World Customs Organization (WCO) developed and updates it every five years. It serves as the foundation for the import and export classification systems used by the United States and most trading partners.

The HS assigns a six-digit code to classify commodities. Countries can add additional codes to follow the first six digits for further classification. The first two digits identify the chapter that classifies the goods. The next two digits identify the headings within the chapter. The last two identify subheadings that are more specific.

The U.S. adds an additional four-digit suffix, called the Harmonized Tariff Schedule, HTS, to the HS. The complete 10-digit code that classifies products for import or export is the Schedule B number. The U.S. Census Bureau's Foreign Trade Division administers Schedule B.

The HTS code system uses a precise structured taxonomy to describe items. For people not familiar with the process, it may be difficult to classify an object properly. The U.S. International Trade Commission maintains a website²⁰⁶ that helps users find the proper HTS. Typing a few descriptive words into the search bar will start the drilldown with results appearing in a window to the left. Adding or removing words helps zero in on the proper code. It also has a tool for translating NAICS, HTS, and Standard International Trade Classification (SITC) codes.²⁰⁷

²⁰⁵ <https://www.trade.gov/harmonized-system-hs-codes>

²⁰⁶ <https://hts.usitc.gov/>

²⁰⁷ <https://dataweb.usitc.gov/classification/commodity-translation>

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c. Import by sea

The vast majority of imported goods arrive in the U.S. by sea in shipping containers. Standard shipping containers are 8 feet wide, 8.5 feet tall and 20 or 40 feet long. The U.S. Customs and Border Protection (CBP) regulations require the filing of shipment data for maritime containerized imports 24 hours before loading the cargo on a vessel. The data filed include the cargo origin, description, and the parties involved in the importation.

The amount of information generated by this process is overwhelming. On a typical day, the import and export trade data consists of almost 60,000 bills of lading. This translates to over 20 million bills of lading with over 10 billion data fields processed in a year. The Office of Trade at the U.S. Customs and Border Protection charges about \$300 per Importer Trade Activity (ITRAC) Request. They provide the data in an MS-Access 97 and takes three to six weeks of processing time.²⁰⁸

Importer names on entry documents are confidential and U.S. Customs and Border Protection (CBP) does not disclose names of importers to the public. However, the privacy statute²⁰⁹ permits a number of private sector media services to collect manifest data at every port of entry. These companies collect, curate, and publish names of importers from vessel manifest data and make it available within hours, in a useful format. They provide different levels of service priced accordingly.

The website **Seair**²¹⁰ offers the capability to search U.S. Customs data by product type. It provides a table with the date, HS code, product details, weight, quantity, exporting country, U.S. port of entry, supplier, and buyer of a shipment. Clicking the “view more” icon at the right of an entry provides detailed addresses, vessel name, container number, and bill of lading.

IHS Markit's database, **PIERS**,²¹¹ provides import and export data at the detailed, bill-of-lading level. They collect, verify, standardize, enhance, and load the data into their database products. They offer three levels of fee-based service, with different levels of content, functionality, and customization.

Trademo²¹² offers a product, Intel, which is a data intelligence platform to help businesses in finding prospective buyers, reliable suppliers, and mitigate supply chain risks. It monitors U.S. Ocean Import Shipments, including bill of lading, shipment arrival dates,

²⁰⁸ <https://www.cbp.gov/trade/itrac-requests>

²⁰⁹ 19 CFR 103.31 (d)

²¹⁰ <https://www.seair.co.in/us-import-data.aspx>

²¹¹ <https://ihsmarkit.com/products/piers.html>

²¹² <https://www.trademo.com/>

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U.S. port of arrival, importer's name, exporter's name, product description, and country of origin. Its database only covers shipments from January 2018. They update the data weekly, with a time lag of 10-12 days from the arrival date of shipment. Users can search by company, product type, country of origin, date range, and others. Trademo charges a fee for this service, but offers a free version that is limited to data from January to March 2018.

Users can access U.S. Customs trade data free through **Port Examiner**²¹³ and **Import Yeti**.²¹⁴ Port Examiner's website is very sparse and lacks any information on who they are and services offered. Other websites assert that the information on these two web sites is outdated and incomplete.

3. Product branding and labeling

Companies use trademarks, service marks, and brand names to differentiate their product from competitors' products. The brand name and labeling convey attributes, quality, and promoted easy recognition on a crowded shelf. The label will also include information, like weight, safety warnings, and ingredients that laws and regulations may require.

a. Trademarks, service marks and brand names

A trademark is a word, phrase, symbol, or design, or a combination of them, that identifies and distinguishes the source of the goods. A service mark is the same as a trademark, except that it identifies and distinguishes the source of a service.²¹⁵ In the U.S., the owner registers a trade or service mark with the U.S. Patent and Trademark Office (USPTO) and uses the ® symbol after the mark, if not yet registered, a TM for goods or SM for services indicates that the owner adopted the mark as a "common law" trademark or service mark. Common law rights protect the use of the mark in commerce only within a particular geographic area.

Unlike patents and copyrights, trademarks do not expire after a set term of years. Trademark rights come from actual "use." A trademark can last forever – so long as the owner continues to use the mark in commerce to indicate the source of goods and services. A trademark registration can last forever, as long as the owner files specific documents and pay fees at regular intervals.

²¹³ <https://portexaminer.com/>

²¹⁴ <https://www.importyeti.com/>

²¹⁵ U.S. Patents and Trademark Office, "Protecting Your Trademark Enhancing Your Rights Through Federal Registration." <https://www.uspto.gov/sites/default/files/documents/Basic-Facts-Booklet.pdf>

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A product will often have a trademark that links it to a particular manufacturer. Trademark searches are a bit more complex because everything matters, the font type, font size, color shade, and embedded images. A resource that the USPTO makes available is free or reduced fee searches through its Law School Clinic Certification Program.²¹⁶

The USPTO provides a Trademark Electronic Search System (TESS), which offers basic word mark searches, structured word and/or design mark searches, and free form word and/or design mark searches.²¹⁷ A TESS help page provides information, with some sample search strategies, on how to search the USPTO's database of registered and prior pending applications.²¹⁸

All personal information that an applicant submits to the USPTO, including the domicile address, email address, and telephone number, become part of a public record. They are viewable at the USPTO website, and search engines like Google can access that information.

The World Intellectual Property Organization (WIPO)²¹⁹ allows the user to perform a trademark search by text or image in brand data from multiple national and international sources, including trademarks, appellations of origin, and official emblems. Its database has more than 44,760,000 records from some 55 national and international collections.²²⁰

b. Private label and store branded products

Private label products are those that one company manufactures but another company sells under its own brand. Private-label goods are available across a wide range of industries including consumer products, food, drugs, and cosmetics. Private label brands that only one retailer sells within its chain of stores are store brands.

The Private Label Manufacturers Association²²¹ is the industry trade group. Private label products come from a variety of manufacturers.

- Large national brand manufacturers utilize their expertise and excess plant capacity to manufacture store brands. This allows them to capture the more price-sensitive space of the market without diluting their own brand value.

²¹⁶ <https://www.uspto.gov/learning-and-resources/ip-policy/public-information-about-practitioners/law-school-clinic-1>

²¹⁷ <http://tess2.uspto.gov/bin/gate.exe?f=tess&state=4801:i2agjt.1.1>

²¹⁸ <http://tess2.uspto.gov/webaka/html/help.htm>

²¹⁹ <https://www.wipo.int/portal/en/>

²²⁰ <https://www3.wipo.int/branddb/en/>

²²¹ <https://www.plma.com/>

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- Small, high quality manufacturers that specialize in particular product lines may concentrate on producing store brands.
- Regional brand manufacturers produce private label products for demographic markets.

c. White box and technology partnerships

The term white box refers to electronic products, usually desktop computers and servers, made by small, relatively unknown companies that assemble components often purchased on the surplus market. The name derives from the packing carton, which is often white and contains no manufacturer name or logo.

White box products tend to be simply constructed, and have less functionality than name-brand enterprise-grade products. Manufacturers will often tailor their white box product to a customer's requirements. This is highly advantageous if the user has an application that requires special features, like a faster graphics card or a more powerful power supply. A white box manufacturer can accommodate those requirements and the customer will only pay an increment for the enhanced components. With brand-name vendors, the user may have to go to a higher priced model, which will have other enhancement that they do not need or want, but will have to pay for.

White box products tend to come with no preloaded software or documentation. Because of the way the white box manufacturers source their components, not all white box products will have the same internal components.

4. Product installation guides and manuals

The first step in searching for product manuals and guides is to determine the exact maker (brand) and model of the product. For some products, a serial number may also be necessary to establish which version or variant you have. Manufacturers sometimes change the design without changing the model of the product. This is particularly true in cases where a manufacturer integrates modules manufactured by another company into their product. For example, a pressure washer may incorporate a small gasoline engine manufactured by another company. The manufacturer may change the source or model of the engine without changing anything else in the product.

The next step is to check the manufacturer's web site to see if it provides a manual that you can access or download. Usually, manufacturers have a tab called "support" or "customer care" where they would put manuals. Some manufacturers provide a chat option where you could inquire about manuals. The Google site search operator (see section 2.A.2.d of this document) is helpful for searching a manufacturer's web site for manuals.

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If checking the manufacturer's web site fails to provide a product manual, a number of alternative web sites that collect and make manuals available for download. Some sites offer the material for free others charge a nominal fee.

The free sites tend to be more limited in scope, often poorly organized, and often provide poor quality scanned images. They rely on user volunteers to upload scans of their manuals to add to the collection. Some exist only as archived pages on the Wayback Machine. Notwithstanding that, it may be worthwhile checking some of the larger free sites for what they have available.

a. Free sites

The site **ManualsLib**²²² has over 4,250,000 manuals that cover over 3,000,000 products. They also serve as a forum, where users can ask questions about products and other site users can provide responses.

Manuals Online²²³ is another web site that has manuals for over 700,000 products. It also offers a user community forum where users can ask other users questions about products.

Schematics Unlimited²²⁴ has about 27,500 free diagrams, schematics, operating manuals and service manuals organized by manufacturer name.

OpWeb's²²⁵ focus is older devices and it offers 11,000 manuals.

ATEcorp is no longer active, having closed down in 2013. Some of its collection of test equipment manuals is accessible through the Wayback Machine Archive.²²⁶

KO4BB²²⁷ has test equipment, ham radio or timing related manuals.

The **Boat Anchor Manual Archive (BAMA)**²²⁸ offers manuals from a large number of manufacturers. The site provides very little information about its material.

222 <https://www.manualslib.com/>

223 <http://www.manualsonline.com/>

224 <https://www.schematicsunlimited.com/>

225 <https://www.opweb.de/>

226 <https://web.archive.org/web/20140228001408/https://www.atecorp.com/atecorp/media/pdfs/data-sheets>

227 <http://www.ko4bb.com/getsimple/index.php?id=manuals>

228 <http://bama.edebris.com/manuals/>

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b. Fee-based services

Emanualonline²²⁹ offers manuals for a very diverse range of products including heavy equipment, commercial handling equipment, automobiles, electronics, and others.

Manual Universe²³⁰ has over 3,416,300 items in their collection of service manuals, schematic diagrams, and user guides for home and professional audio-visual equipment, PCs, and other electrical appliances. They claim the lowest prices.

User-Manuals sells product manuals for \$4.99 to \$7.99.²³¹ Their manuals are a digital version, not simply scanned.

Owner-Manuals²³² sells owner and service manuals for \$4.99.

Manual-Buddy²³³ sells manuals to popular consumer entertainment devices.

The **Schematic Man**²³⁴ offers Photofact schematics and service manuals covering products manufactured from 1946 to 1970. SAMS Technical Publishing produced Photofact service manuals for sale to television repair shops. The service manuals include schematics, parts lists, diagrams, photos, and detailed service information on tube and transistor radios, phonographs, amplifiers, tape recorders, TVs, and other consumer items. SAMS Technical Publishing also sells their vintage publications.²³⁵

5. Product level componentry and/or bill of materials

Product teardown and reverse engineering are processes of disassembling an item down to its individual components. People tend to use the terms product teardown and reverse engineering interchangeably. There are, however, subtle differences. While both focus on identifying the individual components, tearing down primarily looks at the user experience with the product, while reverse engineering looks at its functionality.

229 <https://www.emanualonline.com/all-categories/>

230 <http://www.manualuniverse.com/>

231 <https://www.user-manuals.com/index.php>

232 https://www.owner-manuals.com/index.php?main_page=index

233 https://www.manual-buddy.com/index.php?main_page=index

234 <http://www.theschematicman.com/>

235 <https://www.samswebsite.com/en/photofact/search/types>

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Companies perform teardowns of competitors' products to identify patent infringement,²³⁶ benchmark the competition, and identify areas where they can derive cost or performance advantages in their own products. The teardown process is complex and requires engineering talent spanning multiple disciplines and inputs from non-engineering sectors. It requires attention to minute details.

Some products, especially those involving a license or sold under an explicit contract may prohibit reverse engineering. Since breaches of such clauses fall under contract law, their specific wording and jurisdiction where the breach occurs determine their validity. As actions under contract law, enforcement will often require expensive legal action. Therefore, while companies may have the right to prevent reverse engineering, the sheer cost could prevent them from enforcing their rights.

In light of the expense of a legal remedy, companies often seek technical and engineering solutions, known as anti-tamper, to prevent reverse engineering. Although the term anti-tamper carries connotation of techniques used to secure military systems,²³⁷ commercial companies also use them. Using anti-tamper techniques, especially those that impose a penalty, however, may carry costs of their own. For example, Apple experienced some very negative publicity after it implemented a software lock if an iPhone detected that a non-Apple repair center had replaced a cracked screen.²³⁸ John Deere's lockdown on "unauthorized repairs" forced farm equipment owners to pirate tractor firmware and maintenance tools, just to repair products they thought they owned.²³⁹

Other manufacturers use anti-tamper techniques to prevent or complicate disassembly. Such mechanisms can be as simple as a screw on which the slot is beveled so that a screwdriver will engage only in the tighten direction. Others are more aggressive, and use techniques like potting an assembly in epoxy.

²³⁶ See, for example, <https://ipresearchgroup.com/technologies/electronic-product-teardown-analysis/>
https://www.techinsights.com/about-techinsights?utm_source=ihs&utm_medium=about-us&utm_term=about-us&utm_content=techinsights&utm_campaign=ihs-markit

²³⁷ <http://acqnotes.com/acqnote/careerfields/anti-tamper>

²³⁸ Karl Bode, "Apple Takes Heat For Software Lock That Prevents iPhone 7 Home Button Replacement By Third-Party Vendors," April 19, 2017 <https://www.techdirt.com/articles/20170407/11284137109/apple-takes-heat-software-lock-that-prevents-iphone-7-home-button-replacement-third-party-vendors.shtml>

²³⁹ Karl Bode, "Tractor Owners Using Pirated Firmware To Dodge John Deere's Ham-Fisted Attempt To Monopolize Repair," March 29, 2017. <https://www.techdirt.com/articles/20170322/04582036973/tractor-owners-using-pirated-firmware-to-dodge-john-deeres-ham-fisted-attempt-to-monopolize-repair.shtml>

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Recently, consumers and activists in the U.S. and EU have begun actions at the individual State/Country level to introduce the right to repair.²⁴⁰ If this legislation takes hold, it should make reverse engineering and product teardown easier. Already the two trade groups representing automakers, the Alliance of Automobile Manufacturers and the Association of Global Automakers, have executed a National Memorandum of Understanding, which allows independent shops to repair vehicles.²⁴¹

Some elements of the product may lend themselves to easy analysis, like printed circuit cards with commercial off-the-shelf (COTS) electronic components with part numbers. Others like custom integrated circuits, with proprietary or no labeling, are much more difficult to analyze.

Literature documents the teardown steps.²⁴² The processes used to remove a component without damage and in a way that preserves information, however, can be proprietary, developed by companies that specialize in reverse engineering.

a. Teardown services

Ifixit²⁴³ performs teardowns of popular products like iPhones, and publishes the information on-line. It also provides videos and guides for fixing common problems like cracked screens. It sells the special tools and components like screens and batteries that some products require. Ifixit accepts and publishes users' contributions. Currently, it has information on about 32,000 devices.

In addition to its latest teardowns, **Electronics 360**²⁴⁴ has an archive of teardowns that it has performed in automotive, consumer electronics, industrial and medical, media, and telecommunications sectors.

TechInsights²⁴⁵ performs comprehensive teardowns of electronic products across a range of markets. In addition to developing a bill of materials, it also does cost estimates

²⁴⁰ T. Charboneau, "How the right to repair may affect consumers and designers alike," *All About Circuits*, December 15, 2020. <https://www.allaboutcircuits.com/news/how-right-to-repair-may-affect-consumers-designers-alike/>

²⁴¹ G. Nelson, "Automakers agree to 'right to repair' deal," *Automotive News*, January 25, 2014. <https://www.autonews.com/article/20140125/RETAIL05/301279936/automakers-agree-to-right-to-repair-deal>

²⁴² See, for example, <https://extrudesign.com/product-teardown-process/> and <https://www.philadelphia.edu.jo/academics/ttutunji/uploads/7.%20Product%20Teardown.pdf>

²⁴³ <https://www.ifixit.com/Teardown?page=1&sort=recent&filter=user>

²⁴⁴ <https://electronics360.globalspec.com/teardowns>

²⁴⁵ <https://www.techinsights.com/>

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of components and activities. It shares these reports with fee-paying subscribers, and maintains an extensive library of its work product. Its website also offers significant amount of information at no cost. **UnitedLex** sells its teardown reports of consumer products for \$3,500.²⁴⁶

Some specialize by industry. **Munro & Associates**²⁴⁷ focuses on vehicles and aerospace. **MicroNet Solutions**²⁴⁸ specializes in integrated circuits (IC). MicroNet has developed special circuit extraction software that takes the images generated by delayering and converts them into a netlist.

Some companies like **BCG**²⁴⁹ and **SystemPlus Computing**,²⁵⁰ offer teardown services to help a manufacturer improve its products and lower manufacturing costs. **PennEngineering**,²⁵¹ a fastener company, offers to teardown a product and recommend fastener improvements.

b. Blogs and groups

David L. Jones and David L. Ledger run the **EEVblog**,²⁵² which is one of the most popular engineering community forums. It has a section with information in the form of text and images, and a YouTube Engineering channel²⁵³ with over 450,000 subscribers. A number of the over 1,650 videos that they have posted involve teardowns and reverse engineering.

c. Tips for disassembly

Sometimes looking inside the product case without performing a complete teardown may provide some useful supply chain information. For many products, it will require the removal of a few screws or releasing snap catches. Manufacturers often disguise location of snap catches and cover screws with labels or bumper pads. Other screws, which may be visible or accessible, may perform important functions, like holding internal components in alignment. Removing them may cause irreparable harm to the product.

²⁴⁶ <https://unitedlex.com/solutions/intellectual-property/teardown-reports>

²⁴⁷ <https://leandesign.com/teardown-benchmarking/>

²⁴⁸ <http://micronetsol.net/>

²⁴⁹ <https://www.bcg.com/en-us/capabilities/procurement/product-teardown>

²⁵⁰ <https://www.reverse-costing.com/>

²⁵¹ <https://www.pemnet.com/wp-content/uploads/2020/05/PEMedge-Teardown-Services-Rev3.pdf>

²⁵² <https://www.eevblog.com/>

²⁵³ <https://www.youtube.com/c/EevblogDave>

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Sometimes, disassembling the case may require special tools. For example, in addition to the familiar Phillips and slot screws, there are many variants of fastener screws, each requiring its own special tool. Figure 13 shows some examples of more exotic screw heads. This list is by no means complete. Visiting the website of a company like Fastenright Ltd.²⁵⁴ provides insight on how complex and rich the field of security fasteners really is.

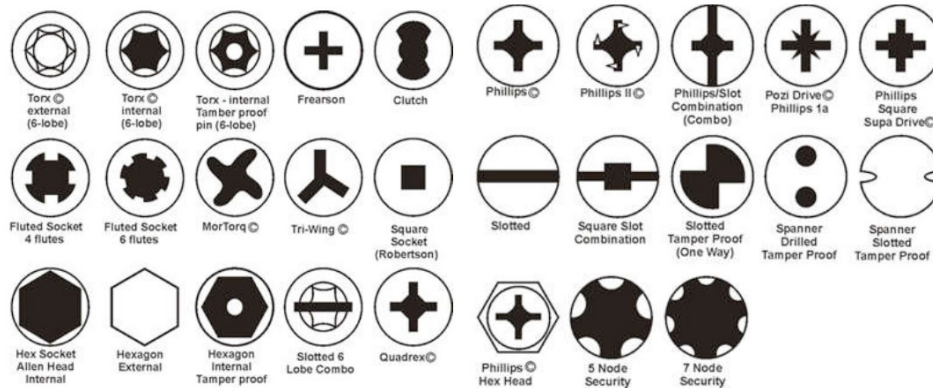


Figure 13: Some examples of specialty fastener heads²⁵⁵

For popular consumer products like iPhones, there are numerous videos on YouTube showing how to disassemble them and repair common problems, like a cracked screen or dead battery. Simple Internet searches will identify vendors who will sell an inexpensive kit of tools needed to open the case and perform the repair. For the most part, these tools are low quality and will not last more than a few uses.

One of the more useful items for teardowns is a disassembly template. It is a plastic plate that overlays a full-size image of the device. It has small compartments for each screw in the exact position where it is located in the device. The disassembly template significantly eases reassembling the item. Figure 14 shows a dismantling template for an iPhone X.

²⁵⁴ <https://www.fastenright.com/products/security-fasteners>

²⁵⁵ Image source: “When a Phillips is not a Phillips,” <https://www.instructables.com/When-a-Phillips-is-not-a-Phillips/>

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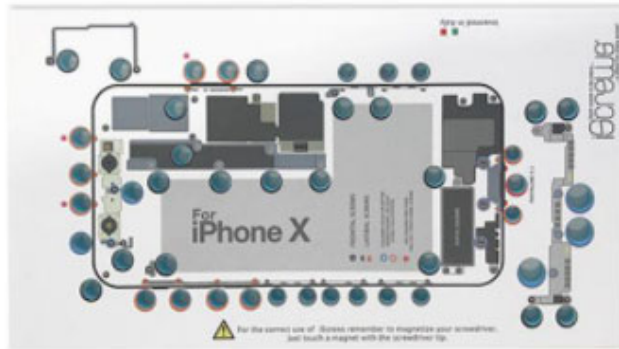


Figure 14: iPhone X dismantling template²⁵⁶

6. Product evaluations and reviews, independent lab tests, certifications

a. Evaluations and reviews

A number of sites offer product reviews. Purchasers of the product or professional reviewers write the reviews. Customer reviews further partition into those who receive some form of compensation, like a free product or discounts, and those that contribute reviews simply as a social service. Analyses of reviews show that incentivized reviews rate products higher than those that volunteers contribute.²⁵⁷

Amazon,²⁵⁸ the largest on-line seller of products in the world, provides customer reviews of products sold on its platform. In 2016, Amazon banned paid reviews.²⁵⁹ Users tend to leave reviews when they feel very strongly about the product, whether that feeling is positive or negative. As a result, Amazon reviews may not be indicative of most people's experience with the product.

C/net,²⁶⁰ which is short for Computer Network, publishes reviews, news, articles, blogs, podcasts, and videos on technology and consumer electronics. It is one of the most visited sites on the Internet.

²⁵⁶ Image source: iScrews <https://www.macmaniack.com/en/tools/5726-iscrews-boss-of-disassembly-iphone-x.html>

²⁵⁷ <https://hbr.org/2018/03/online-reviews-are-biased-heres-how-to-fix-them>

²⁵⁸ <https://www.amazon.com/>

²⁵⁹ <https://reviewmeta.com/blog/amazon-bans-incentivized-reviews/>

²⁶⁰ <https://www.cnet.com/reviews/>

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Good Housekeeping²⁶¹ is almost synonymous with product reviews. It maintains the Good Housekeeping Institute²⁶² with teams of engineers, scientists, analysts, and product experts that rigorously test products. It introduced the Good Housekeeping Seal in 1909 certifying that they have thoroughly vetted a product bearing the Seal. The Seal indicates that product bearing it has Good Housekeeping's two-year limited warranty. It will refund the purchase price up to \$2,000 if a product with the Seal is defective.

ConsumerSearch²⁶³ is a general product review site. It relies on its editors to compile reviews from around the web and synthesize them. It tends to put a greater weight on professional reviews of products rather than user-reviews, though it considers both.

Viewpoints²⁶⁴ focuses on reviews of household goods and appliances. Viewpoints is one of the best product review sites for household goods.

Consumer Reports²⁶⁵ is an independent, nonprofit member organization that focuses on consumers. Founded in 1936, it is the oldest review organization. Accessing its reviews, however, requires an annual membership fee of \$30.

DPReview²⁶⁶ specializes in reviews of all things related to photography. It has buying guides for cameras, lenses, and accessories.

Based in Sweden, **TestFreaks**²⁶⁷ has over 100 million reviews of consumer products. It compiles hundreds of reviews for each product from all over the web, from professional published reviews to user reviews. It then distills them down to a simple five star scoring system.

Based in the United Kingdom, **Which?**²⁶⁸ has a team of experts who conduct rigorous product testing themselves. There is a subscription fee to access Which? premium content, but much of the content is free. Like Consumers Report, Which? began as a magazine in the 1950s.

²⁶¹ <https://www.goodhousekeeping.com/>

²⁶² <https://www.goodhousekeeping.com/institute/about-the-institute/a19748212/good-housekeeping-institute-product-reviews/>

²⁶³ <https://www.consumersearch.com/>

²⁶⁴ <http://www.viewpoints.com/>

²⁶⁵ <https://www.consumerreports.org/cro/index.htm>

²⁶⁶ <https://www.dpreview.com/>

²⁶⁷ <https://www.testfreaks.com/>

²⁶⁸ <https://www.which.co.uk/>

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YouTube²⁶⁹ has videos of people actually using a product. The challenge of using YouTube reviews is identifying product reviewers who have the level of expertise to deliver a truly informative and insightful evaluation of a product.

b. Independent laboratory testing

Businesses use independent testing laboratories to provide objective analytical data on the quality of a product or a process. A number of independent testing laboratories offer testing services to commercial companies. Because the equipment and expertise required to perform testing depends on the product and the purpose of the test, many companies specialize. Specialization may be along the lines of the target audience, for example, government regulators like the Food and Drug Agency (FDA) or Consumer Product Safety Commission (CPSC). It can also be along the product type, like foods, cosmetics, or electronic systems.

Client companies pay for most testing, and the results are their proprietary information. Major testing groups include those that support and validate claims made in advertising, performance (does it work as intended), comparisons to competitor products, mechanical to identify failure mechanism, and adequacy of user instructions. Companies choose independent laboratories for a number of reasons. Its in-house capabilities may be inadequate or unavailable. Getting the necessary capability in-house may be too expensive or take too much time. The customer or the government may require an independent analysis. Sometimes they need outside confirmation of internal results.

The American Council of Independent Laboratories (ACIL)²⁷⁰ is the testing industry's trade association. It provides a service of helping clients identify a testing laboratory that is suitable for the client's specific testing requirements.²⁷¹

1) Underwriters Laboratories (UL)

Underwriters Laboratories (UL) is the largest and best known independent, not-for-profit testing laboratory in the world. For 125 years, UL has performed product safety testing and certification for insurance underwriters. In addition to UL Certified, UL issues three certification designations to products that pass its tests: UL Listed, UL Recognized, or UL Classified. UL Listed labeling applies to stand-alone products tested to recognized safety and performance standards. UL Recognized certification means that an equipment

²⁶⁹ <https://www.youtube.com/>

²⁷⁰ <https://www.acil.org/>

²⁷¹ <https://www.acil.org/search/custom.asp?id=2423>

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component used to produce another, UL certified finished product meets applicable standards. UL Classified products have undergone testing and evaluation for a specific hazard or for performance under specific conditions.

Users must register to search the UL website. There are two sides to the UL organization, the non-profit,²⁷² and for profit.²⁷³ In addition to testing and certifying products, UL performs research and promulgates standards.

c. Certification

Virtually all digital devices fall under 47 CFR Part 15 Subpart B,²⁷⁴ which covers incidental radiators, equipment not designed to emit radio frequency (RF) signals intentionally. Subpart C of the regulation covers equipment that intentionally transmits RF energy. Every manufacturer that wants to sell a product covered by these regulations must submit information to the FCC. Rules covering what companies need to submit are rather complex, and vary by product.²⁷⁵ Once approved, the manufacturer places their identification code and the product's code on a label on the device. Figure 15 shows a label with an FCC ID on an electronic product. The red arrow points to the combined grantee and product code.



Figure 15: A label with the FCC Id on an electronic product

²⁷² <https://ul.org/>

²⁷³ <https://www.ul.com/>

²⁷⁴ <https://www.ecfr.gov/cgi-bin/text-idx?SID=a5d243b1b22a7a0de85651146a8283db&mc=true&node=pt47.1.15&rgn=div5#sp47.1.15.b>

²⁷⁵ <https://www.fcc.gov/engineering-technology/laboratory-division/general/equipment-authorization#step1>

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The filed information is public; the manufacturer must file a request and pay a fee to keep it private. Anyone can go to the **FCC ID search website**²⁷⁶ and look at the information that the company filed. FCC filings can produce valuable information about the product and manufacturer.

The FCC website is not particularly easy to use. It requests the user to input the grantee code into one box, and the product code in another box. Some manufacturers put a dash between the two, but in this case, the manufacturer did not. Since the number of characters that designate the manufacturer has changed over the years, it takes some guessing.

A commercial site, **FCC IO**²⁷⁷ is much more user friendly. It asks the user to put in the whole string, and it figures out the manufacturer and product codes. Searching the code XFJIHM on FCC IO shows that XFJ is the manufacturer's code, and IHM is the product code. Doing a parallel search on the FCC website, during which the user entered the manufacturer and product codes separately, yields a screen with a number of links (Figure 16.)

1 results were found that match the search criteria:
Grantee Code: **xfj** Product Code: **ihm**

Displaying records 1 through 1 of 1.

View Form	Display Exhibits	Display Grant	Display Correspondence	Applicant Name	Address	City	State	Country	Zip Code	FCC ID	Application Purpose	Final Action Date	Lower Frequency In MHz	Upper Frequency In MHz
				XPLORER 40, chemin du Moulin Mervilla	N/A	France (European Territory)			31320	XFJIHM	Original Equipment	03/26/2010	2404.0	2476.0

Figure 16: FCC search results for XFJ-IHM

Clicking on the icon below View Form pulls up the form that the manufacturer submitted. Clicking the check box icon below Display Grant pulls up the form that the FCC issued certifying compliance and allowing the manufacturer to sell the product in the U.S. Clicking the mail icon below Display Correspondence pulls up any correspondence between the Manufacturer and the FCC. Clicking on the link Detail pulls up a list of the files accessible to the public, shown in Figure 17. Clicking on any of the links below View Attachment opens a window with that attachment.

8 Matches found for FCC ID XFJIHM

View Attachment	Exhibit Type	Date Submitted to FCC	Display Type	Date Available
Cover letters	Cover Letter(s)	03/26/2010	pdf	03/26/2010
Cover letters	Cover Letter(s)	03/26/2010	pdf	03/26/2010
External Photos	External Photos	03/26/2010	pdf	03/26/2010
Label and Label Location	ID Label/Location Info	03/26/2010	pdf	03/26/2010
Internal Photos	Internal Photos	03/26/2010	pdf	03/26/2010
Test Report	Test Report	03/26/2010	pdf	03/26/2010
Test Setup Photos	Test Setup Photos	03/26/2010	pdf	03/26/2010
User Manual	Users Manual	03/26/2010	pdf	03/26/2010

Figure 17: List of documents accessible to the public

²⁷⁶ <https://www.fcc.gov/oet/ea/fccid>

²⁷⁷ <https://fccid.io/>

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Returning to Figure 16, clicking on the Summary link provides a list of all of the documents that the manufacturer filed with the FCC, listed in Figure 18. Note that the Block Diagram, Operational Description, and Schematics documents are confidential, and therefore, not accessible to the site user.

OET Exhibits Summary List

11 Matches found for FCC ID XFJHMH

Exhibit Type	File Type	File Size	Description	Submission Date	Permanent Confidential	Short-Term Confidential	Date Available
Block Diagram	Adobe Acrobat PDF	228824	Block Diagram	03/26/2010	Yes	No	
Cover Letter(s)	Adobe Acrobat PDF	28796	Cover letters	03/26/2010	No	No	03/26/2010
Cover Letter(s)	Adobe Acrobat PDF	90079	Cover letters	03/26/2010	No	No	03/26/2010
External Photos	Adobe Acrobat PDF	142500	External Photos	03/26/2010	No	No	03/26/2010
ID Label/Location Info	Adobe Acrobat PDF	135126	Label and Label Location	03/26/2010	No	No	03/26/2010
Internal Photos	Adobe Acrobat PDF	203244	Internal Photos	03/26/2010	No	No	03/26/2010
Operational Description	Adobe Acrobat PDF	275870	Operational Description	03/26/2010	Yes	No	
Schematics	Adobe Acrobat PDF	379288	Schematics	03/26/2010	Yes	No	
Test Report	Adobe Acrobat PDF	424457	Test Report	03/26/2010	No	No	03/26/2010
Test Setup Photos	Adobe Acrobat PDF	506345	Test Setup Photos	03/26/2010	No	No	03/26/2010
Users Manual	Adobe Acrobat PDF	2572079	User Manual	03/26/2010	No	No	03/26/2010

Figure 18: Complete list of documents filed with the FCC

7. Types of proprietary technology

There are two major types of proprietary technology, patented and that protected as a trade secret. The U.S. Constitution²⁷⁸ establishes patents, and Federal law and regulations govern the patent system. State law, on the other hand, governs trade secrets.

a. Patents

A patent grants an inventor of a novel, useful, and non-obvious invention, the right to exclude others from exploiting the invention for a period of 20 years from the filing date of a patent application. This right to exclude others includes keeping them from making, using, selling, offering for sale, or importing a product that incorporates the invention. The U.S. Constitution establishes the patent system.

In order to secure this property right, however, the applicant has to disclose to the U.S. Patent and Trademark Office (USPTO) all information that is material to the patent. This disclosure must be complete enough so that a person of "ordinary skill in the art" of the invention can make and use the invention without "undue experimentation".²⁷⁹

²⁷⁸ Article I, Section 8, Clause 8 – Patent and Copyright Clause of the Constitution. [The Congress shall have power] “To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries.”

²⁷⁹ Manual of the Patent Examining Procedure, Section 2164.03 Relationship of Predictability of the Art and the Enablement Requirement [R-08.2012].
<https://www.uspto.gov/web/offices/pac/mpep/s2164.html#d0e215634>

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Patents are expensive and time-consuming for a company. In addition to \$20,000–\$40,000 in filing²⁸⁰ and attorney fees, the technical staff has to spend a significant amount of time explaining the invention and providing supporting materials to the attorneys. Therefore, companies will not file patents unless they relate directly to their product line and competitive position. Patents are a good indicator of key technology. An easy way to search for a list of patents that a company holds is Justia.²⁸¹ Simply typing assignee:company into the search box will produce a list of patents assigned to the company. Alternatively, the search term “patents assigned to companyname” entered into any web browser will produce a link to Justia with the search results. Justia will let you download the text of the patents, but it does not include the drawings. For that, Google Patents is a good search tool.²⁸²

1) Abandoned patents

In addition to the filing fees, patent assignees must pay maintenance fees. These fees are \$1,600 at 3.5 years, \$3,600 at 7.5 years, and \$7,400 at 11.5 years. If they do not pay the fee, the assignee forfeits the patent. Abandoned patents are a good indicator that a company is no longer pursuing a particular technology.

2) Stealth patents

Since a patent reveals a lot about a company's technology and strategy, companies will at times try to disguise their patents so that a normal search would not flag the patent. Figure 19 shows one example of a stealth patent. The title in all in capitals is not in the format of the chemical formula for tin oxide, which correctly would read SnO. The abstract uses the more arcane term stannous oxide, not the more commonly used tin oxide.

²⁸⁰ <https://www.uspto.gov/learning-and-resources/fees-and-payment/uspto-fee-schedule>

²⁸¹ <https://patents.justia.com/>

²⁸² <https://patents.google.com/>; advanced patent search is at <https://patents.google.com/advanced>.

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US 20130084414A1

(19) **United States**
 (12) **Patent Application Publication** (10) **Pub. No.: US 2013/0084414 A1**
GRANDBOIS (43) **Pub. Date: Apr. 4, 2013**

(54) PLURALITY OF SNO FLAKES (71) Applicant: Dow Global Technologies LLC , Midland, MI (US) (72) Inventor: Matthew L. GRANDBOIS , Midland, MI (US) (73) Assignee: DOW GLOBAL TECHNOLOGIES LLC, Midland, MI (US) (21) Appl. No.: 13/632,010 (22) Filed: Sep. 30, 2012 <p style="text-align: center;">Related U.S. Application Data</p> (60) Provisional application No. 61/541,933, filed on Sep. 30, 2011.	<p style="text-align: center;">Publication Classification</p> (51) Int. Cl. <i>C01G 19/02</i> (2006.01) <i>B32B 1/06</i> (2006.01) (52) U.S. Cl. USPC 428/35.8 ; 428/402; 428/34.1; 428/36.92 (57) ABSTRACT Stannous oxide particles having a methane sulfonic acid dis- solution rate of 3.56 g stannous oxide in 8.1 g of 70% methane sulfonic acid of 30 seconds at a temperature of 20 to 25° C. are disclosed, including methods of making them. Also disclosed are packaged stannous oxide particles that reduce the forma- tion of stannic oxide on the surface of the particles over time.
---	--

Figure 19: Example of stealth patent

In this case, it appears that Dow was trying to obfuscate that it was planning to enter the market for low-alpha tin. In addition to the patent in Figure 19, Dow filed additional stealth patents in the field.²⁸³ Searching for “low alpha tin” does not identify the Dow patents.

Finding stealth patents can be an important clue towards identifying a company’s proprietary technology.

b. Trade secrets

The big advantage of trade secrets is that the protection lasts as long as no one else uncovers the technology through independent legal means. The classic example of a trade secret holder successfully protecting the confidentiality is Coca Cola, whose formula has remained secret for over 125 years.²⁸⁴ If someone independently discovers the trade secret, however, the original owner has no recourse; the other party may use the trade secret in whatever fashion they choose. In practice, multiple parties may hold the same trade secret simultaneously; there is no right of exclusivity.

Generally, state law governs trade secrets. This had led to a patchwork of protection spanning various jurisdictions. In 2016, the Federal government passed the Defend Trade

²⁸³ Process for making SNO, US 2013/0084240 A1, Process for treating crusty SNO, US patent 8,974,752 B2.

²⁸⁴ <https://www.worldofcoca-cola.com/explore/explore-inside/explore-vault-secret-formula/>

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Secrets Act of 2016,²⁸⁵ which strives to create a common trade secret environment. This legislation created a federal, private, civil cause of action for trade-secret misappropriation in which “[a]n owner of a trade secret that is misappropriated may bring a civil action . . . if the trade secret is related to a product or service used in, or intended for use in, interstate or foreign commerce.”

8. Cybersecurity risks in products (CVE, CWE, Patch History, blogs)

Tower Street has around 37,500 records of unique cyber breach incidents.²⁸⁶ They have manually annotated approximately 2,750 records, which include all security incidents related to publicly traded companies, and all companies, which have suffered a data breach of over 1 million records. They have a limited release of a private beta database that they make available to researchers. Researchers who want access should email their background and use case to miguel.pinheiro@towerstreet.co.

²⁸⁵ S. 1890, 114th Cong. § 2 (2016)

²⁸⁶ <https://medium.com/@towerstreetHQ/the-worlds-most-complete-breach-dataset-for-cybersecurity-risk-models-b5e51c6a2efb>

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4. Conducting a search

Appendix B provides template prepared by Strategic Corporate Research (SCR)²⁸⁷ for conducting a PAI search on a corporation and individuals connected to it. SCR makes all of its templates and materials available under the Creative Commons Attribution-Non-commercial-No Derivatives 4.0 international license. The license allows the use of their material for noncommercial and non-derivative purposes.

²⁸⁷ <http://strategiccorporateresearch.org/resources/>

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Appendix A
Annotated bibliography

1. Robyn Winder and Charlie Speight, “*Untangling the Web: an Introduction to Internet Research*,” February 28, 2007. https://www.governmentattic.org/8docs/UntanglingTheWeb-NSA_2007.pdf

A guide to Internet research Commissioned and Published by the National Security Agency Center for Digital Content. This 643-page guide is a bit dated in parts, but still has some valuable tips and techniques.

2. Michael Bazzell, “Open Source Intelligence Techniques, Resources for Searching and Analyzing Online Information,” Seventh edition, October 2019.

The author is a former law enforcement officer. As such, the book focuses heavily on finding individuals and information about them. It spends considerable time on using social media as an information source.

3. Don MacLeod, “*How to Find Out Anything*,” Prentice Hall Press, 2012.
4. Claire Hewson, Carl Vogel, and Dianna Laurent, “*Internet Research Methods*,” Second Edition, Sage Publications Ltd., 2016.

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Appendix B

Strategic Corporate Research report template²⁸⁸

Executive Summary

1 Introduction

- 1.1 Basic information
- 1.2 Company history
- 1.3 Strategy

2 Operations

- 2.1 Products/Services
- 2.2 Facilities
- 2.3 Workforce
- 2.4 Suppliers
- 2.5 Procurement/ Distribution
- 2.6 Customers/Clients
- 2.7 Utilities
- 2.8 Subsidiaries

3 Financial Analysis

- 3.1 Review of balance sheet, income statement, cash flow (over past 3 years)
(Statements attached in Appendix A)
- 3.2 Review of key financial ratios (over 3 years) (table attached in Appendix B)
- 3.3 Comparison of key financial ratios with competitors (Table attached in Appendix C)
- 3.4 Segment analysis (table in Appendix D)
- 3.5 Stock analysis (table in Appendix E)

4 Industry and Competitors

- 4.1 Summary of industry trends
- 4.2 Analysis of competitors

²⁸⁸ Source: <http://strategiccorporateresearch.org/resources/>

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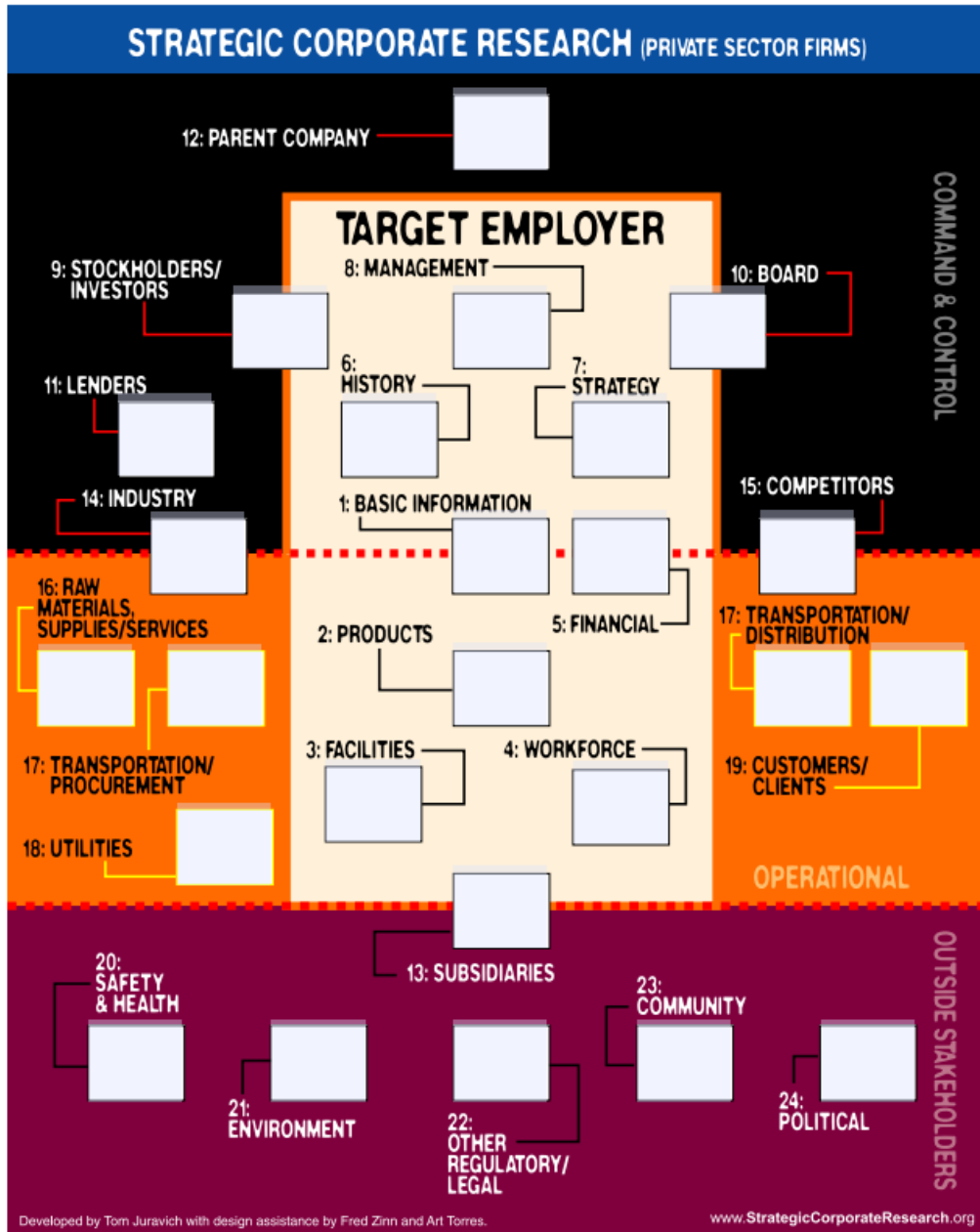
- 5 Command and control
 - 5.1 Management
 - 5.2 Stockholders
 - 5.3 Board of directors
 - 5.4 Lenders
 - 5.5 Parent company

- 6 Outside Stakeholders
 - 6.1 Safety and health
 - 6.2 Environment
 - 6.3 Regulatory/Legal
 - 6.4 Community
 - 6.5 Political

- 7 Conclusions
 - 7.1 Profit center
 - 7.2 Growth plan
 - 7.3 Decision makers
 - 7.4 Key relationships

- 8 Appendices
 - 8.1 Financial statements
 - 8.2 Key financial ratios
 - 8.3 Comparative financial ratios
 - 8.4 Segment analysis
 - 8.5 Stock analysis

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Strategic Corporate Research 24-question model for private sector firms²⁸⁹

²⁸⁹ http://strategiccorporateresearch.org/files/2012/03/SCR_PrivSecFir_form1.pdf

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Appendix C

Shipping terminology²⁹⁰

Every supply chain will involve shipping goods and materials among first tier integrators, fabricators, subsystem, and component suppliers. The shipping industry has its own set of terminology, some of which the International Chamber of Commerce defines and maintains.

The sales contract details all payment obligations between the shipper and the consignee. The contract contains terms called Incoterms, or International Commercial Terms. Incoterms are a series of voluntary and internationally recognized commercial terms published by the International Chamber of Commerce that outline the cost allocations and risks borne between the seller and buyer.

The Incoterms, however, are only a part of the trade contract. They do not outline the price of the shipment, transfer of ownership, product liability or breach of contract, nor can they override existing trade laws. The series is now in its ninth version and there are 11 important Incoterms. Seven of these cover all modes of transport while four cover sea and inland waterway transport.

The next series of tables cover shipping terminology, the shipping cycle, documents required to clear U.S. Customs, Incoterms for all modes of transport, and Incoterms specific to sea and inland waterway transport.

²⁹⁰ Team TRADEMO “Everything Businesses Should Know About Shipping to the US,” November 17, 2020. <https://trademo.com/blog/everything-businesses-should-know-about-shipping-to-the-us>

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Shipping Terminology	
Arrival notice	A notice that the carrier provides when the cargo is delivered to the consignee
Balloon freight	Cargo that is light but high in volume
Bulk cargo	Cargo that is shipped loose, not in packages or containers
Consignee	An individual or organization that deals with the shipment at the receiving end
Consolidation	When cargo from several shippers is combined within a single container
Customs	A government agency that is responsible for enforcing trade regulations and collecting import duties. The assessment of a shipment to ensure compliance with the country's import regulations is called customs clearance
Customs and Border Protection(CBP)	An agency within the US Department of Homeland Security that enforces export and import regulations and checks the flow of goods in and out of the country
Freight	It is the general term for goods transported from one place to another by any means
Freight forwarder	The logistics provider
In bond	Cargo that has not cleared customs
Landed cost	The final cost of the goods, including import duties and shipment costs
Liquidated damages	The payment made by the seller to the buyer if the quality standards or deadline stipulated in the sales contract are not met
Port of Entry	The initial port of entry in a country where a cargo vessel arrives
Shipper	An individual or organization that deals with the shipment at the supplier end
Shipping line/Carrier	The organization that carries product-related cargo

Shipping Cycle	
Export haulage	The first stage in the shipping cycle, it involves the transfer of goods from the shipper to the freight forwarder's premises.
Export customs clearance	This is the first of two documentation stages, wherein a declaration of the cargo being shipped and supporting documents are submitted to a customs house broker for further submission to Customs.
Origin handling	Here, the cargo is received by the freight forwarder at a warehouse, where it is unloaded, counted, and inspected.
Ocean freight	The cargo is passed by the freight forwarder to the shipping line, which executes the ocean freight.
Import customs clearance	This is the second and final documentation stage, wherein the documents detailing the cargo are submitted to the freight forwarder or a licensed customs house broker at the destination. It typically begins before the shipment arrives at the
Destination handling	The cargo is unloaded from the ship and transported to the destination warehouse, where it is inspected and sorted for transportation. This stage is executed by the freight forwarder.
Import haulage	The final stage in the shipping cycle, here the cargo is transported from the warehouse to the consignee, and finally to the end consumer. The transportation is either handled by the freight forwarder or a local transport company.

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Documents Required to Clear U.S. Customs	
Harmonized System Code (HS Code)	The Harmonized System is a commodity description and coding system that is used internationally, based on which customs officials will determine the taxes, duties, and regulations for your goods. Prior to exporting your shipment, it is necessary to determine the Harmonized System Code for them.
U.S. Customs Invoice	The U.S. Customs Invoice is the basic document provided to the shipping line. It identifies the exporter and the type and value of goods shipped. It includes the following information: (i) Description of the merchandise (ii) Quantity of the merchandise (iii) Approximate value of the merchandise (iv) Eight-digit subheading from the Harmonized Tariff Schedule of the United States, and (v) Name and address of the individual or company who is responsible for invoicing the merchandise – typically the manufacturer or seller, or the person or organization who made the goods available for sale.
Inward Cargo Manifest	This is an itemized list of the shipment's contents, usually prepared by the shipping line based on information provided by the shipper. It is submitted to officials for customs clearance either as a paper document or as an electronic copy. Once accepted, the manifest and its Bond Number are monitored until the shipment is closed.
Commercial Invoice	The Commercial Invoice is presented by the shipping line to the customs officials once the shipment reaches the border. It is used to determine the value of the goods and enables the exporter to collect money from the importer and while also assisting the latter in clearing the cargo through customs. It contains the following information: (i) The parties involved in the shipping process (ii) The goods being transported (iii) The manufacturing country, and (iv) The Harmonized System codes for the goods.
Bill of Lading	This document is issued to the shipper by the shipping line. It contains a description of the items being shipped, an acknowledgement of receipt and the terms of the contract for carriage. Copies of the Bill of Lading are issued to the shipper and the importer.
Packing List	This is a detailed description of the goods being shipped. Although the Packing List is not necessary for customs, customs brokers. It includes details such as quantities, items, model numbers, dimensions, and net and gross weights. It is prepared by the shipper before the goods are shipped.
Entry/Immediate Delivery	This document is only necessary for time-sensitive shipments and should be submitted to customs by the shipping line before the arrival of the shipment.

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International Commercial Terms (Incoterms) for all Modes of Transport	
Ex Works (EXW)	Ex Works places most of the obligation on the consignee or buyer. The seller prepares the cargo for pickup at its premises or a pre-decided location such as a factory or warehouse. The pickup is arranged by the buyer, who is also responsible for clearing the shipment through customs and transporting it to the final destination.
Free Carrier (FCA)	The seller handles the transport of the shipment to the carrier chosen by the buyer. The shipment is carried to a designated location. All charges upto this point, including transportation and customs clearance at the origin, are handled by the seller. On reaching the designated location, if the delivery occurs at the seller's premises, the loading and unloading is their responsibility. If it takes place at another location, it is the buyer's responsibility. The buyer is responsible for all charges from the handover of the goods to the carrier to its arrival at the destination.
Carriage Paid To (CPT)	The seller transports the shipment to a predetermined location and also handles the costs for export clearance and transportation charges to the named place of destination. All further charges, including the customs clearance and insurance costs are to be paid by the buyer.
Carriage and Insurance Paid To (CIP)	Similar to CPT, the seller is responsible for transporting the shipment to a predetermined location and also handles the export clearance costs and transportation charges. But in this case, the seller also pays for the insurance of the shipment while in transit. The insurance policy should be in the same currency as that of the importer and should be claimable by the buyer, seller and any other party that has an interest in the shipment. The insurance coverage should be at least 110 percent of the value of the goods being shipped.
Delivered at Place (DAP)	The seller is responsible for all the costs up to the named place by buyer including the customs formalities at the origin but excluding the unloading. At the destination, the buyer is responsible for all the customs clearances and unloading costs.
Delivered at Place Unloaded (DPU)	The seller is responsible for all the costs until the shipment is unloaded at the place named by a buyer, including the charges related to export, carriage, and unloading at the destination port. The buyer is responsible for customs clearance at the destination and all the transport charges after the cargo is unloaded.
Delivered Duty Paid (DDP)	All risks and costs involved in bringing the shipment to the destination are borne by the seller, including the import duties and taxes and securing the necessary authorization at the destination country, except the unloading of the cargo.

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Incoterms Specific to Sea and Inland Waterway Transport	
Free alongside Ship (FAS)	The ship is chosen by the buyer and all charges and risks are borne by them from the moment the shipment is placed in the boarding area alongside the ship, including export clearance and cargo loading costs. The seller is responsible for all charges upto the point of arrival at the port.
Free-on-Board (FOB)	Unlike FAS, the exporter is responsible for all the costs and risks, including the export clearance, until the shipment is loaded onto the ship, which is chosen by the buyer. The latter pays the freight transportation costs, insurance, unloading and transportation charges from port of origin to the destination.
Cost and Freight (CFR)	The seller is required to clear the goods for export, deliver them onboard the ship at the port of departure, and pay for transport of the goods to the named port of destination. The risk passes from seller to buyer when the seller delivers the goods onboard the ship.
Cost, Insurance and Freight (CIF)	The seller handles all costs at the origin – the transportation to the origin port, export clearance and freight costs to the named port of destination. However, in this case the seller covers the insurance costs. The policy is in the same currency as the contract. The buyer is responsible for all costs after arrival at the destination port.

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Appendix D

Google search operators

http://www.googleguide.com/advanced_operators_reference.html

<https://moz.com/learn/seo/search-operators>

<https://www.spyfu.com/blog/google-search-operators/#allintitle->

<https://ahrefs.com/blog/google-advanced-search-operators/>

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Appendix E

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Acronyms and Abbreviations

ACIL	American Council of Independent Laboratories
AIC	Administration for Industry and Commerce
API	application-programming interface
BAMA	Boat Anchor Manual Archive
BODS	Beneficial Ownership Data Standard
bots	software robots
C	Centigrade
CAN	CVE Numbering Authority
CBP	Customs and Border Protection
CEO	Chief Executive Officer
CERT	computer emergency response teams
CFIUS	Committee on Foreign Investment in the United States
CFO	Chief Financial Officer
CFR	Code of Federal Regulations
CFR	Cost and Freight
CIF	Cost Insurance and Freight
CIP	Carriage and Insurance Paid To
CISA	Cybersecurity and Infrastructure Security Agency
COO	Chief Operating Officer
CORDIS	Community Research and Development Information Service
CORDIS	Community Research and Development Information Service
COTS	commercial off-the-shelf
CPSC	Consumer Product Safety Commission
CPT	Carriage Paid To
CSC	Cyber Search Centre
CSV	comma-separated values
CV	curriculum vitae
CVE	Common Vulnerabilities and Exposures
CWE	Common Weakness Enumeration
DAP	Delivered at Place
DBA	doing business as
DDP	Delivered Duty Paid
DHS	U.S. Department of Homeland Security
DoD	Department of Defense

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DPU	Delivered at Place Unloaded
ECPC	Economic Classification Policy Committee
EIN	tax identification number
EU	European Union
EXW	Ex Works
FAPIIS	Federal Awardee Performance and Integrity Information System
FAS	Free Alongside Ship
FCA	Free Carrier
FCC	Federal Communications Commission
FCC	Federal Communication Commission
FDA	Food and Drug Agency
FEDLINK	Federal Library and Information Network
FinCEN	Financial Crimes Enforcement Network
FOB	Free on Board
GHDB	Google Hacking Database
GSA	General Services Administration
HS	Harmonized System
HTML	hypertext markup language
HTS	Harmonized Tariff Schedule
IC	integrated circuit
ICC	International Chamber of Commerce
IPO	initial public offering
ISP	internet service provider
ITRAC	Importer Trade Activity
LDA	Lobbying Disclosure Act
LLC	limited liability corporation
LLP	limited liability partnership
LP	limited partnership
M&A	merger and acquisition
MeSH	Medical Subject Headings
NAICS	North American Industry Classification System
NDNP	National Digital Newspaper Program
NEH	National Endowment for the Humanities
NGO	non-governmental organization
NRL	Naval Research Laboratory
NSA	National Security Agency
NVCA	National Venture Capital Association
OMB	Office of Management and Budget
PACER	Public Access to Court Electronic Records
PAI	Public Accountability Initiative

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PAI	publicly available information
PDF	portable document format
POGO	Project On Government Oversight
RAM	random access memory
RF	radio frequency
SBIR	Small Business Innovation Research
SCR	Strategic Corporate Research
SCRM	supply chain risk management
SEC	Securities and Exchange Commission
SEDAR	System for Electronic Document Analysis and Retrieval
SIC	Standard Industrial Classification
SITC	Standard International Trade Classification
STTR	Small Business Technology Transfer
TESS	Trademark Electronic Search System
Tor	The Onion Routing Project
UL	Underwriters Laboratories
URL	uniform resource locator
USCIS	U.S. Citizenship and Immigration Services
USPTO	U.S. Patent and Trademark Office
VC	venture capital(ist)
VPN	virtual private network
WCO	World Customs Organization
WIPO	World Intellectual Property Organization
WWW	World Wide Web