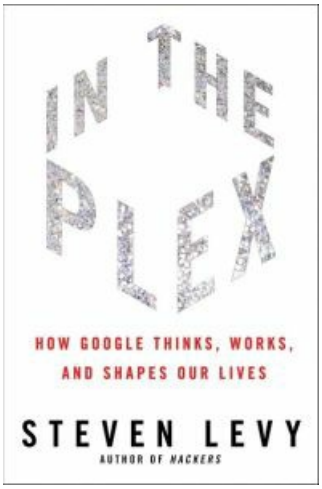

Book In the Plex

How Google Thinks, Works, and Shapes Our Lives

Steven Levy
Simon & Schuster, 2011

Recommendation

Journalist Steven Levy's previous books about Macintosh computers and about hackers make him the perfect insider-outsider, with the knowledge to write a detailed history of famously private Google. Granted unprecedented access, Levy appears to have insightfully interviewed everyone about every moment of Google's history to present this canonical version of the company's saga. Levy seems a little too close to his subject, so perhaps his book is not a warts-and-all chronicle, but most of the stories are fascinating, and it is all well reported. *BooksInShort* recommends this heavily anecdotal history to readers who are launching a start-up, intrigued by computers and cultural history, or interested in a nice, detailed dose of the truth behind all those Google rumors.

Take-Aways

- Google seeks to "organize all the information in the world."
- The two founders Larry Page and Sergey Brin see speed as the most valuable processing quality.
- Google found its moneymaking mechanism with the advent of AdWords in 2000 and had its first profitable year in 2002.
- Page and Brin became billionaires when Google went public in 2004.
- Google plans for the future on the basis of needing and owning infinite storage and bandwidth, and knowing that technology keeps becoming cheaper.
- The company routinely transforms its search engines in great secrecy. In 2009 alone, Google made more than 600 changes to improve searches.
- Google's users unknowingly take part in Google's constant quality testing.
- The firm built more than a "dozen billion-dollar" secure, energy efficient data centers.
- Google constructs servers from low-cost parts, keeps them warmer than industry standards to save energy, expects them to fail and shifts data instantly when they do.
- As of 2009, the number of books in print in all the globe's languages was 129,864,880. If it has its way, Google will scan them all.

Summary

Beginnings

Larry Page and Sergey Brin founded Google. Neither man thought big at the beginning. Big was nothing. They both thought in terms of global. Page was brilliant, farseeing and magnificently ambitious. He so strongly believed in routinely attempting the impossible that his co-workers joked: "Page went to the future and came back to tell us about it."

> "Page and Brin both held a core belief that the success of their company would hinge on having world-class engineers and scientists committed to their ambitious vision."

The partners met when Brin was Page's guide on a San Francisco tour. Both studied computer science at Stanford University in California and reveled in the future they saw coming – a time when everyone would be connected. Brin completed his bachelor's degree in three years and became one of Stanford's youngest-ever PhD students. He finished his required courses quickly and took whatever modules he liked in search of a doctoral thesis topic. Studying computer science, Page became fascinated by how web pages linked. He set out to find a way to navigate the vast random online world and created the PageRank program, which "rated websites by

the incoming links." It granted higher status to pages linked to the greatest number of other pages. After some refining, he realized that its power lay not in "ranking annotations, but...ranking searches." He saw PageRank as a way to search for anything online. That was the foundation of Google.

> "To make progress. . .you would have to live in the data, breathe it in like a fish passing water through its gills."

Page and Brin used PageRank as material for their doctoral theses, but they wanted to earn money from it, too. They offered the PageRank search engine to Yahoo, but, unable to see its commercial potential, the company declined. Page and Brin met with various potential buyers, but all said no, though some deals came close. Determined to build their own company, they selected a name based on the word "googol," meaning a number 1 followed by 100 zeros. Misspelling it as "Google" proved fortuitous, since somebody had already licensed "googol." When one of Page and Brin's first investors gave them a check for $100,000, Brin told him: "We don't have a bank account." They had one by September 1998, when they incorporated Google.

> If you had the right tools, it was possible to treat everything in the open web like a single document."

The company operated from Page's dorm room. In no time, Google was dealing with "10,000 queries a day." Page and Brin scrounged all the servers they could glean as students and even purchased drives. The gear filled the dorm room. Early searches could take an unacceptable 3.5 seconds. Speed, which was Google's Holy Grail from the beginning, mattered more to Page and Brin than any other computer processing magic. Page and Brin were engineers first. They wanted a workforce of the world's best engineers. They hired fellow graduates and former professors. The quality and quantity of their hires convinced Silicon Valley that Google was a serious endeavor. In less than a year, Page and Brin had their own research team and "a group of top scientists totally committed to [their] vision."

Let It Break

By 1999, Google had more than 3,000 computers. Page and Brin's unconventional brilliance was apparent in their choice of hardware. They knew they would need more and more machines, and that would eat their capital. The demand for storage space would only grow. So from the beginning, they bought cheap equipment, much of it "below-spec," machines and parts of such low quality that the manufacturers would not guarantee them. The groundbreaking idea was that Google's engineers did not care if the machines broke. They expected it. Google designed its software to shift storage and processing instantly to other machines in case of failure. Because it bought so cheaply, Google could afford redundancy. Brin and Page always planned – far ahead of anyone else – to have massive storage. Head engineer Wayne Rosing explained, "The unit of thinking around here is a terabyte" (10 trillion bits of data). Google's founders understood that storage demand would always grow and the cost of technology would always drop; chips, processors and servers would become faster and continually cheaper.

> "Just as with its search engine, Google was letting its users teach it about the world."

Page cited inventor Nikola Tesla as his inspiration, but Tesla never made money from his groundbreaking discoveries in electricity. Obsessed with doing well, Page would not repeat Tesla's mistake. Although Brin once wondered aloud if ad sales would grow enough to make it worthwhile to buy a fax machine to receive orders, the advent of AdWords in October 2000 answered that question and ended any risk that Google would fail to reap a huge fortune. AdWords – search terms that customers pay for according to a click-through rate – gave Google its first profitable year in 2002. AdWords Select went on to become a "spectacular commercial success" and "the dominant transaction mechanism" for Internet advertising.

Translation

Page and Brin regard different languages as a mere technical problem. They want Google to be able to translate any page into almost any language. As early as 2001, users could read Google in 26 languages. Google expert Franz Och said, "Provide the computer with large amounts of monolingual text, and the computer should figure out. . .what the structures are." Google built the largest language models "in the history of mankind." When its engineers saw that processors began to understand a language after about a billion words, in true Google style, they fed the system multiple billions. The more sentences a computer absorbed, the more it understood. Google used an ingenious, counterintuitive solution to establish a speech recognition system: The company launched a free US telephone directory service and never monetized it. Google just wanted millions of callers to "teach" its computers how spoken language works. After a few years, when it had enough samples of spoken English, Google quietly discontinued the service.

The Campus

As Google expanded, it outgrew one location after another. In 2003, it bought the campus of Silicon Graphics, a "troubled" software firm. The legendary Google work life began here as Google refitted the building for energy savings and encouraged workers to arrange entire floors for their own efficiency. Over time, Google came to provide on-campus dry cleaning, films, massages, car washes, grocery shopping and gyms. Company chefs offer a variety of free food. Renowned experts lecture on technical and cultural topics, and workers take a wide range of courses at Google University. Google buildings all have tech shops with in-house repair people and conference rooms staffers can book in one-hour slots on a companywide schedule. Every conference table has built-in projection systems, plus plugs and chargers for every computer, tablet or phone. People never have to leave meetings to go back to their offices for missing gear or waste time figuring out how to hook up an audiovisual system. Google does everything it can to make sure "Googlers," as it calls staffers, never have to leave. People channel the time they'd usually spend on errands into their work. Life becomes more efficient for them and for Google.

Going Public

Brin and Page long resisted the gargantuan payday that going public would bring them, their investors and their employees. They ran the business in an intensely private way. They feared that an IPO would make employees overly concerned about the rise and fall of the stock price and that morale might suffer. But Google's venture capital investors knew it was time. As Google contacted various banks to handle the gigantic transaction, it used different phrasing in each letter to each bank to track any possible leaks. Turning away high-profile bank CEOs, Google's chiefs met only with the bankers who would actually do the work. Page and Brin demanded that the value of the original offered shares had to be $2,718,281,828. That was a math gag aimed at geeks who would spot the initial digits of "the irrational number *e*. . .Napier's Constant."

"Google made historic profits...by creating a new form of advertising."

Google launched its IPO on August 19, 2004. That day, Rosing held an all-employee meeting while brandishing a baseball bat. He told the assembled Googlers that if they went out and bought BMWs or Porsches he would be in the parking lot, smashing windshields. Google had always been low-key and dedicated to performance, and upper management was determined that a waterfall of new wealth would not change that culture. But how could it not? When the IPO was finished, Brin and Page each held Google stock worth $3.8 billion.

"Google began making so much money that its biggest problem became hiding how much."

In June 2006, Yahoo, having once refused to buy PageRank, signed Google to handle all its online searches. Seeing Google's logo on every Yahoo search page enhanced Google's brand and weakened Yahoo's. The deal gave Google the "most current data" and the biggest index of web pages in the world – more than a billion. Google constantly revamps its search methods. In 2009 alone, its engineers made more than 600 changes to its search codes and protocols. Google runs new versions for millions of people without them knowing it, thus involving users in constant quality tests. Google operates in such secrecy that its pioneering engineers receive little publicity. They are "heroes at Google but nowhere else."

Data Centers

As the fiber optics market began to collapse after the dot-com bust, Google bought all the fiber optic networks it could. Now it owns more than any other firm worldwide and has so much fiber optic capability that, even with its own incalculable usage, it can rent bandwidth to other data providers. Google never needs to worry about having enough bandwidth, and it is immune to bandwidth price fluctuations. Google just plows ahead with its hordes of cheap servers, all crashing predictably and shuttling data to working machines. Multiple redundancies in servers, cabling and cooling apparatus make the method profitable. Google has never revealed how many servers it requires. Its head of infrastructure, Jim Reese, admitted in 2002 that Google had at least 10,000 servers processing more than 150 million searches daily; today it has many more.

"Google was determined to maintain its sense of play, even if it had to work to do it."

Google stacks its electricity-hungry servers in towers (in 2005, all US data servers combined accounted for 1.2% of the nation's annual electrical consumption). Google data centers, and similar warehouses full of servers, must be adjacent to fiber optic cables, close to water, near power lines, in acres of enclosed space, private and easy to secure. Racks of servers discharge hot air and require cooling so they don't overheat. Seeing existing centers as outdated and energy inefficient, Google used an eccentric, forward-looking method to heat and cool its servers. One groundbreaking step was to run its cool rooms warmer than other companies. This saved a fortune, but more servers failed. "You counted on failure," explained one data center designer.

"Without leaving the campus you could see a doctor, do Pilates, get a Swiss massage."

Google decided to build or buy enormous data centers, fill them with shipping containers, and pack those modules with racks of servers. "Once focused entirely on building Internet software," Google began to construct more than "a dozen billion-dollar facilities" in such places as Goose Creek, South Carolina; Moncks Corner, North Carolina; and The Dalles, Oregon – towns with depressed economies where local governments gladly granted Google sweetheart tax deals to get construction and service jobs. Google manages the servers and runs the centers remotely, whether they hold "500 or 500,000 computers," and hires workers mostly to keep the facilities going.

Google Books

Eager to possess and share all the knowledge in the world, Page and Brin targeted the content of the approximately 33 million book titles printed since the invention of the printing press. Page pushed for a way to digitize the content of every book. Typically, he had no patience with anyone who used the word "impossible." With Google's money, brainpower and reach, he felt nothing should be impossible. Page considered simply buying every book and removing the pages for scanning. Google personnel determined that if they could scan a book for $10 and the world has 30 million books in print, the cost would be $300 million, which "didn't sound like too much" for a company with $28 billion in annual revenues.

"Arthur Clarke once remarked that the best technology was indistinguishable from magic."

However, early scanning methods were primitive. Googlers needed 42 minutes to scan a 300-page book. That seemed reasonable, but they knew the process could be more efficient. Google created a scanner that combined the images from "two special cameras with multiple stereoscopic lenses, each capturing the image of a page" from either end. An infrared camera also shot each page from above. Google could not, in the end, create a device that could turn pages without damaging them, so it hired a small army of page-turners. Google claims its scans were so accurate that page-turners' fingers showed up on the scans. Google captured every page of every book as a separate document so online searchers could access the information in a variety of ways. As of August 10, 2009, the company estimated that the number of books in print in all the globe's languages was 129,864,880. If it has its way, Google will scan them all.

About the Author

Steven Levy is the author of *The Perfect Thing: How the iPod Shuffles Commerce, Culture, and Coolness*; *Insanely Great: The Life and Times of Macintosh, the Computer That Changed Everything*; and *Hackers: Heroes of the Computer Revolution*.