# The Challenge of Engineering Vertical Search



### The Engineering Search Engine®

Jeff Dalton Software Engineer Search Engine Development Team April 3<sup>rd</sup>, 2008

# Vertical Search is hard (to do well)

Hardness	Mineral	Absolute Hardness
1	Talc	1
I	(Mg3Si4O10(OH)2)	1
2	Gypsum (CaSO4·2H2O)	2
3	Calcite (CaCO3)	9
4	Fluorite (CaF2)	21
5	Apatite	10
	(Ca5(PO4)3(OH-,Cl-,F-))	40
6	Orthoclase Feldspar	70
0	(KAISi3O8)	12
7	Quartz (SiO2)	100
8	Topaz (Al2SiO4(OH-,F-)2)	200
9	Corundum (Al2O3)	400
10	Diamond (C")	1500
11	< number tells who?	>1500
12	Ultrahard Fullerite	>1500

# Why is it worth doing?

- Gives users what they want, in their language
- Engage, aggregate, and monetize a specialized market.



### A search engine for engineers



**4.1 million** registered engineering, technical, scientific and industrial professionals

### How engineers use the Internet

#### 2006 2005 2004



In 2006, 91% of engineers reported using the Internet to find components and services and 90% reported using the Internet to obtain product specifications. 82% reported using the Internet for research, compared to 68% in 2005.

### SpecSearch: Parametric search

#### ndustrial Heaters, All Types

#### 79 companies supply Industrial Heaters, All Types.

lick on a listing for more information or filter your list by adding specifications.

	F	Compare Selec	ted Catalo	gs 🔵 🤇 Send Group E-mail 🕽		
<sup>dit</sup> Filter Your Catalog Results	Î	Online Catalog	Custom Order	<u>Company</u>	Headquarters	PRODUCT ANNOUNCEMENTS
		737 products		Alstrom Corporation (The) (Manufacturer)	Bronx, NY	GODBAL
Click to Add Specifications		147 products		Beswick Engineering Co., Inc. (Manufacturer)	Greenland, NH	
Heater Type		51 products		Casso-Solar Corp. (Manufacturer)	Pomona, NY	Global@ccess Global Equipment Company
Heater Type: »		2,529 products		CCI Thermal Technologies Inc. (Manufacturer)	Edmonton,	Inc.
Air Heater (2,623 ) Band Heater (3,481 )		8,537 products		Chromalox (	h, PA	
Coil Heater and Cable Heater		41 products		Cooper Crouse-innus (Manuacurer)	<del>Syracu</del> se, NY	
(392) Cartridge Heater (7,153)		9 products		Dantherm Air Handling Inc. (Manufacturer)	Spartanburg, SC	1000
Cast-In Heater (27)		4 products		DDB Unlimited Inc. (Manufacturer)	Wynnewood, OK	Fast Mediumwave Infrared
Show All Options +		615 products		Durex Industries (Manufacturer)	Cary, IL	Heater Emitters
Fuel / Energy Source		1 product		Ellsworth Adhesives (Distributor)	Germantown, WI	Heraeus Noblelight, Inc.
Fuel / Energy Source: »		160 products		Farnam Custom Products (Manufacturer)	Arden, NC	
Electric (45,766) Diesel / Fuel Oil / Gasoline /		8 products		Fotronic Corporation / Test Equipment Depot (Distributor)	Melrose, MA	Circulation Heaters
Kerosene (10) Hot Water / Steam (814)		62 products		Glas-Col, LLC (Manufacturer)	Terre Haute, IN	
<u>Natural Gas / Propane</u> (74) <u>Other</u> (39)		141 products		Glenro Inc. (Manufacturer)	Paterson, NJ	
		20 products		Global Equipment Company, Inc. (Distributor)	Port Washington, NY	Circulation Heaters Thermtech Systems, Inc.
Maximum Temperature		22 products		Haewa Corporation (Manufacturer)	Duluth, GA	
Maximum Operating Temperature: »		23 products		Heaters Controls & Sensors (Manufacturer)	London, Canada	See more product

# **Engineering Web search**

GLOBALSPEC The Engineering Search Engine	<b>Your Stuff</b>   Your Profile Download Engineering Toolbar GlobalSpec Home
Find:     dc motors     Search     Advanced Search >>	
We found these Engineering Web Results for: dc motors Refine your results: dc motor, Electric Motors, Generators, accessories, Brushless DC Motors, AC motors, More Terms >>	Product-Centric E-llewsletters Receive the latest news, trends, and technology with GlobalSpec's e-newsletters - FREE. (See Titles)
Engineering Web Sites: 1 - 10 of 4,898,816 Next 10 res	sults > Show 10 💌 results per page
The Engineering Web®         Products & Services         Part Number Search         Engineering News BETA         Application Notes	Material Properties Patents Standards
Search by Specifications in dc motors-related categories:         Image: DC Motors (840 companies)       Search By Specification         DC motors are most commonly used in variable speed and torque applications. They include brushless and gear motors, as well as servomotors.       DC Servomotors (297 companies)         DC servomotors (297 companies)       Search By Specification         DC servomotors (100 companies)       Search By Specification         DC servomotors (100 companies)       Search By Specification         Gearmotors consist of an AC or DC motor with an integral gearbox or gear head that steps delivered speed up or down.         Electric Motors & DC Motors.       DC Motors. Brushless DC Motors. Limited-Angle Torque         Motors. PM DC Motors. Coreless DC Motors. Linear DC Motors. Selecting DC Motors. DC Motors. DC Motors.         Linear DC         http://www.electricmotors.machinedesign.com/ - (cached)         DC Motors, Gearheads, Coreless, Brushless and Small DC Motors, encoders and motion control systems, brushless motors, coreless DC micro motors, encoders and motion control lers from MicroMo Electronic specialists in design, manufacture and application of miniature	Sponsored Results MicroMo Electronics: Direct Current (DC) Electric Motors Specializes in the design, assembly and application of high precision, miniature DC drive systems, components, and motion control systems. www.micromo.com Montrol Resources: DC Power Systems Supplies OEM motor, pump and fan speed control and alarm products to the telecommunications, electronics and HVAC industries. www.controlres.com Bodine Electric: DC Motors Supplies fractional horsepower (FHP) industrial electric motor products, including over 1,000 stock electric motors, gearmotors, and motion controls. www.bodine-electric.com

### Why Engineering Web search?

### Britney Spears' Guide to Semiconductor Physics

[Home] [ Picture Galleries ] [ Britney Spears guide to Semiconductor physics ] [ Links ] [ Lyrics ] [ Advertise] [Stuff] [ Chat ] [Link to us] [Awards] [Britney Gossii



It is a little known fact, that Ms Spears is an expert in semiconductor physics. Not content with just singing and acting, in the following pages, she will guide you in the fundamentals of the vital semiconductor laser components that have made it possible to hear her super music in a digital format.

- \* Introduction
- \* The Basics of Semiconductors
- \* Semiconductor Crystal Structures
- \* Semiconductor Junctions
- \star Finite Barrier Quantum Well
- \* Radiative Recombination
- Carrier Transport in Semiconductors
- \* Density of States
- \* Edge-emitting Lasers

Scientific Calculator Click here to donate food to the starving people of the world.



 Vertical Cavity Surface Emitting Lasers (VCSELs)

- \* Photonic Crystals
- Crystal Growth, Fabrication and Processing
- \* Photolithography
- Britney Spears' Guide to Semiconductor Physics wallpaper
- \* Reference and Data
- Lip-glossary of Semiconductor
- 🔭 Terms
- \* About the Author



#### The Process

Domain experts provide seed sites (several hundred to a few thousand) to the crawler to get initial content Once the crawler has found ~ 10,000 sites,
Domain experts "train" the classifers which ones are relevant



Relevant sites are published to the index. URLs harvested from relevant sites are fed back to the crawler to get new content. Hidden web content is published separately. The system "grows" automatically.

### **Practical problems**

- Web crawling
- Spam
- Ranking
- Scale

### Crawling challenges

				About 03 Chireoteer	KOI		<u>с</u>	
• Cr	awl sele	ctio Martín	0					
	ABOUT US EMPLOYEE PROFIL	E CONTACT US HOW TO FIND US	s	Martin Enters in	nto	Joint Venture in Japan		14/12/2005 Martin U.S. Offers Powerfu SuperBig 7K
artin				M ( )	Jap	pan Ltd. to place increased focus		<ul> <li>Read more</li> <li>2/12/2005</li> <li>Martin U.S. Dealer Expansion</li> <li>Read more</li> </ul>
	Martin Enters into Jo 20/12/2001 Martin Professional Japai on key market Martin Professional A/S has e and Hiroshi Yoshida, long tim Japan, to establish a joint cor The joint venture is a collabor automated lighting company Yoshida, a Japanese couple w lighting industry with a reputa The newly established compa 8 employees, will handle distr and Mach products throughou The establishment of a single which had previously been cot companies, is an important si on the Asian market. In 2002 Japanese market. For years Martin has maintain and positive relationship with Matsushita. Martin Profession this relationship with newly es Ltd. In order to demonstrate Marti market, Martin Professional P assumed the position of Chai board members include Mr. A Sales Manager Jonas Eisenha The official opening of the ne February with the participation Marketing Director Pio Nahum	Dint Venture in Japan <b>n Ltd. to place increased focus</b> <b>n tered</b> into an agreement with Chako e distributors of automated lighting in npany, Martin Professional Japan Ltd. ation between the world's largest and majority owners Mr. and Mrs. ith 20 years of experience in the tion for professionalism. ny, located in Tokyo and consisting of ibution and service of Martin, Jem t the country. professional distributor in Japan, wered through three separate rep in Martin's goal of increasing focus , Martin expects positive growth in the ed a successful business association distributors MediaFace and al A/S looks forward to building upon tablished Martin Professional Japan n's commitment to the Japanese resident and CEO Kristian Kolding has rman of the new company. Other and Mrs. Yoshida and Martin's Area rdt. w company is expected sometime in of Kristian Kolding and International		14/12/2005 Martin U.S. Offers Powerful SuperBig 7K ■ Read more 2/12/2005 Martin U.S. Dealer Expands ■ Read more 17/11/2005 Fifth Annual "Martin Intelligent Lighting Technology Grant" to New York City College of Technology ■ Read more 10/11/2005 Martin Reaches another Milestone with MAC Number 200,000 ■ Read more 8/11/2005 Something for Everyone at LDI 2005 ■ Read more ARCHIVE « 6 7 8 9 10 >>	hast nt i llat part part part son 20 int i ssi vi vi mr. sen he pat	s entered into an agreement with Chako time distributors of automated lighting in company, Martin Professional Japan Ltd. boration between the world's largest ny and majority owners Mr. and Mrs. e with 20 years of experience in the utation for professionalism. pany, located in Tokyo and consisting of istribution and service of Martin, Jem rout the country. gle professional distributor in Japan, covered through three separate t step in Martin's goal of increasing focus 002, Martin expects positive growth in the ained a successful business association its distributors MediaFace and ional A/S looks forward to building upon established Martin Professional Japan artin's commitment to the Japanese Il President and CEO Kristian Kolding has hairman of the new company. Other . And Mrs. Yoshida and Martin's Area ihardt. new company is expected sometime in ion of Kristian Kolding and International um. 200,000 If Read more 8/11/2005 Something for Everyone at LDI 2005 If Read more		<ul> <li>■ Read more</li> <li>17/11/2005</li> <li>Fifth Annual "Martin Intelligent Lighting Technology Grant" to New York City College of Technology</li> <li>■ Read more</li> <li>10/11/2005</li> <li>Martin Reaches another</li> <li>Milestone with MAC Numbr 200,000</li> <li>■ Read more</li> <li>8/11/2005</li> <li>Something for Everyone a LDI 2005</li> <li>■ Read more</li> <li>ARCHIVE</li> <li>≪ 6 7 8 9 10 &gt;&gt;</li> </ul>
		this relationship with newly establ Ltd. In order to demonstrate Martin's market, Martin Professional Presi assumed the position of Chairma board members include Mr. And M Sales Manager Jonas Eisenhardt.	comi dent in of Mrs. `	d Martin Professional Japan mitment to the Japanese and CEO Kristian Kolding has the new company. Other Yoshida and Martin's Area		ARCHIVE « 6 7 8 9 10 »		

### **Engineering Web spam**

Brace Darte Brace Fittinge Cable Glande and Cable Accessories Steel DUC covered Flevible conduite

#### centrifugal pump manufacturers

Variscocentrifugal pump manufacturers are manufacturers of self-priming centrifugal pumps and positive displacement pumps, electrically driven pumps, dredging pumps and vacuum prime pumps. The production range also includes automatic firefighting pumps and dewatering pumps. Varisco centrifugal pump manufacturers has become a household name around the world for reliable centrifugal pump manufacturers for difficult applications. Born as a centrifugal pump manufacturers company, it is now part of an international group fully committed to growth in centrifugal pump manufacturers niche markets. Continual investments in latest generation centrifugal pump manufacturers make the factory at Padova one of the best in its field. Varisco centrifugal pump manufacturers specialises in self-priming centrifugal pumps for liquids with solids in suspension from  $1\frac{1}{2}$ " to 12", and positive displacement pumps for liquids of all viscosities from  $\frac{1}{2}$ " to 10". The centrifugal pump manufacturers production range also includes automatic fire-fighting pumps for hoses and sprinkler systems. Varisco centrifugal pump manufacturers is present in three main markets: Industry, Civil Engineering and Safety. We have a long and wide experience in solving problems with difficult liquids around the world. Explore our site now for a taste of what Varisco centrifugal pump manufacturers can do for you, and come back often to check for new features.

#### Hi centrifugal pump manufacturers - Varisco

- we centrifugal pump manufacturers
  - 🔹 varise e
- De self-priming pumps
- St self-priming centrifugal
  - electrically driven pumps
    - dredging pump.
    - vacuum prime pumps
- He · firefighting pumps
- 🗖 🔹 centrifugal pump manufacturers

567 S		
VV VV VV . C	I I a le A D I O U U	

lopment, tm, pcm,

labview, baining, course, integration, site master, national, instruments, anritsu, wilbon, test, analyzer, logger, data, taker, daq, data, acquisition, control, gpib, hpib, ate, image, motor, stepper, servo, visa, hp vee, agilent, vee, software, development, automation, optical, laser, otdr, tdr, wdm, attenuator, spectrum, network, analyzer, vna, sna, vector, scalar, vswr, antenna, power, meter, bransmission, synthesizer, signal, generator, communications, radio, bransmitter, emi, rfi, atm, sdh, pdh, stm, pom, codec, dta, microwave, rf, programming, code, learn, virtual instrument, vi, ets, environmental, vibration, test, equipment, shakers, slip, tables, drop, testers, bump, shock, testers, amplifiers, head, expanders, modal, thruster, overturning, moments,

### Document ranking and recall

• Users compare results with general engines



- Evaluate relevance often
  - Usage data
  - Task-centric comparative studies
  - Surveys

### Scale

- Hundreds of millions of pages
- Tens of terabytes of data
- Failure is routine



### Research challenges

- Integrated text and structured retrieval
- CAD retrieval and indexing
- Research to industry technology transfer

### Unified text and structured retrieval

Find:	12 volt electric motor	Search

#### DC Motors

839 companies supply DC Motors.

Click on a listing for more information or filter your list by adding specifications.

	Compare Selected Catal	ogs 📔 🛛 Send	Group E-mail						
Filter Your Catalog Results	Online Catalog Order	Company	I	leadquarters	PR	ODUCT ANN	OUNCEME		
Click to Add Specifications	Enter one or more Performance Specifications criteria:								
	Shaft Speed:	At least No Pre	ef. No more than	No Pref.	rpm	*	Help		
Performance Specifications	Terminal Voltage:	At least 12	No more than	12	VDC		Help		
Shaft Speed: »	Continuous Current:	At least No Pre	ef. No more than	No Pref.	amps	*	Help		
Less than 23 rpm (994) 23 to 166 rpm (1,570)	Continuous Torque:	At least No Pre	ef. No more than	No Pref.	In-Ibs	~	Helper		
166 to 1130 rpm (1,135) 1130 to 5200 rpm (2,739) 5200 rpm and up (4,303)	Continuous Output Power:	At least No Pre	ef. No more than	No Pref.	HP	*	Help S,		
Terminal Voltage: »	( Cano	Update Results							
<u>7 to 26 VDC</u> (3,747) 26 to 54 VDC (1,468)	109 products	Rochester Hills, MI			()				
54 to 119 VDC (1,132)	162 products	Baldor Electric (	Fort Smith, AR			-			
119 VDC and up (1,870)	96 products	Port							

# CAD (shape) retrieval

- SHREC competition CAD Track
  - <u>http://www.aimatshape.net/event/</u>
     <u>SHREC/</u>
- Purdue and Princeton shape labs
- Search by sketch



(b) Parts with different shape but same name - washer.

Fig. 2. Examples of parts with different forms and functions.



### Research transfer issues



### Strengths

- Easy to use
- Community support and documentation
- 'Good enough' for many applications



#### Weaknesses

- Does not scale well beyond a few million documents
- Lucene's relevance is sub-standard out of the box.
- Index format is not easily extensible
- It is not easy to index large collections.

# Summary

Vertical search is hard



### Pros

- Greater precision from limited scope
- Leverage domain knowledge
- Detailed knowledge about users and tasks

### Challenges

- The same challenges as full-web search
- Most users will not remember your vertical
- Integrating structured and text content

### References

- [1] Jayant Madhavan, Alon Y. Halevy, Shirley Cohen, Xin Luna Dong, Shawn R. Jeffery, David Ko, Cong Yu: Structured Data Meets the Web: A Few Observations. IEEE Data Eng. Bull. 29(4): 19-26 (2006).
- [2] Jayant Madhavan, Shirley Cohen, Xin Luna Dong, Alon Y. Halevy, Shawn R. Jeffery, David Ko, Cong Yu: Web-Scale Data Integration: You can afford to Pay as You Go. CIDR 2007: 342-350
- [3] Marti A Hearst, Preston Smalley, Corey Chandler. Faceted metadata for Information Architecture and Search