Linguistic tools for knowledge discovery

March 2004

The conceptual gaps between subject and functional boundaries are some of the best sources of breakthrough innovation. Yet for a variety of reasons — managerial, technical, and editorial — it's often difficult to exploit them. In this article we use an example from our own research and experience to show how linguistic tools such as thesauri, glossaries, and navigation schemes can promote knowledge discovery by exposing potential linkages between seemingly unrelated subjects.

Knowledge discovery in the "white space"

People who study innovation in a corporate setting stress the importance of "thinking outside the box," using cross-functional teams, and exploring the "white space" between mental models. Or, to quote the CEO of Ceramic Process Systems Corporation, "Our most important technical breakthroughs will come from disciplines and literature outside our industry and scientific field."[1]

In their article "Managing in the white space," authors Maletz and Nohria point out that navigating the white space requires a different compass.[2] Part of the difference, according to Clayton Christensen, is related to information systems. In his book, *The Innovator's Solution*, Christiansen asserts that because corporate IT systems are structured around existing products, customers, and organization units, they are among the most important contributors to innovation *failure*.[3] Data purchased from external sources, he says, have the same impact.

Researchers tell companies to introduce systems that will encourage "creative abrasion" and "boundary spanning" as well as training to help people identify "disruptive ideas" (Christensen's word).

Linguistic tools for innovation

To support these recommendations, linguistic tools are needed to help people:

• get their bearings quickly in unfamiliar territory;

• locate experts that can relate to two or more specialties;

• make the transition from a familiar concept to a related concept in another specialty;

• learn the meaning of unfamiliar terms;

• make it obvious that the same word can mean different things depending on the context;

• visualize relationships.

Targeting audience, not content

Search engines like Google are helpful, but even for skilled researchers, the exploratory process can be time-consuming. Time can be reduced and the likelihood of finding "disruptive" ideas can be increased by using cross references, glossaries, and indexes — but only if they are capable of spanning disciplines and are targeted to the *audience*, not the available *content*.

To see how this can work in practice, we started with "mobility," a concept that surfaced in our research on the triple bottom line — also called "sustainable development" (see our "Managing the triple bottom line" series of articles).[4]

Example: the "mobility" gap

Mobility — the movement of goods and people from one place to another — is an issue
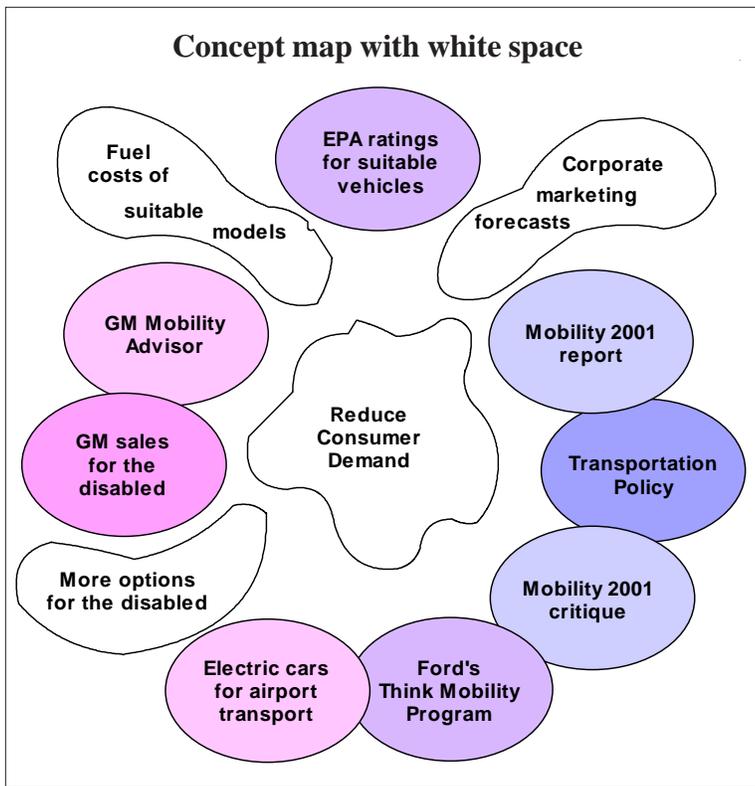
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Mobility 2001 critique

Electric cars for airport transport

Ford's Think Mobility Program

Sustainability topics
Automotive topics

1. *Sustainable development* — Enterprise management that conserves scarce resources for use by future generations, specifically transportation policy.

2. *Automotive design* — Development of vehicles and accessories, in this case specially modified cars and devices to enable disabled people to drive or ride in comfort.

Mapping the white space

Does the gap or "white space" between these specialties contain useful information? If so, what is it and how do you find it? Our exploration produced a concept map with four gaps or white spaces (left).

In the drawing, colored circles represent Web sites that we encountered during our research. Circles touch if it's possible to link from one site to the next. For example, in the Mobility 2001 critique we learned about a Ford program called "Th!nk Mobility," which in turn contained a reference to the use of electric cars. Sustainable Development sites are in blue, Automotive Design topics are in pink. Topics in lavender are Web sites relevant to both areas.

Filling in the white space

The irregular blobs in the drawing are the "white spaces" — topics that are relevant but not mentioned or referenced with a footnote or link. The white spaces mean that:

• A disabled person shopping for a fuel-efficient car can't directly access comparative fuel efficiency ratings from the EPA. They're available elsewhere on the GM Web site but not linked to the GM Mobility Web site.

• Policy makers who read the Mobility 2001 report need market projections from the auto industry to project the number of motor vehicles on the road in the future so they can accurately predict the amount of carbon emissions.

• An elderly person looking for low cost, low pollution transportation options won't learn about electric cars, metropolitan leasing services, or additional reimbursement plans.

These gaps are not too difficult to fill in, but the remaining white space in the center is more intractable. It can be the source of

because it's critical to the economy but generates a lot of pollution. It also impacts the profitability and growth prospects of auto manufacturers and oil companies. It isn't surprising that a group of them is funding a project at the World Business Council for Sustainable Development (WBCSD) to identify mobility trends and collaborate on finding solutions to the major issues, such as reducing carbon emissions and traffic congestion.

After reading the Mobility 2001 report from the WBCSD Web site, we were curious about how auto companies were implementing its findings. However, a search of the General Motors Web site on the word "mobility" led us to GM Mobility, a shopping site for disabled people looking to buy or accessorize a car. We were even more intrigued when we learned that Ford has *two* mobility programs — "Ford Mobility Motoring" (for the disabled) and "Think Mobility" (a program to sell electronic vehicles).

The word "mobility" thus creates a bridge (as well as a source of confusion) between two specialties:

breakthrough solutions, both for business and society, but this will require a different mind set and the courage to confront sustainable development's 900-pound gorilla – how to reduce consumer demand.

"Green" marketing consultant Jacquelyn Ottman makes this point in her article about Ford's well intentioned but failed "Th!nk Mobility" program, a project to sell Neighborhood Electric Vehicles (NEVs):

"Rather than choosing a former engineer for the [Ford] Explorer [SUV] — regardless of how successful and innovative [he might be] — to head the Th!ink Mobility division, might [Ford] have been better served by someone outside the industry, say from communications or even the weight loss industry with its emphasis on behavior change? In short, Did Th!nk think differently enough?

Th!nk provided the playing pieces but no game board." (5)

According to Ottman, NEV technology is good for particular applications like transporting golfers around courses, workers around campuses, and the disabled and infirm inside enclosed spaces like airports or retirement communities. But neither GM nor Ford mentions this use on their Web sites targeted to disabled buyers. It's a classic case of thinking *inside* the box.

Navigating the white space

Some white space issues are easily resolved with links and cross references. For example, the GM Mobility Web site does a good job of helping the buyer select a car or accessory, locate a dealer, and even apply for a grant to help pay for it. But what if the buyer wants to select a car with the lowest fuel costs? GM makes this information available, but it isn't cross referenced on the GM Mobility Web site. What if the buyer wants to invest in companies that develop "green" products for disabled people, provide training and employment opportunities for the disabled, or contribute to organizations promoting his interests?

By the same token, the WBCSD Mobility Web site does a good job of showcasing business efforts to tackle transportation issues.
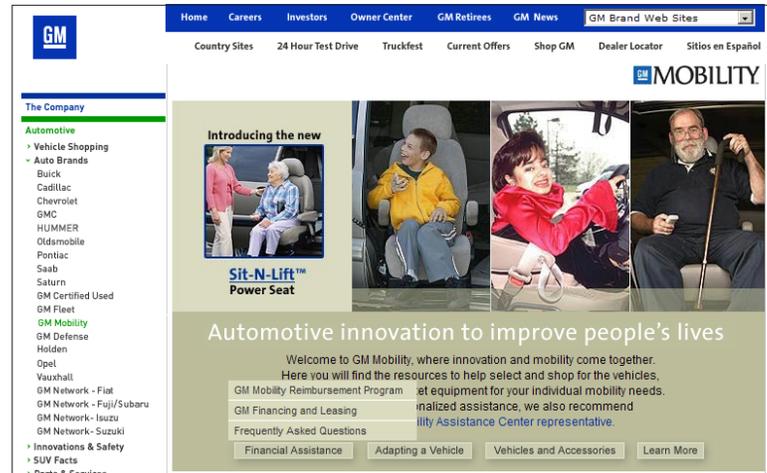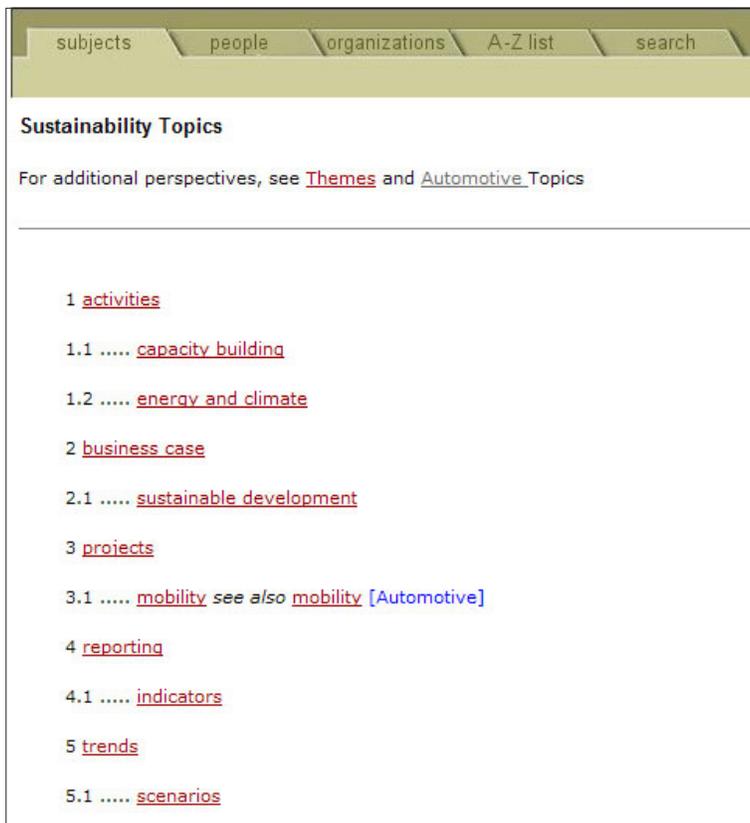

For our example, we used the topics on the GM Mobility Web site (above) to create a "table of contents" for Automotive Topics in the Lab (below).

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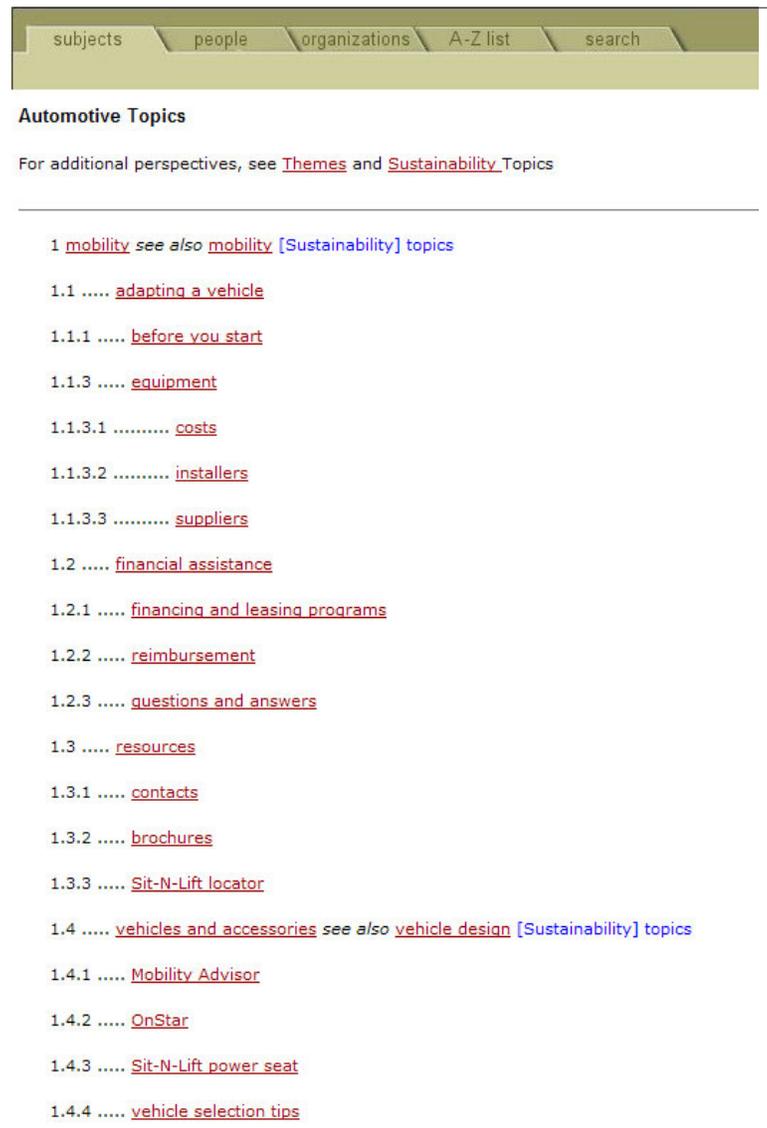
We used topics from the WBCSD Mobility Web site (above) and the Mobility 2001 report to create a "table of contents" for Sustainability Topics in the Lab (below). (To see this demo, go to www.montaguelab.com/demologon.htm.)

But the message would be more credible and effective if visitors to the site could read alternative points of view from other organizations, learn more about the plans and activities of specific companies, and get information on ways to change consumer behavior.

To reduce the time it takes to find this additional information, we created a variety of navigation tools in the Montague Institute teaching Lab. Using the headings on the GM Mobility Web site (page 3), we created a list of topics in the Lab. Tabs at the top provide additional tools — an A - Z index, lists of people and organizations, and an advanced search.

For the policy maker interested in how to solve sustainable development transportation issues, we created a similar set of tools in the Lab using topics on the WBCSD Web site and its Mobility 2001 report (left).

Exploring the white space in the middle
Now we have two parallel organization schemes, each of which provides users with 5 different navigation tools to explore related material in each subject area as well as its contiguous white space. Now, the car buyer can link directly to EPA fuel economy ratings and the policy planner can link to critiques of the Mobility 2001 report and the Ford Think Mobility program.

Certain terms are common to both sets of tools (see the table below).

Automotive terms	Sustainability terms
General Motors	General Motors
mobility	mobility
vehicles & accessories	vehicle design
driver's licenses	driver's licenses
disability research	disabilities

We can now create cross references from terms in the Automotive subject area to related terms in the Sustainability subject area (and vice versa). For example, in the Automotive index below, "mobility" and "vehicles and

accessories," have cross references in blue text. If you click on "disabilities" in the Automotive index, you can access the source associated with that term in the Sustainability index. If you click on "mobility" in the Sustainability index, you can access a definition and a source for that term in the Automotive index (right).

Guideposts in a new territory

The blue cross references are bridges that span the white space. Once the reader has crossed over into a new subject area, definitions help him make sense of unfamiliar concepts (and new meanings for familiar words). The topic list gives him a quick overview of the new landscape, and the A - Z index provides a more detailed view. The lists of organizations and people help him recognize who's important and how to contact them. The advanced search complements a full text search engine (e.g. Google) in two ways — by restricting the scope to a collection of carefully vetted sources and by providing greater precision through qualifiers like publication date and country. The benefit is not only time savings, but new insights.

Knowledge discovery: whose responsibility?

In this example it's important to note that our tools *augment*, rather than replace, the work of the GM and WBCSD editors. Our effort to fill in the white space does not require them to change what they are doing or how they do it; we're merely leveraging their work. By the same token, they could use our tools to improve what they do, especially if they have access to a data structure similar to our Lab.

But a knowledge base like the Lab is only a tool. Knowledge discovery ultimately depends on people. In some cases, this means giving editors the training and incentive to fill in the contiguous white space (areas where the connection is fairly obvious). For example, without too much effort, the editor of the GM Mobility Web site could

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subjects | people | organizations | A-Z list | search

Automotive Terms

Terms and categories relating to cars and accessories for disabled persons, drawn from the GM Mobility Web site

A - B | C - D | E - F | G - H | I - J | K - L | M - N | O - Q | R - S | T - Z

contacts *see also* resources
Contact information

costs *see also* equipment fuel economy
GM Mobility Frequently Asked Questions

disability research *see also* disabilities [Sustainability] topics
National Center for the Dissemination of Disability Research

driver assessment facilities
Before you adapt a vehicle

driver's licenses *see also* driver's licenses [Sustainability] topics
Before you adapt a vehicle

Index detail

disabilities

Documents for this term:

Mobility 2001
This report provides a 'snapshot' of current worldwide mobility, and identifies major threats to its continued expansion. 1/7/2002

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subjects | people | organizations | A-Z list | search

Sustainability Terms

Terms and categories on sustainable development and the triple bottom line, drawn from the World Business Council on Sustainable Development

A - B | C - D | E - F | G - H | I - J | K - L | M - N | O - Q | R - S | T - Z

Mercedes-Benz C-Class
Daimler-Chrysler: Natural fibre car components
1/3/2002

mobility *see also* projects mobility [Automotive]
BASF: Eco-efficiency life cycle tool
1/3/2002

Daimler-Chrysler: Natural fibre car components
1/3/2002

Mobility 2001
This report provides a 'snapshot' of current worldwide mobility, and identifies major threats to its continued expansion. 1/7/2002

Sustainable Mobility Project July 2002
The Progress Report summarizes and updates previous findings, and provides an outlook on the upcoming work of the project. The report highlights three main challenges, and presents the 10 work streams that were established by the Mobility project to tackle these challenges. 1/7/2002

Th!nk Mobility program
A defunct program initiated by Ford Motor Company to sell Neighborhood Electric Vehicles.

WBCSD Mobility report critique
Mobility 2001, the recent sustainable transport report prepared for the WBCSD Sustainable Mobility Project, has come under fire from some of the leading Non-Governmental Organisations working in the field, although they acknowledged the report was not unduly biased towards interests of the auto and oil industries. 12/13/2001

natives *see also* indigenous people

Index detail

mobility *see also* mobility [Automotive]

The ability of an individual with an injury or physical disability to move from one location to another.

Documents for this term:

GM Mobility
Web site for resources to help physically disabled customers select and shop for vehicles, accessories and aftermarket equipment.

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create a link to the fuel economy comparison page on the GM sustainability page.

The non-contiguous white space (areas where the connection is not obvious) usually needs dedicated staff with special skills and training. In our example, this role is performed by external third parties, such as the "green" marketing consultant who analyzed the failure of Ford's Think Mobility program. But there are many reasons why it should be performed internally through specially selected employees or contractors. Both Leonard and Christensen offer tips on finding, developing, and using them:

• *Cross-over people*. Look for people with disciplinary roots in one field (e.g. music, art) who have deep on-the-job training in another field (e.g. computer science).

• *Multi-lingual managers*. Promote people capable of operating in more than one specialized realm and using more than one cognitive style (i.e. analytical and intuitive).

• *Prototypes*. Use prototypes not just for testing technical concepts but also as communication vehicles for problem solving across organizational and disciplinary boundaries.

• *Gatekeepers*. Nurture technological gatekeepers, who expose themselves to more outside sources and keep their colleagues up-to-date.

• *Boundary spanners*. Nurture and support people who understand the world of the source (e.g. R&D) and the world of the receiver (e.g. the customer) and can translate as well as disseminate knowledge.

• *Training in "disruptive ideas."* Provide employees, particularly those in sales, marketing, and engineering, with training in how to recognize disruptive ideas and where to channel them — through established organization units or toward special teams set up to investigate and exploit them.

In many respects, mining the white space for innovations is an unnatural act, especially for large, mature companies. Christensen notes that:

"One of our most sobering realizations is that within the population of companies that successfully caught a subsequent wave of disruption and stayed atop their industries, the vast majority were still being run by the company's founder at the time they tackled the disruption. ... We suspect that founders have an advantage ... because they not only wield the requisite political clout but also have the self-confidence to override established processes in the interests of pursuing disruptive opportunities."(5)

Linguistic tools and "white space editors" can help put disruptive ideas on the corporate radar screen, but it still takes courage and skill to exploit them.

On the Web

To explore this example in the Montague Institute Lab, go to http://www.montaguelab.com/demologon.htm. When prompted, enter user name "TBL" and password "TBL."

Notes

(1) Dorothy Leonard, *Wellsprings of Knowledge,* Boston: Harvard Business School Press, 1995, p. 65

(2) Mark C. Maletz and Nitin Nohria, "Managing in the white space," *HBS Working Knowledge*, March 5, 2001.

(3) Clayton M. Christensen and Michael K. Raynor, *The Innovator's Solution*, Boston: Harvard University Press, 2003, p.89.

(4) Jean Graef, "Managing the triple bottom line," *Montague Institute Review,* December, 2003.

(5) Jacquelyn A. Ottman and Dan Sturges, "Think again about Th!nk Mobility: Questions for the long haul," *Greenmarketing.com*, 2002.