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Using the Web for Technical Support: The Case of The Manufacturing Information Resource Locator

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Introduction: Technical Support Needs of the Manufacturing Extension Partnership

The National Institute of Standards and Technology (NIST) supports a network of centers whose mission is to assist small and medium sized manufacturers (SME). Called the Manufacturing Extension Partnership (MEP), this program has established more than seventy centers spread across all fifty states. With a potential clientele of over 300,000 firms, the MEP program has a daunting task. It must allow each center to structure itself in a manner that best meets local needs, while at the same time fulfilling an obligation to assure consistent high quality service across all centers. Complicating service delivery is the impossibility for any given center to maintain in-house expertise in all the topics of interest to its clients. At best a center can possess deep expertise in a few high priority topics, and generalist knowledge about all the rest.

Because of its capacity for centralized development, widespread access, and two-way communication, the Web seems an ideal medium for MEP to provide technical information that facilitates broad based, consistent, quality service.. As with all technologies, MEP's challenge is to embed this innovation in a set of organizational and business processes that will produce the intended results. This is the rationale for the Manufacturing Information Resource Locator System, contracted to the Industrial Technology Institute to accomplish three objectives:

1. Create a methodology to efficiently develop useful Web-based technical information resources
2. Identify MEP field agent information needs and develop Web site content to fulfill these needs.
3. Test business models to sustain the sites.

Development Methodology

The process of developing Web-based technical information resources evolved as we honed our original methodology against the reality of available information, the capabilities of the Web, and the information seeking behavior of MEP field agents. In other words, our original concept was a bit naïve, but at least we were smart

enough to test our concepts and catch our mistakes early on. As a result, we have made major changes that seem to please our users.

Original Plan

Our original methodology was based on five assumptions.

1. The Web contains a great deal of useful information, but it is well hidden within a much larger volume of mostly useless information.
2. For a variety of reasons, most Web users, employing existing search engines, are not satisfied with the results.

    - Many users do not have the subject matter expertise to ask the right questions.
    - Even if they do ask the right questions, the large number of items returned overwhelms them and they do not have the expertise to separate the wheat from the chaff.
    - Because of the law of large numbers even well constructed searches miss a lot of useful information.

3. Subject matter experts in cooperation with information specialists are able to separate the wheat from the chaff.
4. Rigorous cataloguing, using a well-defined structure and set of key words greatly increase users' ability to identify relevant information.
5. The *structure* of a technical assistance Web site conveys useful information to its users. For instance, a particular choice of sections, headings, subheadings and navigation aids provides users a sense of what is important and how elements of information relate to each other.

Out approach was analogous to developing special libraries of technical information, only on the Web. To this end, we assembled a team comprised of subject matter experts, Web developers, library science catalogue experts, and student assistants to assist with surfing the Web and cataloging sites. While success required interaction among all these groups, the subject matter experts drove progress. The main development tasks were: Web site design; surfing the Web; selection and cataloging of sites; developing a network of technical experts; and developing the Web sites.

The project team worked together to carry out these tasks.

1. Subject experts and Web developers cooperated in the design of each site.
2. As subject matter experts searched for useful sites, they communicated with the student assistants about why each site was vetted as it was, thus providing the assistants with the ability to help with the search.
3. Similarly, the subject experts and the catalogue exerts worked together to develop a context-specific set of key words.

While the structure of each site differed, each was designed with a few important common elements with respect to content and searching capability.

<u>Content</u>

1. Organized by subject experts to be useful to MEP field agents.
2. Some original content written by the subject experts, but mostly hypertext links to other sites.

3. Limited access to technical experts to answer issues not addressed by the site or its links.

Search

1. Limited to sites chosen for their value.
2. Searchable through the filter of the catalogue structure.
3. Free-text searchable through search engines.

Revised Plan

As we began work, revisions to the plan quickly became necessary.

- We greatly increased the emphasis on original content and de-emphasized reliance on linkages to other sites.
- Similarly, cataloging was greatly de-emphasized.
- Access to the specialized libraries is primarily through a search engine.

The reasons for these changes were

- available content,
- economics of site maintenance,
- value added of using catalogs, and
- patterns of user interaction with the site.

Available Content: The primary problem with reliance on outside content is the difficulty of maintaining an "editorial vision", i.e. a focus on what a small set of experts agree that a particular user group needs to know. There was less relevant, deep technical content on the Web than we anticipated. Much of what our users need is thoughtfully organized background knowledge and analytical information, while much of the good technical information on the Web is descriptive (e.g. product specifications, directories of vendors); too narrow (e.g. university research reports); or not context appropriate (e.g. a manufacturer concerned with supplier relations finding EC information about retail sales and banking).

Another part of the problem is that the analytical information that is available is disjointed - one useful piece of information buried in the middle of one Web site, with its logical successor in the middle of a second Web site. Learning is facilitated by seamless access to related information, but presently users must jump from one Web site, back to home and then to another Web site.

Finally, language and tone are important, and these too cannot be maintained when material is drawn from many different sources. Particular audiences resonate to particular approaches for presenting information. Absent the proper resonance, learning is weakened and users' interest is lost. In summary, information MEP field agents need is not easily accessed on the Web and most often difficult to understand when it is available.

Economics of Site Maintenance: Another problem with linking to other Web sites as a primary source of content is that good information often moves around. Linking to other sites requires careful attention to low level URLs because it is at these

levels that valuable nuggets of information are generally found. Low level addresses, however, are notoriously transient because people are forever tinkering with their Web sites. Even with automated link checking and other site maintenance technology, keeping track of the innards of others' Web sites is extremely labor intensive. Further, if an important piece of information disappears, we are put in the position of scrambling to find a substitute. Others' have their own reasons to maintain their sites in their own way, and cannot be relied upon to deploy their expertise and labor in a manner that serves anyone else's' interests.

Although original content may be labor intensive to develop, it can be trusted to stay put and not to move unless you want it to. Especially in a case like ours where development resources were high and maintenance resources low, investment in original content proved by far the superior approach.

Value Added of Using Catalogs: Cataloging turned out to be much too slow and costly to justify its use. In many ways the fate of cataloging was sealed when the choice was made to emphasize original content. With links to the outside as the dominant mode of transmitting information, it made sense to provide users with a proven method to find deep technical information. Once content development experts began to design a system to convey information they knew end users needed, a specialized Web site library took on a much different role. It became a way of helping people get at the kind of supplementary information that the Web excels at, i.e. reference material such as product specifications, vendor lists, and training directories or more narrow and deep technical information.

Patterns of User Interaction: A Web site devoted to technical assistance is more than a repository of technical information. It also has a distance learning dimension, and thus requires careful attention to how information is organized, how graphics are used to promote knowledge acquisition, and what branching choices are offered. Because of these requirements it is impossible to organize a site well without detailed knowledge of the needs of your particular user group. Moreover, even if an outside site were valuable, the more surfing people do, the less likely they are to return to a single information resource. As a minimum, users will be lost. Even if they return, they are likely to have lost a train of thought that site developers tried carefully to nurture.

Content and Form

MIRLS is currently developing four sites:

1. Electronic Commerce,
2. Energy and Environment,
3. Industrial Marketing, and
4. Workforce Development.

"Electronic Commerce" and "Energy and Environment" are already relatively well developed. "Industrial Marketing" is in advanced planning. "Workforce Development" is just getting started. Comparing structure and development history of these sites reveals a lot about using the Web for technical assistance.

Table 1: Content of Developed Sites	
Electronic Commerce	**Energy and Environment**
Primer on EC	Consulting guide for integrating energy and pollution reduction into an overall manufacturing strategy
Common questions about EC technologies	Choosing energy efficient and low pollution manufacturing technology
EC issues in particular industrial sectors	
Life cycle oriented implementation guide	
Background and case material for our published articles.	

Lessons from "Electronic Commerce" and "Energy and Environment"

Table 1 contrasts the major content sections of these sites. While the content and its organization are quite different, there is actually quite a bit of similarity between these sites. First, they are both very heavy on original content. Both development groups arrived independently at the conclusion that such content was necessary if the site was to fulfill its purpose.

Second, they have a very heavy emphasis on tools because both sections of "Energy and Environment" *are* structured tools. The "Consulting Guide" follows a staged intervention strategy and offers instructions, resources and analysis/reporting templates for each stage. The "technology choice" section is a full-fledged decision support tool. While none of the sections in "Electronic Commerce" are organized as tools, many of the sections contain flow charts, templates and structured analysis guides for making technological and business decisions related to electronic commerce.

Another similarity between the sites is that they rely heavily on a staged life cycle perspective of technology management. "Energy and Environment's" consulting guide begins with the initial phone contact, and proceeds in stages to report presentation. In the "Electronic Commerce" section, both the Primer and the Implementation Guide follow a life cycle, from "initial awareness" through "system maintenance and evolution".

These similarities reflect our view of the Web as, perhaps, being less revolutionary, and more evolutionary than we (and many others) thought it to be. It is just another way to provide technical assistance on some aspect of technology management, in a distributed environment, to field agents who are generally knowledgeable but not expert in the topic under consideration.

The major lessons from our experience with MIRL is that whenever technical assistance is provided, in whatever form, four conditions will hold:

1. Design carries significant information. It matters greatly how information is organized. Topics in chapter headings for instance, convey a message about their importance and relationship to other topics. To put it another way, material to support technical assistance is more than a repository of information. It has an educational component, and thus the elements of instructional design must be taken into account.

2. Design depends on interactions among user needs, the worldview of assistance deliverers, and the constraints of the setting the information will be used in. As an example consider technical assistance in the realm of environmental consulting. Field agents have particular needs based on their technical expertise and industry experience. Site developers have their own particular worldview; for example that energy savings and manufacturing process are inseparable. The setting imposes constraints, for example, in the Automotive industry suppliers are under great pressure by their customers toe improve quality, delivery and cost. At the same time, customers may pass on product environmental requirements and there may be pressure by the government to meet environmental regulations affecting their production processes, but quality, cost and delivery requirements are primary If any one of these elements changed, so too would the optimal way of presenting the information.

3. The form of presentation is also influenced by its medium. As an example different kinds of teaching take place in the classroom, in one-on-one interaction, or through the Web. In the case of the Web, the power of linked hypertext files drives the presentation of information.

4. Despite differences in form due to the topic, setting or medium, there is an underlying logic to technical assistance that must be observed. Hence the commonalties of tools and life cycles across "Electronic Commerce" and "Energy and Environment" – two Web sites developed by different people, for a different audience, and on a totally different topic.

Lessons from "Industrial Marketing

The third site under active development - "Industrial Marketing" - provides useful insight on the necessary trade offs of breadth and depth for our kind of Web sites. The original conception was a narrowly focused site on the topic of "new product development". The rationale seemed iron clad. We knew that in the world of SMEs process improvement is well and good, but that by far the greatest payoff comes from new product development. We also knew that rigorously assessing the viability of possible new products was a specialty beyond the expertise of most MEP field agents.

Assessing new product development requires quite a lot of specialized and highly detailed knowledge. Doing it well requires considerable expertise in topics such as manufacturability, intellectual property and competitive analysis. Moreover, decisions in these areas are dependent upon the technical details of the product under consideration. Making an intelligent decision about the manufacturabilty of a metal product might require, for instance, understanding differences in the manufacturing process for steel versus aluminum, or even for different alloys of the same metal. How then, to give advice about products involving metal and plastic products designed for markets as diverse as medical equipment and children's toys? Thus the complexity of decision making, and its associated level of detail, makes it difficult to provide generic information on "new product development", particularly if the site had only a weak component of interaction with experts, as ours did.

Despite this problem we might have made the effort to pitch the site at a useful and manageable level of detail, but were brought back to reality by feedback from users. While users agreed that new product development constituted a grand slam success for an SME, they felt that much of what SMEs need is more mundane help in

marketing to other businesses. This kind of advice can easily be made useful without deep expertise in very narrow specialties, and is thus a more appealing topic for Web based support. Hence the present scope of the site, which will include within it general information on assessing the feasibility of developing a new product.

Site Maintenance and Viability

The overarching question in the MIRLS experiment was how to use the Web as a means of providing technical assistance to a distributed and diverse group of people. While most of the experiment focused on issues of content and form, another important question was how to assure the continuation of such sites once they were up and running. Answering this question requires attention to two related issues:

1. keeping information current, and
2. paying for upkeep.

Keeping Information Current

Keeping information current requires attention to two dimensions of content:

1. accuracy of existing information, and
2. new information.

Accuracy of Existing Information: A great deal of important information has a short half-life. To name but a few examples, consider evolution in the federal government's definition of FACNET as a means of doing electronic commerce with its suppliers, technology for doing structured EDI over the Web, and changing energy regulations. FACNET is evolving from a particular set of X-12 VAN based procedures to a more open approach to exchanging information. New products for doing EDI over the Web seem to spring up every week. Energy regulations are frequently debated and revised. In each of these cases, accuracy requires constant vigilance. In general we have found that "facts" age more quickly than "methods". As an example the methodology of choosing a preferred EC system may remain stable, but the information (e.g. technology cost) used when applying the methodology is likely to change rapidly.

New Information: The second element of information currency is assuring that entire sections of a subject area evolve as needed. As an example the EC site does not contain much information about how policies of the European Union may affect the ability of small companies in the US to do electronic commerce enabled business in Europe. As EU policy changes, covering that topic may become necessary *if* we determine that export related EC issues are becoming important to the customers of MEP centers.

Paying for It

A great many sites exist to sell or advertise products and services. In these cases the business case for their existence is straightforward -- the site will pay for itself by generating sales.

The business case behind MIRLS is very different. In our case NIST has decided that its interest in maintaining the quality of MEP centers is great enough to justify

sponsoring the site. While sponsorship by NIST is a reasonable business model, there are good reasons to diversify. First, there is the business risk of existing with only one major customer. Second, MIRL seems to have considerable value for users outside of the MEP system, and it makes good business sense to derive revenue from groups who are using, but not paying for, the information.

The critical question, of course, is, "How best to derive that revenue?" We are exploring four avenues. The first is to repeat the "NIST as customer" model. In this case we would seek other non-profit entities whose success depends on providing information services to its members. Prime examples include trade associations and state or local economic development agencies.

The second approach is exclusive sponsorship of one or more Web site by a commercial entity that has an interest in furthering the use of the technology it sells. A large ISP for instance, may wish to disseminate information that makes it easier for potential customers to use more of its services. The choice of sponsors is sensitive in this model because there is an implied endorsement of the sponsor's product.

The non-exclusive form of the sponsorship approach is the third possibility, i.e. the sale of advertising to interested parties. Implied product endorsement may be less of an issue with this alternative.

Finally, there is the possibility of direct payment by end-users or their employers. In this case either a subscription or pay by use model could be used. We are fairly dubious about the current viability of this approach.

Any combination of these models might work, and we are in the process of exploring possibilities. The outcome of our explorations is important not only in terms of MIRL's viability, but also in elucidating how our genre of Web site might sustain itself.

New Directions

We see several ways in which sites of this kind could be expanded. The first is to develop an interface to proprietary databases. Such an interface is important because a great deal of the best technical information exists within databases that charge for producing information. We envision a situation in which MIRLS would provide focused pointers to information in proprietary data bases, thus making access to those data bases less expensive and more appealing to a larger number of potential users. Whether this can be done depends on the business models used by the data base proprietors and the technology available to implement the interface. The main problem to date has been identifying both needed data and providers willing to jointly develop sites and modify their business model to one that charges for use, rather than by the number of potential users.

Another useful extension would be to greatly expand the level of personal interaction that is available to users. At the moment MIRLS does contain an "ask the expert" email dialogue box and the Energy and Environment sites has a link to a list of

consultants. But this is bare bones functionality. The EC expert is a single person at the Industrial Technology Institute who attempts to find answers as best he can. Users of MIRLS cannot exchange information with each other. There is no repository of information to record collaboration among experts and users. Ideally each MIRLS domain would link a network of experts to large numbers of users who would use MIRLS as the nucleus of a learning community. Establishing this community, however, would require extension of the MIRL business model to justify the time of recruiting the experts and maintaining their involvement.

Finally, a distance learning component could be added to MIRLS. While each MIRLS domain has a logical structure that conveys information, the system cannot be used for organized learning. As it presently stands MIRLS cannot be used as a training workshop on electronic commerce, energy and environment, or industrial marketing. We are actively investigating the feasibility of adding this dimension to the system.

Summary

MIRLS started as an ambitious attempt to create distributed special collections of technical information on the Web. While we proved that it could be done, it was not what users needed or wanted. What our users needed was a "Do-It Yourself" reference, with trustworthy pointers to supporting reference information. We have also proved that this could be done on the Web, it remains to be seen if the system can become self-sustaining.