

# Corporate Intranets as Adaptive Learning Environments

Frank Linton, Gary Gengo, Dawn Hersey, Alice Schafer

The MITRE Corporation  
202 Burlington Road  
Bedford MA USA 01730  
linton@mitre.org

**Abstract:** We observe that informal learning in the workplace is the norm for employees. Therefore all *workers* are simultaneously *learners*, and the workplace is a learning environment, albeit an impoverished one. We have added two tools to the corporate intranet to provide individualized learning experiences for every employee. Both tools provide feedback related to the information employees post on the intranet. One tool also provides recommendations to employees regarding valuable information they might find on the intranet. These tools illustrate a general way to accelerate workplace learning.

## 1 Introduction

We take informal learning in the workplace as the norm for employees. As we consider workers to be simultaneously learners, we use the terms *worker*, *learner*, and *employee* interchangeably. We thus consider the workplace to be a learning environment and add two tools to the corporate intranet to provide individualized learning experiences for each employee. Both tools address employees in their role as intranet content providers, the second tool addresses them in their role as intranet content consumers. The first tool provides informative feedback to employees regarding their success with respect to the goal of creating intranet content of value to their fellow employees. The second tool provides employees with recommendations regarding intranet content their peers have found informative. Content providers also use this second tool to learn more about their 'customers'. With these tools, workers receive individualized performance feedback and individualized learning recommendations that are generated by an automated analysis of workers' behaviors, without conventional classes, classrooms, curricula, or teachers. We believe the tools presented here are specific instances of a more general approach to accelerating informal workplace learning. Tools of this sort would be based on an analysis of data obtained by implicit observation of employee activity in combination with interventions founded on constructivist learning principles. Embedded in the electronic work environment, these tools would gradually but continuously increase workers' professional knowledge and skills.

The ability to provide employees with useful performance feedback relies upon monitoring user behavior at some level of detail. Such monitoring inevitably raises questions of workplace privacy. We have found that it is quite possible to monitor user activity in sufficient detail to provide useful feedback while adequately respecting individual privacy. However, the actual level of monitoring that employees

are willing to accept will depend on the general workplace climate of the organization and the specific benefits the monitoring provides. The employees at my organization, MITRE, for example, readily accept both individualized recommendations that are based on their own data and intranet-published reports that are based on aggregated data.

The MITRE Intranet is known as the MII, for MITRE Information Infrastructure. It provides a publishing space for each organisational unit (department, division, center), each project, and each individual. Each of these units is expected to make its products available to all the others. The tools we present here help to make this knowledge exchange more effective. The MITRE Intranet currently consists of more than 900,000 documents on more than 90 servers, with over 300 collections (sets of URLs) on the main server alone. We combine web server log data with data from other sources and make the results available to all employees. In this article we describe the interfaces through which our learners ask their questions, the methods we use to collect and process the raw data for later use, and the means by which learners' queries are processed to give them actionable information.

## 2 Feedback to Content Providers

Workers in the role of content providers obtain informative feedback from two tools, IUP, and IURS. Both use the same data sources. We describe each in turn.

Intranet Usage Profiler (IUP). While there are many excellent web log analysis packages on the market, intranet content providers can learn a lot more about the nature and interests of visitors to their sites by combining web log data with data from other sources [Fa02]. For example, at MITRE we combine web log data with workplace demographic data from our employee 'phone book' thereby presenting our content providers with a means of answering questions such as How many individuals (vs hits) are visiting my site? Which departments do my site viewers come from? Which job families are my site viewers members of? What level of technical expertise do my site viewers have?

Our content providers ask their questions and obtain their answers via two web-based graphical user interfaces through which they enter parameterized queries with a few mouse clicks and view the results in charts and tables. The first interface, the Intranet Usage Profiler (IUP) is shown in Figure 1. On the MITRE Intranet, each content provider is responsible for a set of URLs known as a *collection*. Content providers use the IUP interface to ask questions, such as those listed above, about the nature of their viewers. To use the interface, content providers make a selection from each of the four parameter sets on the interface, first they select their collection from the list of collections, then they select the usage period for which they desire the information, then the specific type of information they wish to see, and the display format. Finally, they click on [Create Profile] and their data is displayed (Figure 1).

In the example in Figure 1, the content provider has chosen to see the number of visitors to her site, the Knowledge Management collection, in the last 30 days, grouped by their business center, and displayed as a bar chart. Below the bar chart, the data is also displayed in tabular form so that it may easily be transferred to another application if the user desires. The tabular form is more suitable than the chart in certain cases, for example, when the data is displayed by job title, of which there are more than 500 in our organization. Both the input and the output portions of the page (and all the other interfaces described here) are written in HTML and JavaScript – no applets or plug-ins are required – thus the application is available to all intranet users, even those in remote locations with slow connections.

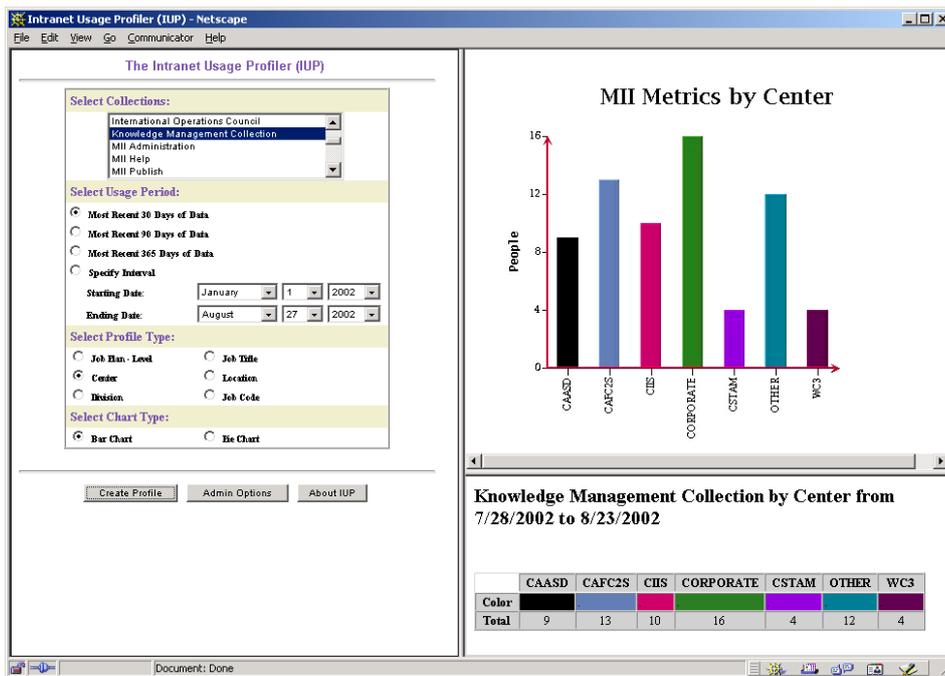


Figure 1. The interface of the Intranet Usage Profiler (IUP).

IURS. After content providers have used IUP to perform a general analysis of their site’s viewers, they may choose to perform a more-detailed analysis of the site-viewing patterns of a specific workplace demographic group; for this task we have provided another interface, IURS. With IURS, content providers can examine the behaviors of the group that comprises their sites’ intended audience, for example, or those of a group that has recently come to their attention.

To use IURS, content providers first select their collection from the list of collections, then select the workplace demographic group of interest based on any of these workplace demographic factors: level of expertise, job title, organization unit, and

location, and then hit the [Begin Search] button. For example, the content provider of the Knowledge Management site might elect to see which URLs individuals with the job title Lead Artificial Intelligence Engineer, working for the FAA Center and located in Washington DC, have found worth looking at.

Query results reflect usage for the last 90 days of data. The query parameters are displayed at the top of the page. The meat of the display is the list of URLs visited by the selected group. The URLs are sorted by their hit counts, which appear in parentheses beside the title of the URL. The URL itself is also listed, as is its sequence in the list. Viewers can go directly to the URL by clicking on its title. To summarize, by using IURS, content providers can determine precisely how interesting each of their pages is to any particular group of visitors.

### **3 Recommendations for Content Consumers**

We have been discussing our services to MITRE's Intranet content providers. However, IURS may be even more valuable to a much larger group, MITRE's Intranet content consumers. Content consumers use IURS as a simple *recommender system* [RV97]. In fact, IURS stands for Intranet URL Recommender System. Recommender systems are invaluable tools for knowledge sharing. They augment and extend the natural social process of people learning from each other. Readers may be familiar with the recommendations on sites such as Amazon.com "Readers who bought this book have also bought these books:..." Recommender systems like these analyze learners' natural activities to compute *implicit* recommendations. Dozens of such systems can be found on the Internet recommending all manner of products. We have implemented a simple recommender system for MITRE Intranet users, instead of recommending purchases, it recommends noteworthy URLs, based on the URLs one's peers (or any other workplace demographic group) have visited that the individual has not.

To find out which intranet URLs their peers are visiting, employees, in their role as intranet content consumers, simply input their own workplace demographic group on the IURS interface. They then input their employee number in the appropriate field at the bottom of the page and click on [Begin Search]. The software will select the URLs the peer group has visited, exclude those the employee has already seen, and display the remaining URLs.

### **4 Data Input and Output**

The data presented in the interfaces mentioned above comes from three main sources, a) web server logs, which record that a specific URL was served to a specific computer at a specific date and time, b) the property database, which records who owns the computer identified in the web server log, and c) the 'phone book', or employee workplace demographic database, which records employees' job family, level of technical expertise, location, and organizational details. Data from these

sources is acquired, processed, and entered into tables. Further processing refines the data and creates sets of snapshots to reduce system response time to learners' queries; certain responses are precomputed and stored in html files. Learners' queries, input as interface selections, are translated into SQL and retrieved via views on the snapshots or files.

One of the most difficult and frustrating tasks we encounter in providing this system is maintaining data quality. Maintaining data quality has required a significant effort since the initial feasibility demonstration. With a large number of content providers deploying content on a number of servers using a variety of web server software, any of whom or which may change without notice, simply ensuring that the log data is retrieved without gaps and is parsed without error requires constant attention. A similar vigilance is required at every step of the process, including updating the personnel and computer ownership records, dealing with machine names, IP addresses, and DHCP, ensuring adequate database space, ensuring that all automated processes run in the proper sequence, and ensuring that the code underlying the interfaces continues to work with new data.

## **5 Closing Remarks**

We have characterized the workplace as an informal learning environment and added two tools to the corporate Intranet to provide individualized learning experiences for each employee. Both tools allow employees, in their role as Intranet content providers, to learn more about their viewers. IURS also allows employees, as Intranet content consumers, to discover potentially valuable information. The feedback and recommendations generated by these tools enable workers to learn from each other. Similar tools for accelerating informal workplace learning would be based on an analysis of data obtained by implicit observation of employee activity in combination with interventions founded on constructivist learning principles. For this sort of feedback process to be effective, it is crucial that the system be deployed in an environment of trust in support of self-development. These tools, embedded in the workplace environment, would gradually but continuously increase workers' professional knowledge and skills.

## **Bibliography**

- [Fa02] Fayyad, U. Evolving Data Mining into Solutions for Insights. *Communications of the ACM*, Volume 45, number 8, pp 28-31.
- [RV97] Resnick, P., and Varian, H. (1997). Introduction to Special Section on Recommender Systems. *Communications of the ACM*, 40(3), 56-58. <http://www.acm.org/cacm/MAR97/resnick.html>.