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User Experience White Paper

Macromedia Flash™: A New Hope for Web Applications

By Christine Perfetti and Jared M. Spool

Creating Powerful Web Applications with Macromedia Flash™

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Macromedia Flash: A New Hope for Web Applications

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Published by User Interface Engineering
242 Neck Road
Bradford, MA 01835
(978) 374-8300
uie@uie.com

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Companies Mentioned in this Report

The Broadmoor Hotel
reservations.broadmoor.com

Fluid
fluid.com

Macromedia, Inc.
www.macromedia.com

Moen
www.moen.com

One Man's Eye
www.onemanseye.com

Smartmoney.com
www.smartmoney.com

Theyrule.net
www.theyrule.net

Timbuk2 Designs
www.timbuk2.com

Volkswagen
www.vw.com

Volkswagen Asia Pacific
www.vwasia.com

Washington Post
www.washingtonpost.com

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Macromedia Flash: A New Hope for Web Applications

The next generation of web applications leverage the strengths of Macromedia Flash to offer users an engaging experience.

Macromedia Flash is a powerful development tool that offers tremendous capabilities. Until recently, developers mostly utilized Flash's strengths to create complex animations or fast-loading movies. However, the most recent versions of Flash offer developers capabilities far beyond the tool's original scope. Using Flash, developers can create web applications with all of the same power and advantages of traditional client-server technologies.

Some new, cutting-edge applications have demonstrated Flash's potential to surpass the power of traditional software applications. These web applications leverage the strengths of Flash to help users make better sense of large amounts of data, presenting information in an easily accessible, graphical visual representation. In this white paper, we will explore how Flash can help developers easily build the next generation of web applications. We will also look at several new applications that have recently appeared on the scene and talk about how they leverage the benefits of Flash.

The Emergence of Flash as a Next Generation Development Tool

In the late 1980's, client-server applications were coming of age. As a step up from the world of mainframes and "dumb terminals," client-server applications enabled developers to move from text-based to graphic user interfaces (GUIs) and introduce sophisticated business applications with client-side processing. These new GUI client-server applications handle user interaction, validation, and business rule processing on the client, minimizing the burden on the server.

When the first HTML-based web applications appeared, much of the GUI application's power was lost. Browsers, like the dumb terminals of the 70's, pushed control of the application back onto the server.

HTML, as a first-generation web development language, creates problems for both developers and users. Because every combination of browser version and operating system produces a slightly different result, developers spend a tremendous amount of time testing and debugging platform issues. More importantly, the document metaphor inherent in an HTML application constrains developers, forcing them to fit complex application interactivity into a linear, page-based process. As a result, users suffer from the difficulty of working on a dumb client to process even the simplest of requests. The creators of HTML, originally a document markup language, never really intended it for the complex interface design of web applications.

To compensate for the inadequacies of HTML, next generation tools began appearing on the scene. Java and ActiveX appeared simultaneously, with different software ven-

dors backing each, resulting in inconsistent behaviors on users' computers. DHTML attempts to increase the flexibility of the HTML language. However, lack of a solid specification has made the differences between browsers even more pronounced.

But now there's a new contender in the web application space. Macromedia Flash, an authoring tool with a light weight, vector-based file format, gained early popularity among web developers for creating animated demonstrations and movies with fast load times.

Building on this initial popularity, Macromedia strengthened Flash's simple-to-learn scripting language, enabling developers to create applications with more sophisticated client- and server-side interactivity. When integrated with sophisticated server-side software like Macromedia ColdFusion® Server and JRun™, Flash delivers the power and flexibility to become a serious contender in the web application space.

An Interactive Experience for Users

HTML, as a first-generation development language, is unable to deliver a direct, interactive experience that matches the capability of GUI client-server applications. Macromedia Flash's strong scripting capabilities make it possible to create interactive, engaging online experiences not possible with HTML.

Immediate Feedback Made Possible with Macromedia Flash

Fluid, a developer of e-business applications, created a web-based mortgage application designed to give users desktop functionality in their browser. (http://macromedia.com/resources/business) Creating a successful mortgage application places huge demands on developers. Users have many questions about their mortgage loans: How much do interest amounts decrease and principal amounts increase over time? How much money can I save by increasing my monthly payment amounts? When can I pay off the loan?

To address these complex questions, the application's developers chose Flash to give users a detailed, interactive exploration of their mortgage accounts. (Figure 1)

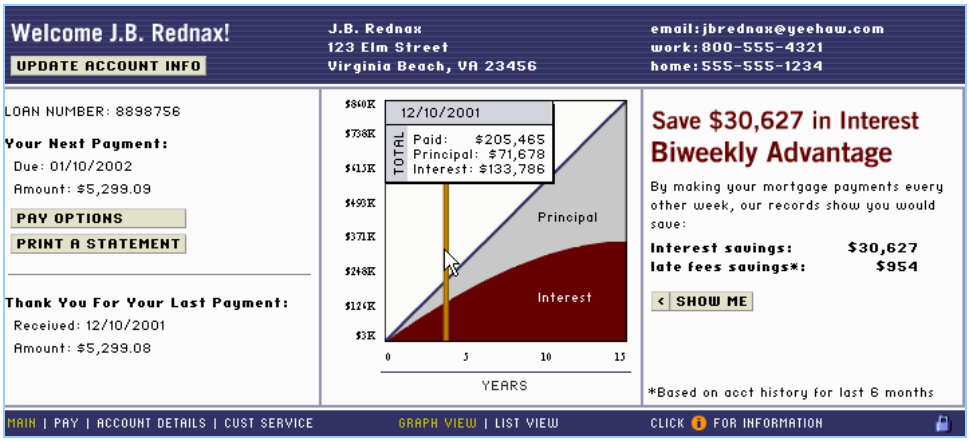


Figure 1: Fluid's Flash-based mortgage application gives users a direct, interactive experience.

Users move a vertical bar that slides across the mortgage schedule graph to get immediate feedback on total mortgage payments, and a breakdown of principal and interest

amounts paid on the loan. The principal and interest amounts update in real time as the bar moves across the graph. (Figure 2)

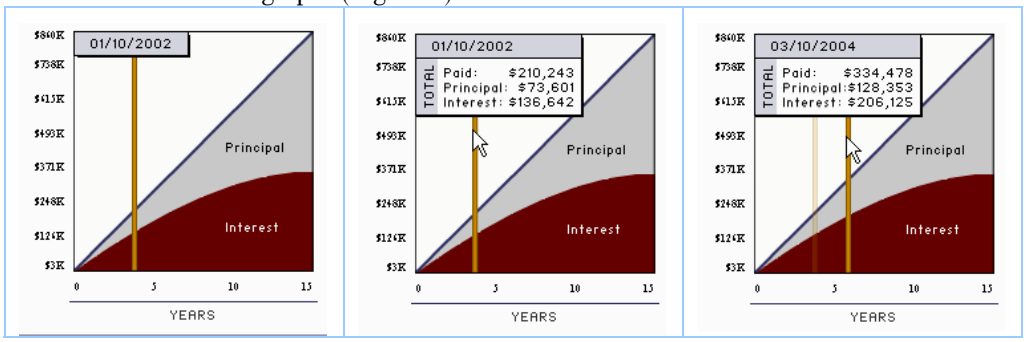


Figure 2: Fluid's application lets users move their mouse over the interactive timeline. *When users place their mouse over the vertical line, they view principal and interest amounts.* *As users move the line over the timeline, the principal and interest amounts update immediately.*

The Flash application also lets users add additional principal amounts to their monthly mortgage payment. This functionality gives users an instantaneous, graphical view on how the added principal will affect their overall loan payment schedule. (Figure 3)

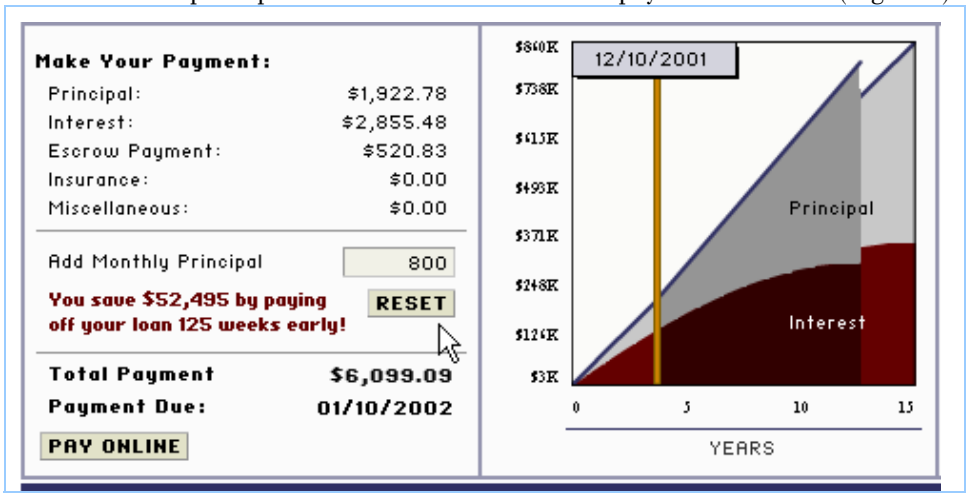


Figure 3: When users add monthly principal amounts, they can see how much money they save over the life of the loan.

Business applications often have to provide immediate feedback in response to changes in the application data. If Fluid's developers had created an implementation in HTML, they would have been limited to a static design—text and charts that users can't manipulate without reloading a page. By choosing Flash, the developers took complex content on mortgage information and made it instantaneously real for users.

More Control with Macromedia Flash

Business rule processing has always been a challenge in application development. The transition from standard GUIs to first-generation web development tools such as HTML, pushed developers' capabilities a huge step backward. In HTML, almost all business rules are resolved on the server, but Flash makes client-side business rule processing an additional possibility. Client-side processing allows for immediate interaction with the user, while reducing server and network burden on resources. This advantage

brings web applications back up to the level of sophistication of GUI client-server applications.

Graying Out: Conditionally Enabling and Disabling Data Fields

In HTML, something as simple as graying out (or conditionally enabling and disabling input fields) on a data-entry screen based on business rules becomes very difficult. For example in an e-commerce application, when users specify they want to pay by check, there's no easy way in HTML to gray out the data entry fields corresponding to credit card information. (Figure 4)

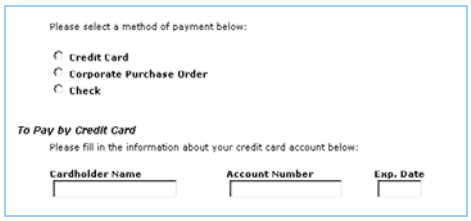


Figure 4: In an HTML application, there is no easy way for developers to gray out the credit card option for users.

As a result, users must interact with an application that cannot offer some of the most basic functionality of traditional software. This limitation is likely to create situations where users enter conflicting or incomplete data into fields that the application does not know how to interpret.

In contrast, The Broadmoor Hotel uses a Macromedia Flash-based application called iHotelier that provides dynamic content based on choices users make as they progress through the steps required to reserve a hotel room online. (http://reservations.broadmoor.com)

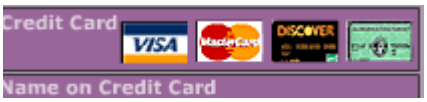


Figure 5a: iHotelier's Flash-based display before the users click an option.

Figure 5b: When users click on the VISA payment option, the other credit cards immediately gray out.

In this application, when users click on the VISA credit card payment option, the other credit card options immediately gray out. (Figures 5a-5b) Flash makes it easy to do things that are difficult to accomplish in HTML, like graying out data fields.

Solving Validation Problems

The process of ensuring that user input adheres to business rules, commonly referred to as validation, is straightforward with traditional software applications. However, with HTML-based applications, developers have to jump through hoops to show users if they have entered a field properly. Users assume their specifications are correct unless told otherwise by the application. As a result, it's the responsibility of an application to provide validation to alert users when there is a problem.

Developers have a couple of options for validation. They can create field-by-field validation with a combination of HTML and more sophisticated JavaScript™. However, the result is an overly complex solution with browser compatibility problems. For example, developers will have to create a five-line program just to check if an email address has an "@" in it.

To get around the difficulty of field-by-field validation, developers have tried page-by-page validation in HTML. This validation is handled on the server side, where there is a lot more programmatic capability than client-side HTML/JavaScript. This method requires developers to group several fields on a page before sending the entries to the server for validation.

Unfortunately, page-level validation has its own set of problems for users. When users receive a lengthy error report, they may have trouble identifying and keeping track of the list of fields where the mistakes occurred. Often the reports don't contain enough information for users to understand how to fix the problems. (Figure 6)

Figure 6: Page-by-page validation can make it difficult for users to manage a huge report of errors.

Macromedia Flash offers a better validation solution. Flash has a powerful client-side language that gives developers strong capabilities for dealing with the subtleties of even the most complicated validation issues. With Flash, it's easy to create validation that gives users instant feedback. For example, the Flash-based iHotelier reservation application immediately gives users a prompt when they fail to enter all of their information on the reservation form. (Figure 7)

Figure7: Users who have missed a field entry will get immediate validation from iHotelier's Flash-based application. A menu appears indicating that the order form is incomplete.

Pop-Up Windows

Macromedia Flash allows developers to control all of the pixels on the screen, which makes it easier to develop sophisticated interface elements, such as pop-up windows. For example, when users click on the "Update Account Info" button in Fluid's mortgage application, the developers coded a pop-up window to appear, with all relevant interface elements visible to the user. (Figure 8)

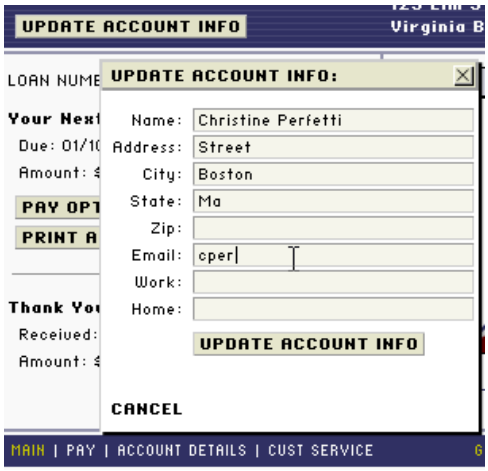


Figure 8: When users click on the "Account Update" button, they can edit their information in a pop-up window.

It's virtually impossible to create this type of implementation effectively with HTML. Developers can try to create these pop-up windows in Java™ and ActiveX®, but the result is clumsy. If web developers must waste time fumbling with the mechanics of something as simple as a pop-up window,

it follows that they cannot develop truly interactive business applications quickly.

As a next generation development tool, Flash provides powerful layout capabilities for developers to create graphical, interactive interfaces so users can access critical information quickly and easily. Flash also helps reduce user errors caused by validation problems and issues of not conforming to business rules. As a result, using a more sophisticated development tool to automate coding previously done by hand, developers can spend their time on features that really add value to the business.

Data Queries: Invisible Client-Server Interaction

In a successful web application, users should be completely unaware of the mechanics of client-server interaction—it's a distraction for them. Macromedia Flash makes this process invisible.

In the Broadmoor Hotel example from the last section, developers created both an HTML and a Flash version of the application. With the HTML reservation system, using five pull-down menus, users specify their check-in date, and the number of nights, rooms, adults and children planned for their hotel stay. Unfortunately, with this interface, it's easy for users to end up without an available room that matches their requirements. After spending a lot of time navigating through the multi-step process, the HTML application may require the frustrated user to return to the beginning. (Figure 9)

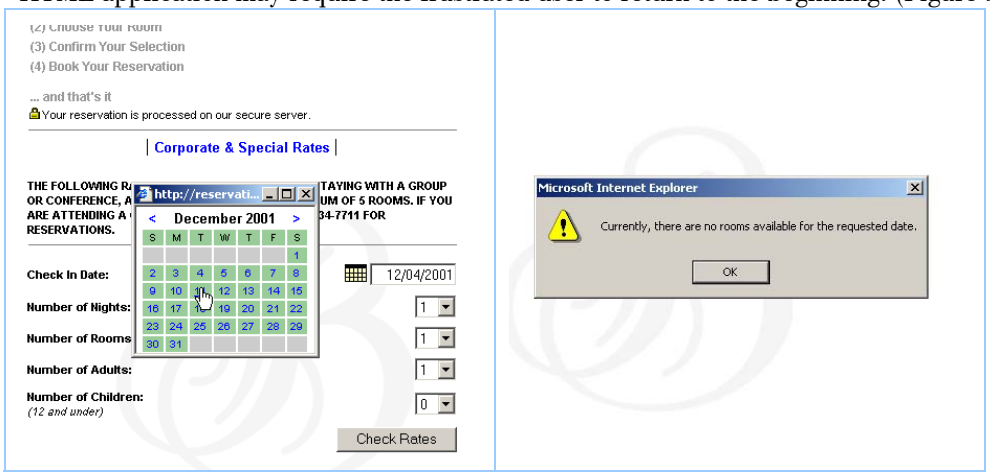


Figure 9: With Broadmoor's HTML application, users must make specifications for a series of five pull-down menus before finding out whether a room is available for their requested dates. In many cases, after completing the whole process, users find out there aren't any rooms available.

With the HTML implementation, the client is a "dumb" browser with limited logic capabilities. As a result, the control of the application must be handled on the server side—every time a user presses a button, the server sends a new page of the application.

First-generation development tools make users abundantly aware of every communication with the server. As a result, users end up attending to distracting details of the client-server interaction, taking away from their ability to concentrate on the task at hand—booking a hotel reservation.

To streamline this process, Broadmoor engaged Webvertising® Inc. to redesign the application in Macromedia Flash. They created iHotelier, a fully interactive, data-driven reservation application that reduces the entire reservation process down to a single screen. Users looking for information on available rooms for specific dates highlight their preferred dates in a calendar. With one click of the mouse, the Flash application displays the available (and unavailable) rooms, and their cost. (Figure 10) As a result, users do not feel like they've wasted a lot of time and effort if their first room choice is not available.

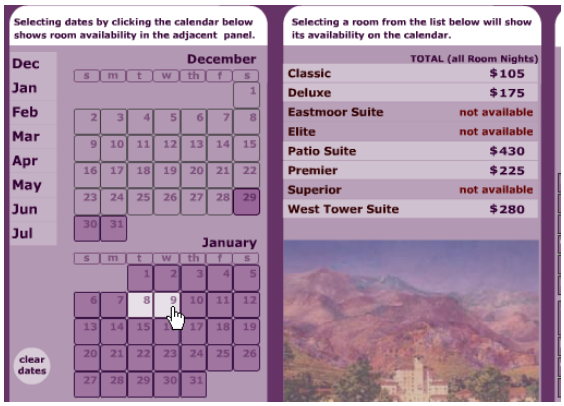


Figure 10: Broadmoor's Flash-based iHotelier application gives users feedback with just one click of the mouse.

A server-side HTML database query functions like a search engine. Users enter their full query, click a button, and wait for the server to return relevant results. Unfortunately, users have to adopt a wait and see attitude as to what information will come back. In contrast, the Flash-based iHotelier application renders the client-server interaction invisible to the user. With Flash, users perceive that they're getting immediate responses to their queries, because of the invisible interaction between the client and the server. As a result, users can focus on their tasks and not on the interaction between the client and server.

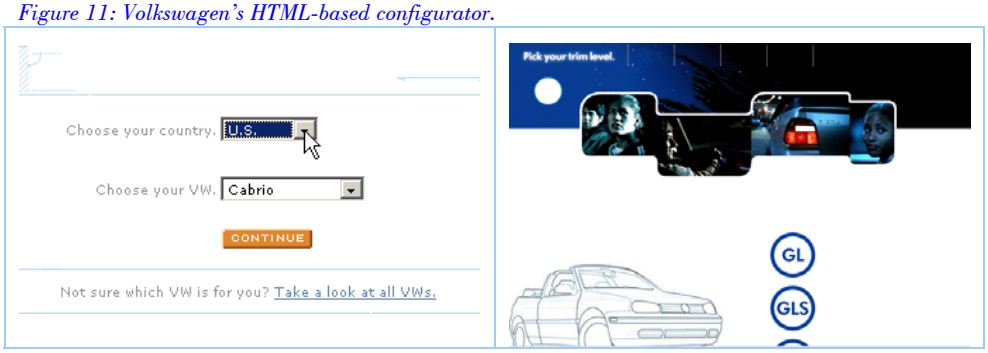
Displaying the User Workflow

Web applications involve users completing a process, or a series of steps to get something done. With the first generation of development tools, users typically have to access multiple screens to complete a process, with no control over the order of these steps. With Flash, developers can display all of the users' necessary steps on a single screen, giving users a "big picture" view of their workflow.

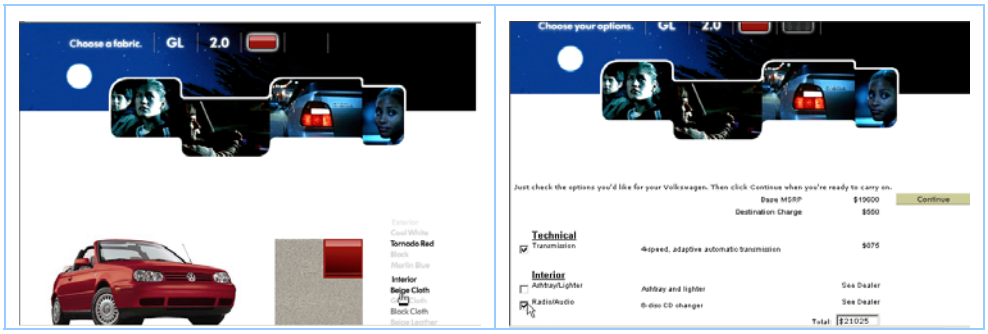
Displaying the "Big Picture"

For example, Volkswagen's web site lets users configure their own car using the "Build Your Own Car" function implemented in HTML. (http://www.vw.com) Users can specify the type of engine, the color of the car's exterior and interior, and optional features. (Figure 11)

Figure 11: Volkswagen's HTML-based configurator.



1. Users choose their country of residence, *2. choose a trim,*



3. choose an external color and interior fabric, *4. and select additional options.*

To configure a car, the interface requires users to click through five different screens. The problem is that users can't see how many steps are ahead of them. They don't know if they're a quarter of the way into the process, or only a tenth of the way in.

Users also don't know if they can easily go back and change their specifications. Choosing an interior trim that costs extra might be acceptable early in the process, but when a more preferable option comes later, they may want to change their interior again to reduce costs. With the HTML application, users cannot tell if this will be a simple process or not, adding an element of uncertainty to their experience and increasing their chances that they will not complete the transaction.

Figure 12: Volkswagen Asia Pacific's Flash configurator lets users make all specifications on one screen.

In contrast, the developers of Volkswagen's Asia Pacific application created a car configurator implemented in Flash. (http://www.vwasia.com) The configurator matches the functionality of the HTML implementation, but it lets users choose all specifications on one screen. Users can drag and drop their specifications into a template to immediately see the results of their actions. (Figure 12)

In addition to the entire process being accessible on one screen, users get immediate responses to their specifications, without having to wait for new pages to load.

The Order of Things

Having a flexible application workflow allows users to zoom into the features that are most important to them first. Imagine you want to revise your life insurance policy, but only want to change your beneficiary information. In an HTML form, you may not be able to access the beneficiary data until five screens into the process. Using Macromedia Flash, developers can easily build flexible applications that let users attack the process in their own order.

To illustrate, Moen Design Center's application lets users build their own product on one screen. (http://www.moen.com) They can design their own kitchen by choosing the type of faucet and the colors of the sink, countertop, cabinets, walls and windows. (Figure 13)

Figure 13: Moen's "Design Your Own Kitchen" implementation lets users specify their criteria in any order.

1. Initially, a user can change the color of the sink.

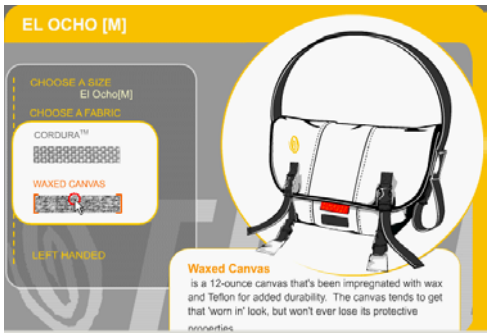
2. Then, change the color of the countertop.

In addition to viewing the entire workflow on one screen, users have control over the order they specify preferences, something not easy to implement in HTML. As soon as users specify the criteria, the visual display reflects their choices.

While there are ways to create the Moen implementation with JavaScript and HTML, it's very clumsy and involves a great deal of download time. It would require a JavaScript function that replaces one image, or choice, with another, based on the colors selected. For Moen's developers to do this with JavaScript, they would need a separate picture of the kitchen with every possible color/sink combination. This becomes very difficult for developers to manage.

Similarly, Timbuk2's application lets customers build their own messenger bag with control over the workflow. (http://www.timbuk2com) Users can specify the size, material, color, and other features they want in a custom-made messenger bag. (Figure 14)

Figure 14: Timbuk2's Flash-based "Build Your Own Bag" application.



1. Users choose size and fabric preferences by clicking on the appropriate option.

2. The site then lets them choose from 16 different colors.

3. Users can then add custom features to their bag. Notice how the site tracks the price as users add or remove options.

4. Users can even specify if they need a "left-handed" bag.

When buying a messenger bag, not all content is equal to users. For example, some people who are price sensitive may want to jump across criteria, changing the size and color of the messenger bag to make quick cost comparisons. Flash enables designs to have a flexible workflow, allowing users to zoom into the features that are most important to them first.

Macromedia Flash Can Move Web Applications Beyond the GUI

Macromedia Flash can also be a valuable tool to help users make sense of large amounts of data by presenting it in an easily accessible, graphical representation. Today, it is easy for companies to build up a massive data warehouse with terabytes of historical data. However, to turn all of that data into valuable information, employees need tools to help them visualize the abstract concepts and make important business decisions. In this section, we'll explore some common business problems and examine how some preliminary Flash implementations are showing promise for future web applications.

Plane Manufacturing: Visualizing Airplanes from Documents

Today, plane manufacturers build dozens of airplane models. In 2001 alone, Boeing shipped more than 300 commercial airplanes in six different models with dozens of variations and customizations.

Each plane has many different subsystems, from avionics to wings to engines. Each subsystem consists of thousands of components. Every component on every plane built has to be specified, tracked, and inspected, creating literally millions of documents. Engineers and managers have the difficult task of keeping track of every detail of a plane. As production on a new plane progresses, manufacturers must track all changes and notify everyone who needs to be involved.

Development teams for plane manufacturers need more than data entry screens with a database back end—they need sophisticated tracking tools that can let the team members visualize the airplane they are designing as described in thousands of specification documents. These companies could benefit from the graphical capabilities of Flash.

One analogous example of how this might work is the application One Man's Eye. (http://www.onemanseye.com) (Figure 15) While developers created this application to show various types of artwork in a gallery, it demonstrates the potential that Flash applications hold for visually representing a large number of documents.

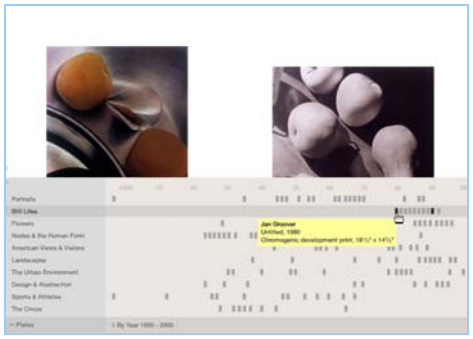


Figure 15: One Man's Eye represents a large number of documents in one visual display.

One Man's Eye organizes over 100 photographs using a visual display broken down by photograph category, for example, landscapes or portraits. (Figure 16)

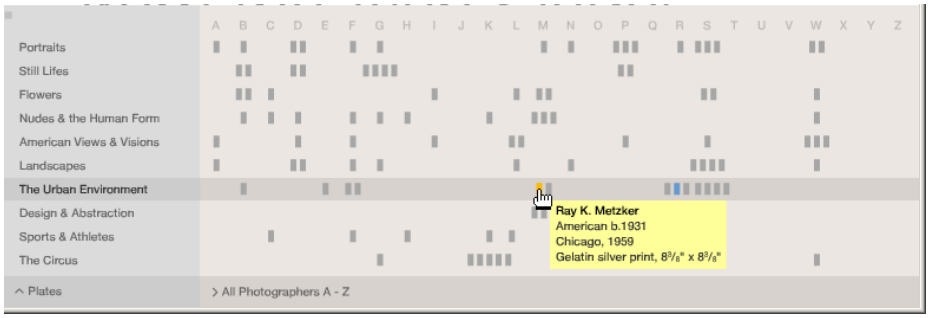


Figure 16: Users interacting with the One Man's Eye application can quickly view the photograph directory and see the large amount of information in a clear and understandable visual representation. The display also allows users to easily visualize groupings of data.

The application lets users sort each of the photographs by photographer name and by year of production. One Man's Eye enables users to make quick sense of the photograph categories without having to look at every single photograph in order to see the big picture.

In the future, we can see manufacturers of large systems, such as airplanes, using a similar implementation for visually organizing their huge number of documents. By using Flash, people can click on one document and see other related documents based on a variety of filters.

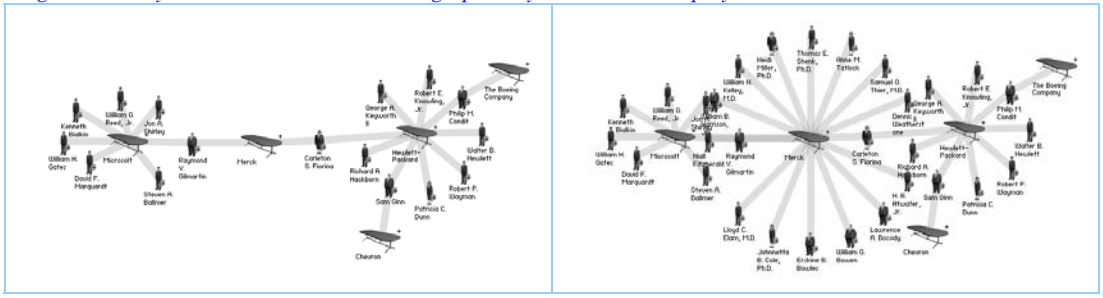
Financial Services Firms: Finding New Marketing Opportunities

Customers of financial services firms are always looking for new ways to increase the return on their investments. They come from all walks of life, with different needs and different expectations.

Some investors are trying to save for their retirement, others for school loans. Some are heavily involved in investing; others have more modest financial goals. Some have a lot to invest, others just a little. Therefore, one marketing message is not going to work for the entire customer and prospect base of a financial services firm. They need tools to identify the patterns that make some customers different from others. One Macromedia Flash application we found that demonstrates the power of this drill-down capability is TheyRule.net. (http://www.theyrule.net) In the United States, many corporate board members hold seats on other boards or government committees. To help examine these interlocking memberships, the designers of TheyRule.net used Flash to illustrate the interrelationships.

With TheyRule.net, users drill down on a display to view all of the directors on any board, and view all the different company boards on which each member sits. For example, Figure 17 illustrates how easy it is to see that representatives from both Microsoft and Hewlett-Packard sit on the board of Merck. Interactive clicking on the display allows users to drill down graphically and discover new relationships.

Figure 17: Theyrule.net lets users drill-down graphically on the visual display.



1. This interactive diagram shows the relationship between Microsoft and Hewlett-Packard; employees of both companies sit on Merck's board.

2. When users click on Merck's graphic, they can view all of the different members who sit on the board.

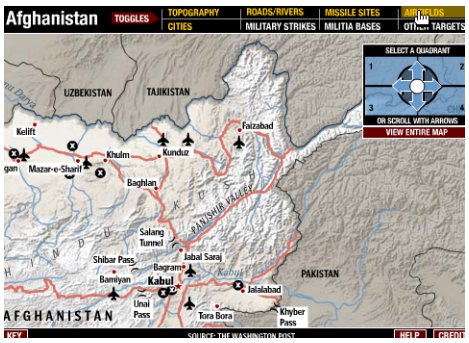
Managers at companies like Fidelity could also benefit from seeing data represented graphically. Flash makes it easy to take a standard map and overlay it with information, such as which type of products customers have purchased, and other interesting demographic information.

Another illustration of this type of Flash application is The Washington Post War Zone Explorer, which gives users the capability to view the geographic war regions in Afghanistan. (http://www.washingtonpost.com) Interacting with the War Zone Explorer, users can add layers of information on the map including roads, river, missile sites, airfields and military bases. (Figure 18) Users can zoom in on different parts of the map to gain a much deeper understanding of the battle area.

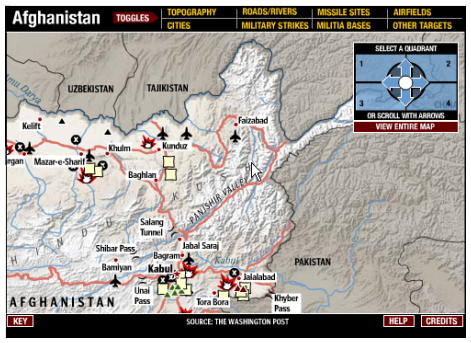
Figure 18: Washington Post's Flash-based "War Zone Explorer".

1. Users can add topography and city labels to the map.

2. A user adds road and rivers,



3. airfields,



4. and military bases.

While on the surface, the Washington Post War Zone Explorer does not seem directly applicable to the needs of financial service companies, it clearly shows the promise of Flash for complex data visualization. A financial services firm might create a similar application to the War Zone Explorer that lets their marketing professionals look at a map of a sales region to gain insight into customer profile patterns. With Flash, developers can easily "layer" different information, allowing users to quickly see relationships they might otherwise miss.

Recent Flash implementations such as One Man's Eye, Theyrule.net, and the War Zone Explorer hint at the major advances still to come in the world of web applications. Flash's information visualization capabilities let businesses begin serious knowledge processing, enabling users to make sense of large quantities of data through graphical representations—something not possible in the web application space up until this point.

A New Hope for Web Applications

Macromedia Flash allows developers to create applications that offer users advanced capabilities beyond what is possible with first-generation tools such as HTML. As a result, Flash can help developers dramatically enhance the user experience.

Flash matches the power of the GUI client-server applications. It offers users direct interactivity and immediate feedback that isn't possible in the rigid world of HTML. Flash excels as a tool that makes the interaction between the client and server invisible

to the user, allowing users to attend to the task at hand. Just as important, Flash-based applications make it simple for users to view the entire workflow, helping them see the "big picture" of an application.

We're confident that with the use of Macromedia Flash, web applications will move far beyond the functionality of GUI applications. Flash's leading-edge capabilities for creating powerful interfaces and graphical displays are the first components in a new wave of data mining and knowledge processing applications.

New Report Available: Making the Best with Flash

A new report, written by Christine Perfetti and Matthew Klee, provides a detailed description of our latest research on developing Flash applications. This report discusses the five best practices for creating engaging content with Flash. Perfect for anyone currently developing in Flash or is considering it in the future.

For more information, visit http://www.uie.com.

About User Interface Engineering

About Us - User Interface Engineering is a leading research-driven company specializing in web-site and product usability. By providing usability information based on detailed observations rather than opinions, we empower development teams to create web sites, software applications, and other products that increase customer satisfaction and loyalty.

Best Practices Report Series - Based on years of watching real users on real web sites, this report series reveals design practices of the most-successful sites. We've packed each report with practical, hands-on advice plus plenty of examples from live, production web sites. You'll learn exactly what the best sites do to succeed and find out what mistakes to avoid. Contact us at uie@uie.com if you would like us to notify you as soon as we release our next report.

User Interface Engineering Web Site - Our web site, www.uie.com, has many resources for people involved in web and product development, including:

- Free white papers about our recent e-commerce research
- Articles on various aspects of web and product usability, including paper prototyping
- Descriptions and schedules for our public courses
- Upcoming conferences where we will be speaking

How to reach UIE - If you have questions or would like more information about our offerings, please send e-mail to uie@uie.com. You can reach us at (978) 374-8300, by fax at (978) 374-9175, or by mail at 242 Neck Road, Bradford, Massachusetts 01835, USA.

Author Information

Christine Perfetti, Consultant

When you talk with Christine, it doesn't take a long time to realize that you're talking to someone who knows a whole lot about designing usable web sites.

Christine is co-author author of *Making the Best of Flash,* a report about the best practice for creating engaging experiences in Macromedia Flash. As one of the most requested instructors at User Interface Engineering, she has worked with dozens of companies on their toughest web design problems. It would be very difficult to find someone who knows more about task design, user recruitment, and usability testing practices than Christine. In the last year alone, she's been a top-rated presenter at CHI 2001, the UIE Research Forums, Intranets 2001, and STC regional conferences. She has taught Human Factors at the prestigious Tufts University Gordon Institute for Engineering Management.

Christine previously worked at Fidelity Investments, where she was an influential member of their systems company training team. She received her Master's Degree in Experimental Psychology from Brown University.

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Jared M. Spool, Founding Principal

If you've ever seen Jared speak about usability, you know that he's probably the most effective, knowledgeable communicator on the subject today. What you probably don't know is that he has guided the research agenda and built User Interface Engineering into the largest research organization of its kind in the world. He's been working in the field of usability and design since 1978, before the term "usability" was ever associated with computers.

Jared spends his time working with the research teams at the company, helps clients understand how to solve their design problems, explains to reporters and industry analysts what the current state of design is all about, and is a top-rated speaker at more than 20 conferences every year. He is also the conference chair and keynote speaker at the twice-annual User Interface Conference, is on the faculty of the Tufts University Gordon Institute, and manages to squeeze in a fair amount of writing time.

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