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WHITE PAPER

Rich Internet Applications

Sponsored by: Macromedia and Intel

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IDC OPINION

The Internet has emerged as the default platform for application development. Unfortunately the demand to build applications of increasing complexity has continued to outpace the ability of traditional Web applications to represent that complexity. The result is frequently a frustrating, confusing or disengaging user experience resulting in unhappy customers, lost sales, increased costs and the disappointment that the Internet has not lived up to its promise.

In response to this opportunity, Macromedia has developed technology and tools that enable new kinds of engaging, highly interactive, applications and user experiences. Using a series of case studies, this White Paper examines Rich Internet Applications – what they are, why they're needed, who can use them and the business benefits available to companies that employ them.

IDC concludes that Rich Internet Applications:

- Provide a very viable technology capable of addressing a broad range of Internet, intranet and corporate application needs without requiring wholesale replacement of existing Web application investments.
- Empower companies to create wholly new kinds of engaging, innovative user experiences and applications with features or capabilities that in most cases would be extremely difficult or impossible for a developer to create using traditional Web technologies.
- Deliver a variety of substantial business benefits including: highly qualified lead generation, increased sales, increased brand loyalty, longer stays on sites, more frequent repeat visits, reduced bandwidth costs, reduced support calls, and deepened customer relationships.
- Offer the potential for a fundamental shift in the experience of Internet applications, leading to applications that come closer to delivering on the promise of the Internet.

MARKET OVERVIEW

We are in a period of expanding opportunity for Internet and intranet applications. The growth in adoption and usage of the Internet has acted as a driver behind technology spending, and enterprise integration trends that seek to marry back-office infrastructures with new front-office applications and the Internet. Integral to this is the need to communicate better with employees, customers, suppliers, and partners. Intranet applications, including enterprise information portals and employee facing applications, are increasingly depended upon to share information across a company, while outwardly focused extranet applications seek to more tightly bind networks of partners, suppliers and customers and make communication, business transactions and support easier.

As a case in point, over the next 4 years, IDC expects businesses to continue to invest in their enterprise information portals (EIP). EIPs are expected to grow at a 41.2% compound annual growth rate (CAGR) to over $3.1 billion in 2006, as EIP benefits become more widely understood and broader adoption occurs across companies. As well, the worldwide market for B2B and B2C marketplace applications is expected to post a CAGR of 20% through 2006, largely on the strength of the need for companies to better communicate with their customers and suppliers through commerce-ready portals and marketplaces.

While we have passed through the hype and failure of the dot-com era, it marked the start of real online electronic commerce both direct to consumer and between companies. IDC expects ecommerce to grow substantially over the next 4 years, as will the market for the applications that make that growth possible. According to IDC's Internet Commerce Market Model, ecommerce spending is expected to grow at a 57.2% CAGR from $598 billion in 2001 to over $5.7 trillion in 2006. Last year alone, almost 200 million people bought something online, resulting in almost $1 trillion of Internet commerce.

Worldwide spending growth on ebusiness software applications will increase from 3.2% in 2001 to 7.7% in 2002, reaching 11% annual growth in 2004 and beyond. The market for ebusiness applications will grow at three times the rate of the overall applications market and become an increasingly important percentage of the total.

All of this data points to the notion that people are continuing to adopt the Internet and it is becoming the platform of choice for software development. IDC expects this general trend to continue.

CHARACTERISTICS AND LIMITATIONS OF CURRENT WEB APPLICATIONS

The Internet as an application development platform emerged rapidly from obscurity to the dominant position it now holds in enterprise and inter-enterprise computing. Over the brief life of the Internet, Web applications have grown in prominence and capability. Each successive wave of client and Web server technology has upped the ante on the previous generation, increasing capability, integration and responsiveness. Web applications have come a long way from the first hard coded unchanging Web pages and CGI Web server scripts.

Yet while incremental technology changes were being added to make more powerful, dynamic and back-end integrated applications, the user demands and expectations placed on Web applications continued to push ahead at an even faster pace, continually exceeding the capabilities of the underlying technologies.

Results from IDC's 2001 eConsumer Survey, for example, found that 61% of Western European respondents agreed that it is difficult to navigate and find products on the Internet, and more than 60% were discouraged by the "bad" shopping experience when buying products online. It concluded that in order to increase the share of Internet buyers in the population, navigation and the experience on most shopping sites should be made more user-friendly and easy to use.

This is only one example, and can perhaps be considered the tip of an iceberg. Additional IDC research points to the challenges of searching and of finding information within both corporate portals and retail sites. Ease of navigation, the ability to find information, and the overall on-line experience are significant surface aspects not only of retail sites but of all departmental, corporate intranet and Internet applications. At the core, traditional Web applications face a substantial challenge: They suffer from the inability to adequately visually represent the complexities required in today's applications.

Examples of these complexities include:

Process complexity. The required representation of a multi-step or multiple option task or interaction introduces process complexity. In HTML, a multi-step task could be represented on a single page. However due to the limitations in the interactivity of HTML, it would likely result in a page 3 feet long that is confusing, unwieldy or simply too long for users to easily work with. Working around this kind of unacceptable user experience has required breaking the task into steps, at seemingly "natural" places and typically to map those steps to new pages. This requires users to switch pages to do something, to complete steps in a process, etc. This page-centric user interface often results in back and forth page flipping to address changes made in sequential steps that affect one another. An artificial interruption in the user experience is also created that is actually not part of the original process workflow. The result is a slow, awkward, confusing and often frustrating user experience.

Worse yet, users have now been lead to believe that all processes must be represented in this multi-step, multi-page workflow, and that page flipping to see the results of their choices (rather than seeing the results on the same page as the query) or being lead to a dead end path (such as the zero results search page) is an acceptable user experience. It's not. Pages are fine for simple or linear workflows. But a new approach is needed to represent these more complex processes, one which reduces the number of steps or page-flips and enables a higher degree of interactivity within the user interface. In many cases, a highly interactive single screen interface can represent these complex, multi-step or non-linear workflows directly and intuitively.

Data complexity. Examining the inter-relationship of pieces of data or information illustrates data complexity. For example, departmental and enterprise application users are often attempting to make optimal use of internal data, but there is often too much of it. Tools are often limited in their ability to detect patterns in data and make them visible via a Web interface. New ways to interactively visualize data are needed. Interactive data exploration can allow users to navigate through the data and get a better understanding of it. Such tools allow users to look at a chart and then drill down into sections by clicking on them to see increasing levels of detail. When users are able to visualize and manipulate intricately related data, data complexity is reduced or made understandable and compelling by the simplicity and elegance of the visual presentation.

Configuration complexity. Web sites have been unable to present to users a visual picture of custom-built products or present anything other than text for representing the result of a criteria-based or parametric search.

For example, many Web applications allow users to configure their own custom product – something as inexpensive as a bag or as expensive as a computer or even a car. But configuring products is difficult. It's difficult because the application has to represent the complexity of presenting to a user all the possible valid combinations of product options, essentially allowing that user to create one item from tens, hundreds or thousands of options. Representing this complexity includes indicating required elements, indicating both valid and invalid combinations, indicating selected trouble-causing elements and their proper resolution, providing cost information for each individual selection and the total cost (as it changes), and probably most importantly, enabling users to visualize the end result – a specific configuration. This reduces the number of users who abandon their effort part way through the process.

Scale complexity. Internet applications can access a whole new scale of data that was previously available and this adds a new level of complexity requiring new techniques to search and compare data. One example is criteria-based product search that allows the selection of one item from hundreds or thousands of items. Today most of these types of search sites are textual with a sprinkling of images for good measure. The user enters his or her criteria – for a digital camera it might be its price, image size in pixels, memory technology, flash etc. – and the site returns pages of items, consisting mostly of descriptive text that meet the criteria. An alternative would be to use visualization to reduce the complexity of the search space – that is to provide immediate, dynamic visual feedback showing the results of the search filters. On a site that allows selection of a camera based on its criteria it might occur as follows: The site starts with a single screen containing pictures of all available cameras. As the user selects filter criteria using check boxes or sliders or data entry fields, it instantly removes all pictures of cameras that do not match the criteria, leaving visible only the cameras that match. The result is a radically different experience, of narrowing the focus to zero in on the few cameras that fit the criteria, one perhaps closer to the user's actual physical world buying experience.

Allowing users to visually eliminate the invalid options or filtered results removes complexity and increases user confidence.

Feedback complexity. Highly interactive applications, such as games, introduce feedback complexity – the feedback loop that exists between the actions of the user and screen elements in a fast moving or rapidly changing scenario. Historically this has been almost impossible to represent in traditional HTML pages. What's needed is the ability to have highly interactive and locally intelligent client-side applications that can respond to user input and change their state or interface without the need for a full-page refresh or interruptive communications with a server. This departure from today's server dependent client would enable more engaging user experiences and would address the problem of feedback complexity.

Web applications need to be able to represent complexity – allow users to visualize complex data, configure products with multiple options, visually search large data sets and allow for interactive exchanges between the user and the data. Why can't Web applications represent these complexities?

The Limitations of HTML Pages

One key reason Web applications cannot represent these types of complexity is because of the limitations of HTML pages. The Internet grew up on the notion of a network of loosely coupled, unintelligent clients that communicate with increasingly intelligent servers by sending requests for pages. Thus a large portion of the reason for some of the current challenges of Web applications is attributable to the historical reliance on and the limitations inherent in a page-based client model.

In this model, the page is the default user interface. It defines the user interface and degree or kind of interactivity. It is also the smallest unit of transfer and refresh. It is self-contained and therefore requires an external mechanism to maintain context across pages. Lastly, it is both a natural and an artificial divider of process – it is the mechanism used to explicitly request new content or submit a response, or to segment a process into steps.

Use of this limited model has led to the need to develop a variety of sophisticated caching algorithms, mechanisms and coding practices aimed at optimizing page content transfer so as to reduce refresh speed and bandwidth usage. Over time the Web page has been given increasingly dynamic features to improve its interactivity, but even these remain limited in what can be presented or how the user can interact with the content. Pages are further handicapped by the underlying request/respond communication model which dictates that the client side has no autonomous say in what information it needs or when it can get it (e.g., asynchronously, in the background). It must wait until an explicit page request is made by the user to do anything and it then it must get a whole page.

While simple and elegant in design and intent, ironically the page-based model has become cumbersome and complex in order to be usable. As a result today's Web applications are hindered by these limitations in representing complexity, and they are costing companies real revenues, market share, customer satisfaction, loyalty and worker productivity.

WHAT'S NEEDED FOR WEB APPLICATIONS

Web business applications demand more. Based on the growth opportunities presented in IDC research, it is clear that the impact of Internet applications on the overall business will continue to increase – especially as companies continue to work more closely with customers and suppliers, and internally among employees.

As has already been described, however, when the Web came along, the client-side was functionally emasculated. In some respects it resulted in a giant step backwards – equivalent to moving from a smart, powerful, graphical user interface to mainframe green screens, except now the screens are more colorful. These interfaces have significantly restricted the kinds of interactive user experiences possible on the Web to date, and the ability for Web applications to represent the increasingly complex kinds of information and interactions required.

To solve today's problems, the ideal Web applications would to be able to:

- Utilize a ubiquitous client
- Run unchanged across the Internet on multiple hardware platforms
- Execute well across low or high bandwidth connections
- Restore processing power (not just rendering capabilities) to the client
- Deliver engaging user interfaces with high degrees of interactivity
- Represent process, data configuration, scale and feedback complexity
- Utilize audio, video, images and text in a seamless manner
- Support the mobile workflow by allowing users to work on- and off-line
- Allow the client to determine for itself what content or data to access and when (Asynchronous content retrieval)
- Access multiple middle tier services (both .NET or Java) and backend data stores
- Provide a dynamic and powerful front end for the evolving Web Services based network – use emerging standards, such as XML and SOAP
- Integrate with legacy applications and systems
- Allow for the incremental addition of new functions to existing Web applications and environments to get the most out of existing Web application investments

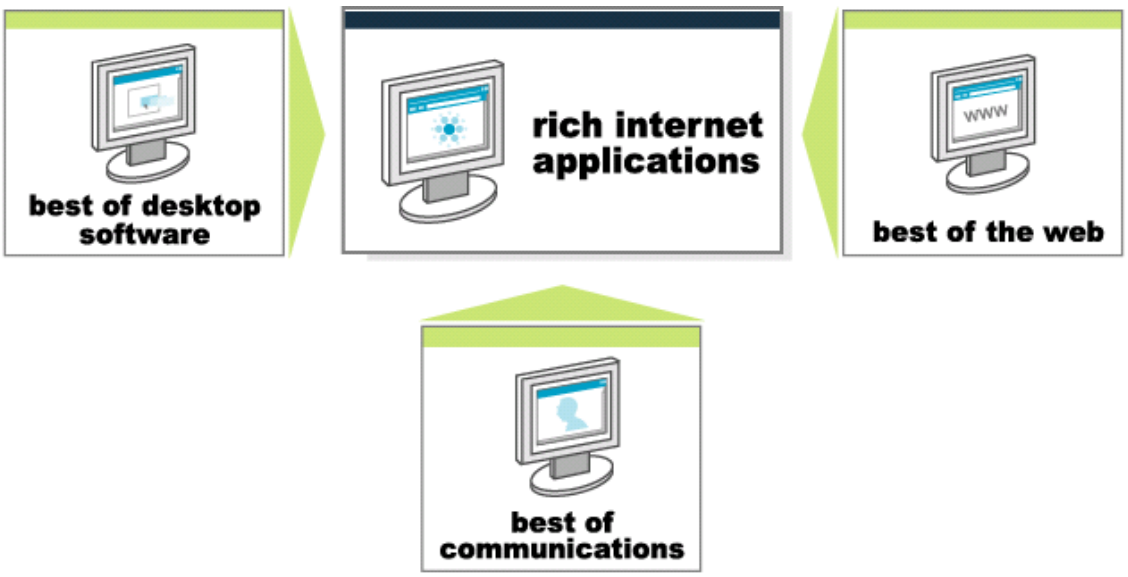
Candidate technologies for these solutions would not simply address the limitations of the page-based model, but would also provide the above capabilities, empowering developers to create wholly new kinds of engaging, innovative user experiences and applications.

RICH INTERNET APPLICATIONS DEFINED

Rich Internet Applications (RIAs) provide this Web application solution. Macromedia defines RIAs as combining the best user interface functionality of desktop software applications with the broad reach and low-cost deployment of Web applications and the best of interactive, multimedia communication. The end result: an application providing a more intuitive, responsive, and effective user experience. Specifically, the best of the desktop includes providing an interactive user interface for validation and formatting, fast interface response times with no page refresh, common user interface behaviors such as drag-and-drop and the ability to work online and offline. The best of the Web includes capabilities such as instant deployment, cross-platform availability, the use of progressive download for retrieving content and data, the magazine-like layout of Web pages and leveraging widely adopted Internet standards. The best of communication means incorporating two-way interactive audio and video.

FIGURE 1

Rich Internet Applications Combine the Best of the Desktop, Web, and Communications



Source: Macromedia, 2003

This means that in a RIA, the client is capable of doing more than just rendering pages. It is able to perform computations, send and retrieve data in the background asynchronously from the user's requests, redraw sections of a screen, use audio and video in a tightly integrated manner, and so forth, independently of the server or back end it is connected to.

An RIA provides a strong technical platform that effectively restores the client's abilities to be more like that of desktop software applications, or a traditional client in a client/server system. It fits into the traditional n-tier development process and integrates into legacy environments to extend existing applications without the need to rework them. And it also can serve as an interactive presentation layer above underlying Web Services. It is able to address various kinds of complexity. It enables development of applications that have complexity requirements, reducing the cost of development and frequently making development of such an application possible in the first place.

The ubiquity of the Macromedia Flash player means that today most RIAs are running Macromedia Flash on the client as a lighter weight and lower-bandwidth application interface than traditional desktop client software. One benefit of these Macromedia Flash-based RIAs is their support for a broad range of platforms and devices – applications work the same across operating environments and browsers. This can cut quality assurance time for cross-platform support and deployment while allowing for broad cross platform deployment.

Because of their architecture and capabilities, RIAs have the potential to fundamentally change the way companies engage and interact with their Web users, leading to more effective user experiences with top- and bottom-line results.

COMPANIES THAT SHOULD CONSIDER RICH INTERNET APPLICATIONS, AND WHY

The Web has long promised to be a conduit to connect directly with prospects, clients and partners. Yet company executives often express disappointment because they feel they are not yet realizing the full promise of the Internet.

While Rich Internet Applications apply across a broad lattice of industries and uses, one of their primary virtues is to allow a company to reduce the complexity that stands between where they are today with their traditional Web applications and where they want to be. RIAs are consistently bringing companies closer to their vision of their application, closer to their customers, and closer to the business impact they believed the Internet could actually have on their overall business. This is expressed most clearly in what RIAs have allowed or enabled companies to do. Companies have considered and chosen RIAs because they believed they could:

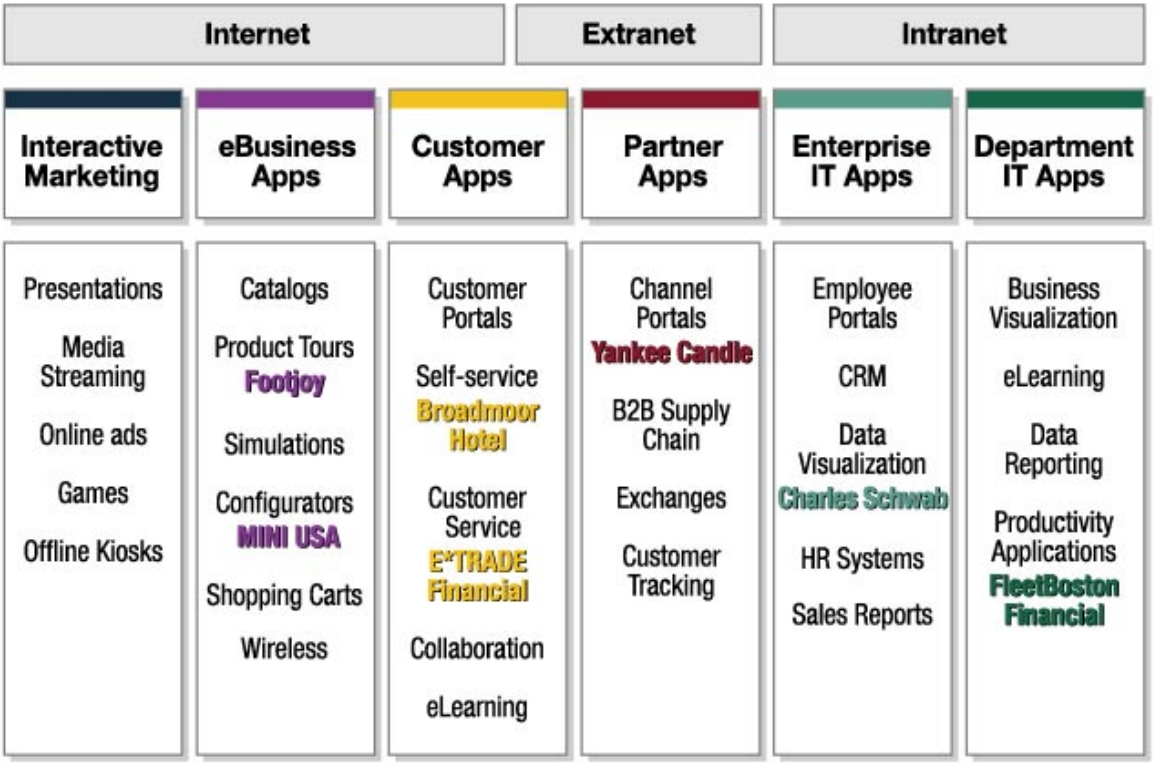
- Develop new kinds of applications with features or capabilities that would be extremely difficult or impossible for a developer to create using traditional Web technologies.
- Engage, guide and listen to their customers on-line more intimately or more closely to how they would do it in person to increase loyalty, improve service, deepen the customer relationship, distinguish the company, or guide product development.
- Create compelling, attractive Web sites using audio, video, text and graphics that generate leads, increase sales, simplify communication and create a unique on-line experience worth returning to.

- Simplify typically complex processes like registration, configuration or purchasing leading to increased leads, sales, bookings, time on the site and repeat visits.
- Present information to their employees, management and partners in clear, innovative, intuitive and effective ways to increase productivity, information sharing, decision-making and competitive advantage.
- Provide an engaging, highly interactive presentation layer to underlying Web Services.
- Reduce bandwidth costs associated with frequent page refresh for high traffic sites.
- Dramatically increase sales of their products and services through their Internet channel.
- Build an engaging, highly interactive Web site or application at a reduced cost compared to using alternative Web technologies.

These are the reasons why companies should consider a Rich Internet Application for their business.

FIGURE 2

Rich Internet Application Spectrum



Source: Macromedia, 2003

Figure 2 shows the spectrum of potential uses for Rich Internet Applications. It is broad, ranging from externally facing interactive sites, to customer and partner facing applications, to internal enterprise and departmental applications. Case studies examined in this paper (and labeled on the figure) span this full spectrum.

CASE STUDIES

IDC conducted interviews with 7 companies resulting in the case studies that follow. The case studies illustrate the efforts of companies that developed a Rich Internet Application and realized many of the aforementioned business benefits and return on their investment. They are grouped into four areas in which RIAs show that they can provide immediate utility and business value. The areas are: eBusiness applications, Enterprise IT applications, Customer applications and modules or components embedded in existing site pages.

TABLE 1

Summary Benefits

Company	Challenge	Solution	Results
Broadmoor Hotel and Bluegreen Vacation Rentals	• Increase online conversion rates by reducing registration complexity • Reduce offline reservation costs • Simplify the user experience	Implemented an easy to use, single screen interface for on-line reservations	• 89% increase in reservations • Nearly doubled the conversion rate to more than 4.1% on average • 50% increase in revenue booked • 66% increase in room nights booked
FootJoy	Improve site usability by: • providing an online experience replicating their in-store experience • Tap expertise of company golf pros • Streamline the update process • Put in place strategic technology foundation	Developed the Product Finder, a rules-based expert product guide	• Reduced customer support to the site • Created and deepened relationship with customers through interactive polls and easy to access, knowledgeable product guidance • Increase in repeat visitors • Users in 85%-90% of inquiries, follow through to examine product details • Established an expandable technology foundation that will be the basis for additional customer-centric applications

TABLE 1

Summary Benefits

Company	Challenge	Solution	Results
MINI USA	• Create a highly interactive, fun and exhilarating on-line experience that represents the MINI brand • Insure online branding is consistent and integrated with offline branding campaign • Support sale of 20,000 vehicles in North America in 2002 • Drive loyalty and evangelism among owners	Developed single screen MINI automobile configurator	• Exceeded goals for registered users by 52% • 73% of registrants configured a MINI • Generated 12,000 qualified leads against year end goal of selling 25,000 MINIs • Over 50% of all leads generated by site • Exceeded 2002 US sales goals by 25% • 50% of all leads generated by site
Yankee Candle Company	• Increase online sales by allowing buyers to better configure and visualize custom candles	Developed a single screen custom candle configurator for real-time visualization of candles	• 25% increase in product revenue and average order size • 70% decrease in call center calls for custom candles • Developed the application in the same amount of time but at half the project cost of alternative approaches
Charles Schwab	• Provide a centralized marketing planning calendar • Present deep multi-dimensional data sets in an intuitive, responsive interface • Address multiple types of users with different information needs and requirements • Provide sophisticated yet easy to use tools • Allow the user to be in control	Built a custom data visualization solution that displayed multiple interactive views of data for marketing project managers and executives	• Provided executives with visual, holistic views of marketing budgets, leading to better decisions • Realized more efficient use of marketing budget • Increased awareness of marketing campaigns and their status

TABLE 1

Summary Benefits

Company	Challenge	Solution	Results
FleetBoston Financial	• Explore use of RIA as an interface for a major enterprise application • Allow business managers to rapidly create and add new products and promotions • Integrate with legacy back end	Developed working prototype of their bank branch application	• Include RIA technology in future evaluations for similar enterprise application projects
E*Trade	• Deliver security quotes as quickly as possible for customers and as efficiently as possible for E*Trade • Support cross platform, multi-country deployment	Developed quote application module that is embedded into every page in the investing section of the existing site	• Reduced bandwidth costs by eliminating need for full page refresh for each quote request • Improved performance and user experience

Source: IDC, 2003

RIA For E-Business Applications

E-business has become one of the fundamental uses of the Internet. Whether it is to purchase goods like books and computers, or services like flights, and hotel accommodations, or to better engage customers through on-line product tours, companies are continually looking for ways to improve the customer's experience on the Web site. The better the experience the more likely they are to stay, to visit again and to buy.

There are many ways to improve customer experience on a Web site. Removing complexity is one way – by presenting information simply, eliminating unnecessary navigation, or guiding the customer to the right product. Companies like Amazon with its patented processes for "one-click" purchasing provide an example of this type of simplification. Another way to improve the customer experience is to fundamentally change the interaction with a RIA to allow a user to perform the entire transaction (search, retrieve, get deeper information, and buy) all on a single page.

Let's examine two different examples: Travel reservations and golf equipment.

The Broadmoor Hotel and BlueGreen Vacation Rentals

Making travel reservations on the Web has become a fairly common occurrence. But it is often frustrating. Frequently, users traverse through several pages of search and result screens, selecting hotels, dates and room types, then checking availability only to discover that there isn't room at the inn, or the unaffordable room rate isn't revealed until the very end, forcing the user to repeat the process again.

At the same time, the Web is the cheapest sales channel for hotels. Using a travel agent can cost a hotel 15%-30% of the revenue in commissions, and many large hotels and chains must pay to use a global distribution system (GDS) to electronically distribute their inventory. If the hotels can move more reservations to the Web they can save substantial money. But the catch is that they need to be assured that they are not going to move people to the Web only to have them unable to complete a reservation. If a better experience leads to more completed reservations and thus increased revenues, having a Web site that provides a better experience becomes an imperative for the hotels.

webvertising, a firm in Houston Texas, markets a suite of products and services for hotels, including OneScreen, an innovative, easy-to-use, single screen interface for on-line reservations. Over 800 independent hotels, hotel companies and destination marketing organizations now use webvertising's solutions to manage room inventory and electronic distribution over the Web. OneScreen allows over 200 hotels, like the Broadmoor, a Mobil 5-star luxury hotel, and time-share organizations, like Bluegreen Vacation Rentals, offer a better reservation experience to travelers that is leading to increased reservations and room nights booked.

Today most hotels use a traditional multi-step, multi-page reservation approach for online reservations. The challenge for the Broadmoor was to fundamentally change the user's reservation experience such that the simplicity, clarity and ease of use of the experience led to a more satisfied customer and increased bookings. Key to this was reducing the number of steps involved in making the registration.

Using Macromedia Flash MX, ColdFusion MX, Flash Remoting and FreeHand, webvertising created OneScreen. Unlike the traditional approach, users never change pages. webvertising collapsed the five step reservation process into a single interface. OneScreen presents hotel information in a three-section interactive screen (see Figure 3 below):

1. An interactive calendar that immediately displays room availability and rate information in response to user selection of arrival and departure dates as well as room type

2. A room information pane displaying room type and rate information along with a picture and description of the selected room type

3. A billing pane displaying a bill of the total cost of the stay, including taxes, and a credit card payment form that is filled out and submitted to complete the transaction

Users immediately see the effect of changing information in one section on the other two sections. For example, changing the room type will change the room rate displayed in the calendar. And users are immediately notified via a pop-up window of unavailable dates, changes in room rates, minimum stay requirements and missing information so that it can be easily rectified.

The impact of the OneScreen RIA on the hotels was stunning. Webvertising's hotel customers reported online reservations in general increasing 46% over the previous year, due to the natural growth in the use of the Web to make reservations. However, hotels that moved from an HTML interface to the OneScreen interface saw an additional increase of 89% in reservations. Furthermore while the average conversion rate (from visitor to buyer) for hotels using the HTML-only interface was 2.3%, it was almost double that with the Flash-based OneScreen. In one instance, the Greenbrier Hotel saw a dramatic 8-fold increase in conversions from 2.7% for their HTML interface to 22% when they used OneScreen. For most hotels, even a 1% increase can be worth hundreds of thousands of dollars a year.

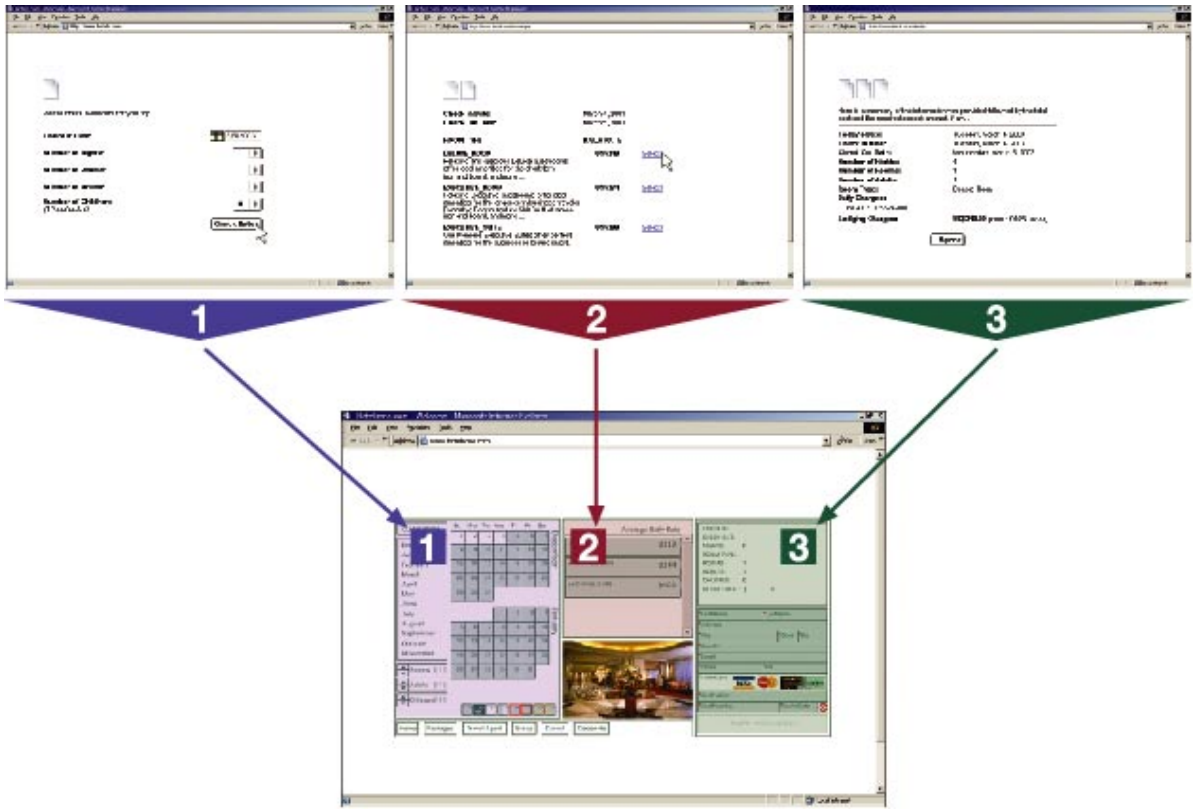
Bluegreen Vacation Rentals also reported substantial changes in their business due to the OneScreen RIA. Specifically, for a comparative period Bluegreen reported:

- A 20% increase in Number of Reservations
- A 50% increase in Revenue Booked
- A 66% increase in Room Nights

For Bluegreen, two important objectives were accomplished: by better presenting availability information, both the number of reservations were increased, as were the dollars per reservation. As this case study demonstrates for hotels, changing the user experience using a Rich Internet Application can result in substantive, business changing results.

FIGURE 3

Single Screen Interface



Source: webvertising, 2003

FootJoy

As one of the major brands in the Acushnet Company, FootJoy is the number one manufacturer and distributor of golf shoe and golf glove products in the world. They are estimated to own 55%-60% of each of those markets. Other products include socks, outerwear and accessories.

The company distinguishes itself in two ways: by the quality of its products and service, and by its reputation for innovation in golf shoe and glove technology. They pride themselves on their expertise and relationship with the consumer – not only for the best golf shoe, but also a great experience – whether you're speaking with a sales representative, a touring pro, a green grass pro, a person in the trade or someone in the local golf shop. They believe they have a very good feel for the consumer, his or her needs and how to serve them.

In order to retain their substantial market share, FootJoy working with Macromedia Alliance partner Mindseye decided to upgrade its Internet channel. The Web site was seen as a component of an overall marketing effort. Their previous site was

predominantly "brochure-ware". Visitors were limited to browsing an on-line catalog and getting tour updates and statistics.

They faced several challenges:

- Improve the usability of the site. They wanted to provide a two-way interactive experience with a look and feel better representing the brand. They wanted the ability to support the customer and better spotlight or merchandize information such as new products, news, etc.

- Enable the customer to develop a relationship with the company by mirroring on the site the kind of expertise and guidance the customer would get in person in a FootJoy store. Specifically they wanted to develop the Product Finder based on product knowledge captured from FootJoy experts, to allow visitors to quickly identify themselves and their needs, and to map these needs to an appropriate product.

- Put a strategic technology foundation in place, including content management, and ties into their legacy product system, that would serve as a base for future site development.

- Bring organization to the catalog content to allow them to update on-line catalogs more rapidly by themselves, without involving expensive and over-booked technical resources.

- Create a participatory site fostering community, by soliciting user feedback through on-line polls, and by providing information about products, golf courses, tips, expert interviews and weather reports.

Launched in summer 2002, the key area of this new site was the Product Finder, which was built with Macromedia Flash MX, and Dreamweaver MX, connecting to XML data sources.

The Product Finder uses a Macromedia Flash interface to present a series of questions that guide the visitor through a product selection process, similar to how an expert might engage the customer in the store. Product experts were interviewed to come up with the questions and selection rules. Content such as pictures of golf shoes or gloves and brief textual product descriptions are pulled from the content management system. Upon finding an appropriate product, customers can then view product details, add the product to their wish list or locate a dealer near to them. XML houses the bulk of the product information, which is all now managed in a content management system allowing FootJoy to more easily update the product content or change the formulas and criteria weights used in the recommendations.

Using Flash ActionScript allowed FootJoy to easily instrument the Product Finder to gather valuable visitor activity information in real time, such as the number of searches, the number of products displayed, who's examining the detail, and who is adding it to their wish list, etc. From this information, FootJoy is starting to perform trend analysis. Initially they have found that between 85% and 90% of customers who use the Product Finder complete their inquiry all the way through to examining the product details. Additionally they are starting to see fewer customer service calls

related to the Web site. They cannot yet tell if it is a direct result of the availability of the Product Finder, but the statistical trends are indicating that the Product Finder is quite popular.

Using the Macromedia products, FootJoy felt that it was able to build the kind of interactive, smooth, engaging application they envisioned and that made this foundational step a success.

In early September 2003, with help from Macromedia Alliance Partner Mindseye FootJoy subsequently launched myjoys.com, a Rich Internet Application to revolutionize the way Golf Shoes are purchased online.

The site is built as a full Macromedia Flash MX application connected via Flash Remoting and .Net services to a full content management system. Through the application, customers can access an elegant shoe creation interface that allows them to see exactly what their shoe will look like as they design and change it (MyJoys offers the user 2 base and 14 saddle colors option as well as the chance to personalize the shoe with up to 3 letters and/or numbers). Leather stocks are checked in real-time (from China), via Flash Remoting, notifying the customer if their leather selection is unavailable and emailing them when it is back in stock.

The application includes a fully integrated shopping cart and check-out process, including encryption (via Verisgn SSL), anti-fraud credit card checking and real-time address checking and tax calculation to ensure an accurate and secure check-out experience. The "My FootJoy" area allows users to save custom shoes to their wish list and track their orders. Customized shoe orders are sent directly to China where the shoes are manufactured and shipped to the customer within 3 weeks.

In addition FootJoy used Flash MX to develop a fully integrated Customer Service portal back-end connecting to AS400 fulfillment system. It allows agents to place custom shoe orders, track shipments and process returns.

FootJoy has exceeded usage expectations by over 200%. At an average of $150 per shoe order, this unexpected increase will have a substantial increase on revenue for FootJoy, and will see a substantial increase the ROI on the MyJoys application.

FootJoy's use of a Rich Internet Application is allowing them to revolutionize the way Golf Shoes are purchased online. This strategic approach directly engages and empowers the customer, promotes the brand and represents through a new channel, the kind of customer service, support and attention to customer needs that distinguishes FootJoy. It is evidence that Rich Internet Applications allow companies to develop the kinds of applications that better represent the kind of experiences they want their customers to have on the Web. These improvements in the customer's experience are beginning to bear fruit in the form of increased sales, revenues, savings and brand loyalty and provide a substantial competitive advantage.

RIA for Customer Applications

One common yet challenging type of customer application is a product configurator. These applications allow customers to configure custom products such as a computer, a candle or a car. It offers another opportunity for RIAs to have a dramatic business impact.

When configuring a custom product on the Web, users typically meet with one of two problems. Either they cannot see what the final version of the product they just designed looks like or they are only told late in the process that there are actually conflicts between two or more selected features, and they must go back and resolve these conflicts. Both are examples of configuration complexity.

In the first instance of configuration complexity, the inability to visualize the final product often deters buyers from completing the purchase, or leads to increased calls to the support call center. In the latter case, HTML interfaces suffer from the limitation of a paged-based model – they have to evaluate all the selections at the end, after all have been made, when the page is submitted, and then provide static feedback on the conflict (e.g. highlight it in red) on a new page. This leads to confusion, a poor user experience and frequently a lost sale as the user clicks off of the site in frustration.

Rich Internet Applications can remedy both of these situations leading to more people successfully completing the configuration online and not dropping off altogether or moving over to more expensive channels. The end result for the business is more highly qualified leads, increased sales, longer stays on sites, more frequent repeat visits and reduced support calls.

MINI USA

Consider MINI USA, one of the BMW Group brands. MINI was re-entering the US market after a 35-year absence. MINI USA had a three-fold challenge. They needed to create a new automotive segment (MINI is the smallest car on the American road), launch a new brand and introduce two models simultaneously. Considerations included: how to leverage the history and heritage of MINI and the MINI brand, how to talk about the BMW Group's state of the art engineering, how to differentiate MINI's motoring fun and exhilaration, and how to promote the brand's unique selling proposition of customization and personalization. MINI's goal was to bring the brand to life on-line.

Partnering with Macromedia Alliance Partner, Euro RSCG Worldwide, they faced the challenge of creating a highly interactive, fun, and exhilarating Web experience that thoroughly represented the MINI brand values yet departed from typical on-line car manufacturer sites. It had to resonate with the free-spirited, adventurous, self-expressive nature of MINI prospects and owners, allow them to easily design their own personal MINI, while at the same time be consistent with other off-line branding efforts and interactions with the customer. This included supporting a seamless user experience with the dealer network and dealer sites, providing a sustainable stream of highly qualified leads, and allowing users to send the car that they'd designed on-line to a dealer where it could be purchased.

They chose Macromedia Flash because, according to the site's developer "If there was a software version of the MINI, it's Flash. It's incredibly quick, let's you do things with a lot less money, and allows you to play with peoples' emotions using music, animation, tones, and the element of surprise. A significant component of the brand is its unique stylistic features. Flash allows you to bring that to life – bring superior design front and center to the users."

While the entire site clearly reflects the brand, the configurator is the heart. It is the embodiment of MINI. It allows people to customize their own personal MINI through a simple, non-linear five-step process that includes the ability to add aftersales MINI Motoring Accessories such as custom roof graphics and wheels. The navigation assures that everything is viewable on one page. Users can see the exact car that they are getting and can understand the price implications of their configuration choices at each step of the process. It's rules-based architecture assures that it only allows the ability to configure a vehicle that can actually be purchased, and allows MINI to easily maintain the rules, as the vehicle specifications change from model year to model year. When users have finished configuring a car they can give it a name, save it, calculate payments for it and easily send their configuration to a MINI dealer or a friend. MINI encourages them to configure and save as many customized MINIs as they like.

MINI is thrilled with the impact of the site on their business – it has fundamentally enhanced its business model. They substantially exceed their goal of 100,000 unqualified leads (registered users on the site) by ending 2002 with 152,000 registrants. Of those new registrants 73% actually configured a MINI. People were configuring an average of 1.48 MINIs each and sending them to friends, thereby expanding MINIs advertising dollars through word-of-mouth and viral marketing. With over 50% of the total leads generated by the MINI site, it was the largest generator of leads, when a year prior the site didn't exist. It generated, on average, 60 leads per dealer per month. Comparatively dealer sites generated 35% of the leads and walk-ins to the dealership generated the remaining 15%. But probably the two most telling statistic is that MINI exceeded its 2002 retail sales by 25%, from 20,000 units to 25,000 units, and by year end the site had generated 12,000 qualified leads against the year-end goal of selling 25,000 units! In August 2002 MINI launched an on-line owners environment called the MINI Owners' Lounge, and to date 15,000 out of 25,000 owners have registered. That is powerful brand marketing, enabled by a Rich Internet Application.

Yankee Candle Company

The Yankee Candle Company is another strong example of how a RIA-based configurator impacted a company. It is the leading designer, manufacturer, retailer and wholesaler of premium, scented candles in the U.S. with annual sales of $380 million in 2001. They sell directly through their stores, catalogs and on-line Web site, as well as through partners. They had strong growth plans, and wanted to create a better e-commerce environment than their current site offered.

They faced the challenge of increasing buyer confidence to improve sales of custom candles on-line. Customers buy custom candles for very important events such as weddings or corporate events, and they typically buy them in bulk. The problem was

that buyers had difficultly visualizing what the custom candle would look like once they had made all the selections. The initial version of the Web site's custom candle section used HTML pages and required that users check boxes to select the candle color and fill out a form with the text for the candle label message. Once selected, however, they could never see what this configuration actually looked like before being asked to buy the candle in bulk and on faith. It was no wonder then that people would abandon their shopping cart or call customer service for reassurance that the candle would look like what they imagined.

Yankee Candle felt that this section of the Web site was ineffective. This was corroborated by data indicating that the average purchase was smaller on-line than through other channels. This, perhaps, was also an indication that they were doing an inadequate job of up selling and cross selling on-line.

Technically the problem was that using HTML they couldn't represent what the final product would look like. Partnering with Molecular, a Macromedia Alliance Partner, they chose a Macromedia Flash-based user interface for the custom candle configurator for several reasons. First it allowed them to dynamically render a picture of the candle, based on the user's selections. It also allowed them to create a better Web customer experience that would behave consistently across platforms, a benefit of the broad reach and cross-platform support of the Macromedia Flash player. Second, they could develop the application more quickly and thus less expensively than with alternative technologies. This was due in part to the Macromedia development tools, which provided out-of-the-box user interface components such as drop down menu boxes, and because they were able to integrate the presentation layer into their existing backend system, which consisted of an Oracle product database and BroadVision eCommerce system.

While the majority of the site is HTML, the custom candle configurator is a single screen Flash-based interface that utilizes their existing e-commerce infrastructure. It pulls data and imagery from the product database and ecommerce system. As users select the label and fragrance and enter the label's text message, they immediately see a realistic picture of the custom candle as it will appear when complete. Users are encouraged to select optional finishing touches such as wrapping the candle in fabric or adding a ribbon or a flower, creating the opportunity for Yankee Candle to upsell the customer. The user can construct "what-if" scenarios at any point to see what it will look like and what it will cost for both the basic candle as well as the additional options.

The end result was that this real-time visualization of their custom candle gave consumers a higher level of confidence, and they bought more candles. Yankee Candle saw a 25% increase in both product revenue and average order size, exceeding their expectations. In addition, they had a 70% drop off in calls to their call center for the custom candle line, and they received multiple customer testimonials with positive feedback on the site. There was an additional surprising result: their own call center representatives started going to the Web site and using the configurator when fielding customer calls.

They do not believe that they could have developed the configurator any other way. If they had tried to create such a rich application in the same amount of time with

alternative technologies such as Java, they estimate that it would have increased the development time by 50% or more, and could have doubled the project cost. Dennis Shockro, Yankee Candle's Vice President of IT was quoted as saying "Now you can do everything but smell the candle."

These examples clearly illustrate how Rich Internet Applications can bring simplicity and visual clarity into traditionally complex configuration problems. In doing so they can have a material impact on a company's business. For its part, MINI has changed the game for automotive manufacturers and their Web sites. Their site distinguishes the brand, engages the customer before, during and after the sale, and advances the engagement with the customer to a totally new level, one that no other manufacturer can currently match. MINI enables their customers to use the Web to configure-to-order the car they will own. MINI's site illustrates just how far we've come from Ford's notable quote, "You can have any color Model-T you want, as long as it's black."

RIA for Enterprise Applications

The Internet has become the default development platform not just for inter-company and consumer facing applications but also for internal enterprise application development. RIAs are applicable within an enterprise for providing an integrated single screen view into legacy systems, business data visualization, e-learning and information portals, or in serving as a presentation layer to Web Services-based applications.

Data visualization is an area where Rich Internet Applications excel. They enable companies to create a whole new class of application to present and interact with data in dynamic, interactive and intuitive ways that lead to greater productivity and deeper understanding. They succeed where traditional Web-based interfaces simply cannot provide the interactivity or visualization capabilities required for complex data.

Charles Schwab

Charles Schwab's marketing planning calendar provides an excellent example of an application for cross-departmental data visualization.

The Charles Schwab Corporation is a leading provider of securities brokerage and related financial services, including retail, telephone and Internet-based brokerage operations. Schwab's marketing department needed to centralize the planning, tracking and analysis of all marketing initiatives and make the information visible and accessible to both executives and marketing project coordinators. They needed to build a highly complex enterprise reporting application.

They were faced with many challenges. They needed to:

- Address multiple types of users with different information needs and visualization requirements
- Present deep, multi-dimensional data sets (e.g., how much money was spent on which projects over what time) in an intuitive, logical and visual way

- Provide sophisticated yet easy-to-use reporting tools usable by both executives and project planners

- Deliver responsive and interactive tools that allowed the user to be in control

Working with Macromedia Alliance Partner Carbon Five, they chose Macromedia Flash to build a custom data visualization solution to be able to dynamically communicate to different constituents. The sophistication of the data visualization required a wholly new approach and exceeded what was realistic using HTML or any out-of-the-box or web-based calendaring tools. They wanted, for example, a drill-down Gantt chart in which they could see the spending details of a particular project. It was not possible to do that in HTML.

To meet two different and distinct user needs they developed two views: timeline and analysis.

The timeline view presents information in the form of a dynamic Gantt-style calendar and is targeted at project coordinators. Using this view, project managers could quickly and easily visualize the overall time-based status of multiple projects. Drill down capabilities allowed the project manager to click to see individual project details within a program, such as budget data, or to manipulate projects, such as plan advertising for a different media channel. The tool gave them a framework to visualize and manipulate the detailed marketing planning information.

The analysis view presented an aggregated holistic view that allows Schwab marketing executives to answer bigger questions, like "How am I spending money in the first quarter?" With this dynamic visual tool, Schwab executives could rapidly analyze marketing expenses across initiatives and time, and realize a more efficient use of the marketing budget. They could change the selected characteristics to pose different questions and get a different view on the data. Using this tool they could slice and dice and then visualize the information in useful ways that were not possible before.

The Schwab executives were very excited with the analysis view tool. As a result they wanted increased reporting capabilities added to the tool. Project planners were also excited about the tool's detailed project view. Schwab has recently committed to develop an enhanced version that will streamline the data entry and provide additional reporting capabilities.

FleeTBoston Financial

FleetBoston Financial is the seventh largest financial holding company in the US with $190 billion in assets and is the largest retail bank in New England. Their Internet Strategy group is chartered with evaluating new technologies for use in the company's core business-critical applications.

The group was considering what to do with some existing legacy Windows client applications running in their back offices. Macromedia Alliance Partner Molecular brought RIAs to their attention as a potential technology that would allow them to take advantage of the Internet and the browser, but still develop a more functional, low

bandwidth client. Fleet chose to prototype a portion of their internal CrossSell platform as a RIA.

The CrossSell application provides customer and product information to customer service representatives in the more than 1500 branch offices. Built over the last 15 years by numerous developers, CrossSell connects back-end mainframe information and applications to the branch offices. Due to its development history, today it takes months to regression test a single new or changed business rule that would add a new financial product, promotion or information capability, such as the ability to add a credit card to an account or add the user's email as a contact point.

The challenge was to create a prototype platform in two months that would allow a business manager to quickly develop and change, and centrally deploy new financial products, promotions and conditions. The prototype needed to connect to the mainframe on the backend, and be able to work with narrow 58K network to the branch offices. As part of the effort, they worked with the product group to prototype a visual rule construction tool that would allow a line of business manager to create rules himself without the need to go to the IT department.

The Internet Strategy Group was impressed with the final prototype, more so than they expected to be. They had not originally thought that Macromedia Flash could be used for building enterprise class RIAs. However by the project's conclusion, they were more convinced that it could be an applicable technology to build these kinds of banking applications. They plan to include the technology in consideration for future applications of this type.

Embedded RIA Modules

Rich Internet Applications need not be full blown applications. A RIA can also be used in a hybrid application consisting of a Macromedia Flash module embedded into an existing HTML page of a site or application. These components can be used to perform a very specific, often highly repetitive function, such as providing a stock quote, taking a quick user poll, or providing simplified site navigation. This use allows data to be quickly gathered and more importantly returned to the page and presented with out the need for a full-page refresh. Since fewer pages are sent from the server, it can result in significant bandwidth savings and cost reductions for high traffic sites. This use also illustrates a simple way to ease into the use of RIAs to perform small, well-defined tasks. In creating a hybrid application, embedded RIA modules can allow users extract more value out of an existing site.

E*Trade and FootJoy provide two excellent examples of RIAs used as embedded modules in hybrid applications.

*E*Trade Quote Module*

E*Trade provides online financial services, including value-added investing, banking, research and educational tools. It also offers automated order placement and execution, portfolio tracking and other services. Every day the company delivers millions of real-time quotes to their investment customers on their Web site. They wanted to find a way to deliver them as quickly as possible for the customer and as

efficiently as possible for E*Trade. This included making the user experience of them more dynamic, having quotes appear in a common form ubiquitously around the site, and eliminating the use of HTML to reduce the number of full-page refreshes for every individual quote.

They used Macromedia Flash MX to develop a quote module. The quote module appears on and is embedded in every page in the investing section of the site. It accepts user entry of multiple kinds of security symbols (e.g., a stock, option, or mutual fund), figures out which it is and delivers the appropriate data in real time back through the module. With one click a user can initiate a trade of that security.

The quote module eliminated the need to do a full-page refresh every time a user searched for a new quote. It also reduced server-side processing and enhanced site performance. They improved the user experience, and lowered costs by reducing the amount of pages delivered and the bandwidth used on the site.

As a platform-independent, low-bandwidth solution, Macromedia Flash technology was chosen not only for improved performance, but also to potentially provide better platform and browser compatibility for E*TRADE Financial's 12 branded country sites. They were able to develop the same component once, for multiple browsers and multiple platforms without additional development or quality assurance efforts.

FootJoy Poll Module

FootJoy wanted to use its Web site as a way to engage its customers in interactive, two-way communications. While the Product Finder described earlier provided guidance to customers in selecting the right product, the company wanted to engage its visitors and tap their experience to help guide them with product direction.

Working with Macromedia Alliance partner Mindseye, as an experiment they developed an interactive polling module to solicit direct and immediate feedback from site visitors on a range of product-related questions. The poll asks a different question each time the pages on which it appears is visited and is smart enough not to double count an answer if a question is repeated. The cumulative results of the poll in both percentage and actual number of votes for each response are immediately presented as a bar graph to the user, without a page refresh.

The feedback is used to guide the direction of new products and product marketing. According to FootJoy's Interactive Marketing Manager, "With this module, burning questions of the day can be relayed out to footjoy.com in a matter of minutes, allowing us to have access to core users faster than ever before. Feedback that would have taken months to trickle in, now takes days." With the module:

- FootJoy receives free, instant product marketing feedback.
- Pages are used more deeply – the same page asks a different question each time it is hit.
- Users are engaged and can provide their input.
- The user experience is fast and continuous – no page refreshes are required

They also have the potential to save bandwidth costs. So to illustrate, the page is roughly 100k. Subtracting out images, which will be cached on a page refresh, leaves 24k of text in the HTML. That means that for every page containing the polling component the savings is 24k.

On a larger page or a high traffic site, such a highly used module could lead to substantial bandwidth savings. For example, on a hypothetical high traffic site such as a brokerage or portal with text heavy pages, the savings per page could well be over 50k. So in such an example, if the site receives a conservative amount of traffic of say 1 million views in a day, that 50k or more of savings, could well result in an aggregated savings of 50 gigabytes in bandwidth usage per day or more than 1 terabyte per month.

CASE STUDIES SUMMARY

The case studies presented in these four different areas of use give a sample of the range and kind of business benefits afforded by Rich Internet Applications. They show how RIAs have the ability to handle various kinds of complexities and in doing so, enable wholly new kinds of Web applications. While some results are visibly more dramatic or compelling, taken as a whole they begin to paint an alternative picture of how Web applications can be, and how they can in many instances, fundamentally change a company's business or the nature of the game with their competitors.

In ebusiness applications, RIAs allowed hotels to dramatically increase their reservations, revenues and room nights booked by simplifying the workflow complexity of making a reservation. Using a phased approached, FootJoy was able to initially create the necessary foundation for communicating with their customers – by guiding them to select the right golf products, as they would if they were in the store with a pro – and then fundamentally revolutionize how customers purchased shoes.

RIAs transformed configuration applications, especially when they required enhanced visualization. For both MINI USA and The Yankee Candle Company, the ability of a Rich Internet Application to let buyers purchase products off a single screen and see the product that was the result of their selections transformed the user experience. For MINI it led to brand loyalty throughout the lifetime of the car, thousands of qualified leads, increased auto sales and a very happy community of MINI owners. For Yankee Candle, it substantially reduced support calls and substantially increased order size and revenues for custom candles.

Schwab demonstrated that RIAs could have a strong impact on internal corporate applications, by facilitating data visualization and reporting across different groups of users. And Fleet found RIAs to be a serious technology for developing major enterprise applications and potentially serving as a presentation layer to Web Services applications.

Using RIA modules embedded in a Web site, both E*Trade and FootJoy were able to better serve their customers by quickly providing information and cut costs by reducing bandwidth once required for page reloads. E*Trade was able to provide a more efficient and effective means for providing millions of quotes per day, quickly and elegantly while using the same existing infrastructure.

In all these cases, the RIA had a substantial impact on the business, and in some cases, such as MINI and FootJoy it changed their business.

FUTURE DIRECTIONS FOR RICH INTERNET APPLICATIONS

These case studies offer a glimpse of what is possible with rich Internet applications. But this is just the beginning. One of the key trends taking place in the Global 2000 is an urgency to integrate disparate systems and software tools to reduce costs, increase developer productivity, reduce the need for manual processing and intervention in transactions, and decrease time to market. To achieve all these objectives organizations have increased the adoption of standards-based systems combined with a migration to Web services and Service Oriented Architectures. This requires the creation of a consistent and more intuitive interface to applications, data and services. The immediate goal of these efforts is to provide easier, quicker, and more efficient access and processing of data and information. Longer-term aspirations are to offer customers application interfaces that are more personalized and customized to each individual's specific requests and requirements.

Small, highly skilled teams developed many of the RIAs in these case studies. This speaks not only to the power of the first generation of RIA tools, but, perhaps, also to the expertise required to achieve results without the enhancements now appearing in the new generation of RIA tools. It is clear that RIAs offer the potential to fundamentally change the user experience and in doing so, yield significant business benefits. However, in order for RIAs to be widely employed, and for more companies to receive these kinds of returns, technologies to build RIAs will need to appeal to a wider range of developers. The ability to cost effectively create rich, engaging user experiences that support corporate objectives and reach a broader developer audience without sacrificing development productivity will require a new generation of RIA tools.

To meet the needs of IT organizations these tools will have to allow them to continue to work they way that they already do and not force them to rip out and replace legacy technology. These new RIA tools will need to provide the features that enhance IT developer’s abilities to be more creative and to accomplish RIA development with the same or less effort than the tools they use to create other types of applications. What is required are the tools that can help developers in Global 2000 companies achieve these objectives without encountering the difficulties of trying to write RIAs using just 3GL code, relying on only HTML or other scripting languages, or having to learn a completely new development approach.

In summary the new generation of RIA tools must do the following:

- Allow developers to write applications using familiar development models to utilize and extend their current skills without requiring them to adopt entirely new or different skills
- Use standard and standards-based technologies
- Use industry specific programming models and patterns

- Use and/or leverage the existing IT infrastructure through wrap and reuse rather than rip and replace
- Provide pervasive, familiar programming models and an expressive user interface across platforms and devices
- Allow developers to create a solution that delivers scalable, secure, high performance solutions that are bandwidth efficient

IDC believes there are two vendors who have the technology and ability to fully deliver on the promise of rich Internet applications, Macromedia and Microsoft. With Microsoft's Longhorn, Avalon and XAML, developing rich applications to run on Microsoft operating systems will come to fruition, but not until 2006 when these technologies become available. The full promise of Longhorn will only be realized in 2008, when end users have purchased the required hardware to run Longhorn applications on Windows. In turn, Macromedia is delivering technology for rich Internet applications now and in the first half of 2004 that leverages the ubiquity and cross platform and device support of the Flash player, and works with the hardware and infrastructure that already exists.

RIA DEVELOPMENT PROFILES

The case studies indicated that developing a RIA leverages the skill sets and expertise of the development team as well as the unique characteristics and needs of the organization. As adoption of RIAs continue, in order to achieve the kinds of business benefits identified in this paper, while building more effective and dynamic applications, organizations will be required to utilize development teams and technologies that meet all the above requirements.

From these case studies and additional IDC research, IDC has identified two RIA profiles. These profiles correspond to the kind of rich Internet application and the scale of development.

TABLE 2

Rich Internet Application Development Profiles

Profile	General Characteristics	Scale	Development Skills	Applicability
Visual / Rapid Application Development (RAD) Developer	• Visual development • Rapid application development • Smaller team	• 1-5 developers • 3-6 months • Small or mid-size company or departmental app in a larger company	• PowerBuilder • Delphi • VisualStudio / Visual Basic	• Internet • DB reporting • Business Process Automation • E-commerce • Self Service

TABLE 2

Rich Internet Application Development Profiles

Profile	General Characteristics	Scale	Development Skills	Applicability
Enterprise Developer	• Server side coding • Longer time frame • Larger team • Security and standards are critical • High availability and performance is critical • Transactional based applications	• 5-20+ developers • 6-18 month timeframe • Mission critical or strategic projects in Global 2000 or midsize to large company	• Standards-based development with either J2EE or .NET • JDeveloper • JBuilder • WebSphere Studio	• Business Intelligence • Retail • E-Commerce • DB access and preprocessing • ERP / CRM • Intranets • Extranets • Internet • SOA

Source: IDC, 2003

Two specific examples of products that address the unique needs of the different RIA profiles in creating RIAs and achieving new corporate development goals are described as follows.

Visual/RaD Developer Approaches

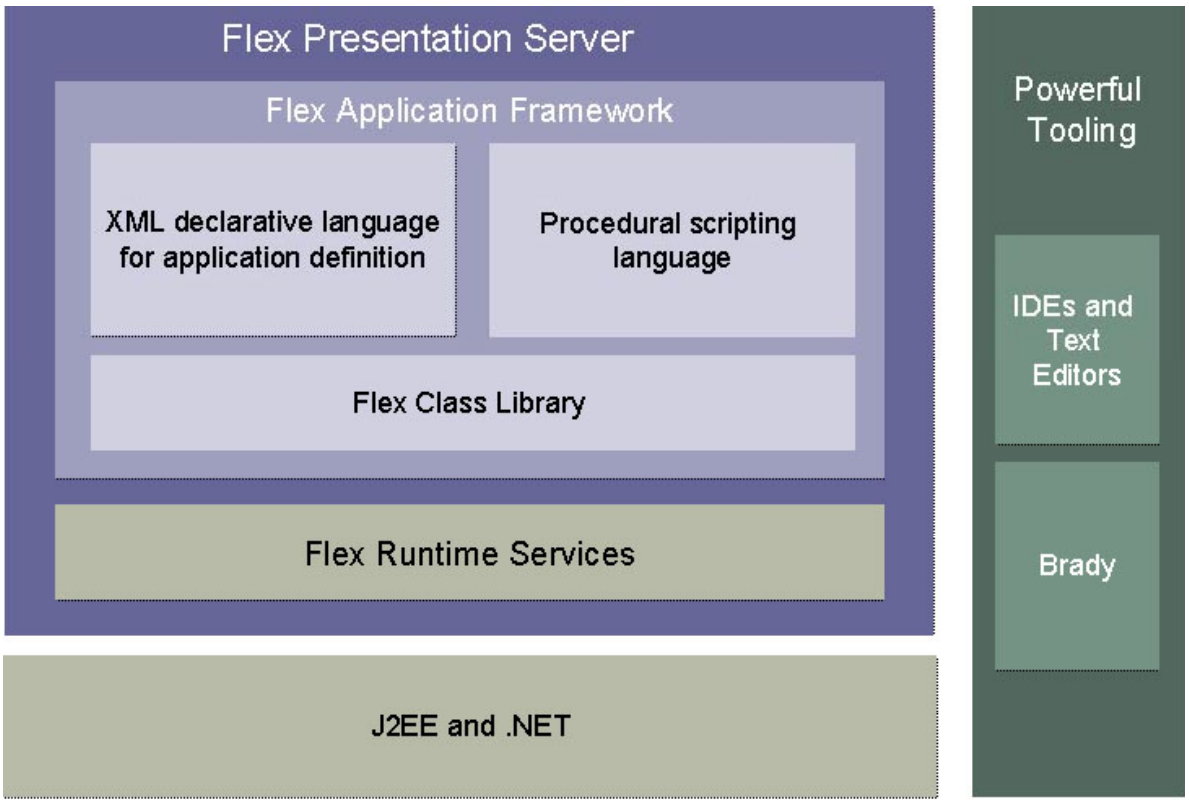
Developers who fit the Visual/RAD developer profile tend to work in a highly visual manner, and the projects they work on normally involve small to medium sized teams on projects with shorter timeframes. These projects usually address database reporting, business process automation, e-commerce and self-service. One tool that should be considered by Visual/RAD developers is Flash MX Professional 2004.

Enterprise Developer using Macromedia Flex

One new technology designed to address the needs of enterprise developers is Macromedia Flex (previously code-named Royale). Flex provides a standards-based, middle tier presentation server specifically designed for construction of server based Rich Internet Applications. Macromedia has developed Flex with the goal of improving the user experience of creating rich, dynamic, Internet applications and to help developers accomplish more with fewer resources.

FIGURE 4

Macromedia Flex Presentation Tier



Source: Macromedia, 2003

The Flex Presentation Server is logically divided into the client-side Application Framework and the server-side run-time services. Flex delivers highly interactive, XML-based graphical user interfaces to extend the power of Flash and Flash-based browsers, while providing an execution and deployment environment that manages backend connectivity, data mapping, caching services and remote service invocations. Flex utilizes an existing application server or can install its own server if one does not exist. The application uses SOAP for communications back to the server.

Flex also provides a development model that will be familiar to JSP, ASP, XSLT developers. Using MXML – the codename for a XML declarative programming language for creating and defining rich user experiences that is currently being proposed as a new XML standard – and ActionScript, a programming language for procedural programming, Flex allows traditional developers to utilize their existing XML and scripting skills to develop new rich Internet applications. Flex applications may be developed using any editor or Interactive Development Environment (IDE) and will be constructed as a number of files that contain MXML and ActionScript code. The MXML document is deployed into the application server, and when it is invoked the application is compiled into executable SWF (if necessary.) Flex comes

with a class library consisting of components such as containers, controls, etc. and managers, which are services that are commonly used and simplify the creation of rich applications.

Lastly, Flex applications can be built using leading IDEs or text editors. Flex delivers an XML schema, so developers can use their current IDE of choice, and work in a familiar environment. With Flex developers don't have to learn a new tool to be productive. Macromedia is also working on extending Dreamweaver MX 2004 functionality to handle Flex code editing and visual layout, with a project code-named Brady.

BUSINESS BENEFITS OF NEW TECHNOLOGIES

As the web becomes the preferred delivery mechanism for dynamic data driven applications and content management systems, there is a growing demand for more dynamic and rich content as a more effective means of branding, attracting and retaining customers, as well as providing a more effective way to present and process complex visual information.

RIAs offer the potential to fundamentally change the user experience and as a result increase customer retention and improve customer loyalty. As the RIA development and delivery technologies improve over time, the ability to personalize and customize applications so that each user experience is unique and tailored to individual user needs will become more easily achievable. The new breed of RIA development tools aim at delivering this level of business benefit.

For example, Macromedia Flash MX 2004 enables Visual/RAD teams to work in a familiar forms based environment and thus incur minimal ramp up and training costs in the development of more personalized rich Internet applications that generate significant ROI.

Macromedia Flex is designed to allow enterprise developers and IT professionals a comprehensive platform that doesn't require wholesale technology and skill change, but instead allow developers to utilize their existing XML and scripting talents to create enterprise scale RIAs, that can change the competitive landscape or visualize information that was previously difficult to present interactively.

In general, RIAs are well suited to many types of applications, as shown in Figure 2 earlier. And as this paper has illustrated, the ROI from RIAs is clear. Moving forward, there are a number of areas where IDC believes that the return on investment from rich Internet applications will be particularly high. Table 3 outlines the characteristics of those areas. Each grouping can be looked at independently. For developers working on a project or in an industry that encompasses one or more characteristics in Table 3, IDC believes that a rich client approach may yield the best results.

TABLE 3

Characteristics of Rich Internet Applications that deliver Highest ROI

Application Challenges	Multi-step processes Direct manipulation Complex selection Client-side processing Data visualization
Application Types	Product selection and configuration Customer self-service Business intelligence
Verticals	Financial services Retail/ e-commerce Broadband portals

Source: IDC, 2003

These new RIA tools will give companies a significant way to develop applications, using the same development approaches that improve sales or provide better, more effective customer service, customer support, and marketing. They will allow organizations to display data, information, or products in more meaningful and engaging ways with the end result of helping organizations gain a distinct competitive advantage.

IDC expects that these new technologies will have some significant benefits helping businesses create and deliver these types of applications, to remain competitive while reducing development costs and development time. These new technologies are the first in a wave of products that are created to simplify the deployment, management and development effort of creating RIAs without having to rip out legacy technology investments to achieve significant business objectives.

NEXT STEPS AND RECOMMENDATIONS

IDC has the following suggestions and recommendations for organizations looking at developing Rich Internet Applications.

Macromedia has shown that Rich Internet Applications can have a significant and at times transformative impact on a company's business. IT managers and on-line business owners should:

- Consider starting an RIA project that brings the company's Web presence more in line with business goals
- Consider adding RIA components to existing sites and applications to reduce costs and become familiar with the technologies
- Consider RIAs for the next stage of the Internet – to support mobility initiatives with online and offline capabilities, to support device-based applications, and as a front end for Web Services
- Leverage their existing IT and Internet investments and get more out of them by adding an RIA presentation layer

CHALLENGES/OPPORTUNITIES

Macromedia has the opportunity to be a catalyst for a significant sea-change in the way in which customers, partners and employees experience Internet, extranet and intranet applications. This small sample of companies illustrates some of the business benefits and success available to companies that make the investment and come on board now.

The challenge for Macromedia is to make the development of RIA increasingly accessible to a broader range of developers, and at the same time to continue to demonstrate the business value of a Macromedia technology investment. The new Macromedia Flex product has the potential to address both these challenges, in particular to expand RIA development to a much larger and more traditional developer population.

The impending crossover to Web services will give companies an opportunity to re-evaluate some applications and the user experience available for accessing information from multiple data sources. Data visualization technologies and technologies which help users to integrate structured and unstructured (e.g., image, audio, video, and text) information into compelling, understandable, and innovative user experiences will have an advantage.

SUMMARY AND CONCLUSION

Rich Internet Applications offer the potential for a fundamental shift in the experience of Internet applications. But there is no need for companies to wait to see if the technology takes hold. As shown in this report, companies are already realizing dramatic benefits from and return on an investment in the use of RIA applications with their customers and within their enterprises. Macromedia continues to provide innovative technologies and development tools that go beyond flash and sizzle to enable the development of meaty, breakthrough applications.

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