THE INITIAL SOFTWARE DEVELOPMENT PROCESS AT AN INTERNET START-UP COMPANY: A STUDY OF TEAM COMMUNICATION, PRODUCT DEFINITION, AND THE RESULTING DESIGN DECISIONS

by
Ann Duffy

A Master's paper submitted to the faculty of the School of Information and Library Science of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Master of Science in Information Science

Chapel Hill, North Carolina
December, 1999

Approved by:

_____
Advisor

Ann Duffy. The Initial Software Development Process at an Internet Start-Up Company: A Study of Team Communication, Product Definition and Design Decisions. A Master's Paper for the M.S. in I.S. degree. December, 1999. 61 pages. Advisor: Stephanie Haas

This paper is a study of a software development process at an Internet start-up company that offers an information product delivered over the World Wide Web. This product gives specific information about customer usage patterns and activity on the Internet to Internet Service Providers, e-merchants, and advertising agencies. An analysis of the product development process,

which includes defining and then building this application, is the central issue of this discussion. Questions are explored that relate to communication and workflow within a development team, as well as questions relating to design decisions specific to a Web-based implementation environment. The paper is written from the perspective of the web developer.

Headings:

Computer Software - Development

Software Engineering

Organizational Communication

Teamwork in Industry

Table of Contents

Abstract……2

Table of Contents……...3

Introduction……..4

Purpose of Study……5

Literature Review……7

Software Development Process……..11

Communications Section……11

Product Section……20

Product Implementation Environment……33

Discussion and Conclusion……...44

References……45

Appendix A..…… ……47

Appendix B..……...48

Appendix C……..…… ……49

Appendix D……..…… ……50

Appendix E…… ……..……51

Appendix F…… ……... 58

Appendix G..…… . ……59

Appendix H..……..60

I. Introduction

This paper is a study of a software development process at an Internet start-up company in Research Triangle Park, NC, which will be referred to as Internet Data Views (IDV) for the purposes of this paper. IDV collects Internet data by installing patented software on Internet Service Providers' networks at their point of presence (POP). The data is anonymized, meaning it is stripped of individual user identifying information and replaced with a session ID so the anonymous user can be tracked during a session, the period of time between logging on to and logging off of the Internet. (IDV has a proponent in Christine Varney, who chairs the Online Privacy Alliance, an industry consortium that acts as a watchdog for consumers regarding matters of privacy and the Internet.) IDV shows customer usage patterns in the aggregate for a particular ISP service area. The company has also begun to introduce its data to the e-merchant and advertising agency markets by providing these industries with the means to better understand consumer behavior on the Internet. Consequently, this paper will be discussed with the awareness that the need for scalability will figure prominently into all aspects of product development. What has been developed to date for ISP customers will be used as the precedent for future product sites aimed at other types of customers.

The data IDV provides its customers is its product. The implementation environment for this product is the Internet. As such, IDV is concentrating much of its product development efforts on translating the raw data from databases into statistically relevant and visually clear graphical representations in a format for the Web. This process involves database administrators and developers, statisticians, web developers, Java programmers, GIS (graphical information systems) developers, a systems engineer, a project manager, a product manager, and other technical staff, including system administrators. The development of this product has gone through three main prototype iterations, and the development team continues to move toward a final web-based product for customers. The release date for the beta version of the web-based ISP product is December 15, 1999.

II. Purpose of Study

The purpose of this paper is to isolate issues involved in the product development process at IDV. After being involved in and observing this process, it has become clear to the writer that an analysis of it is necessary to understand where improvements can be made to the system. An especially important area for better understanding the system's performance and effectiveness is team communication and interpersonal networking. To what degree is there a symbiotic relationship between team communication and design implementation? To what degree are employee interactions and network

building aiding the process of translating conceptual definitions into implemented design choices? Where are the disconnects between dialogue and completed design? Once the design process is underway and the product has been defined, how well does the team continue to communicate about alterations to the original plan? What suggestions for improvement can be offered in analyzing the development process at IDV?

By analyzing IDV's software development team and process, the writer will offer her experiences to others who are responsible for or feel the necessity of establishing software development standards for newly formed development projects. With the rise of the e-market and of e-commerce, the economy often requires that companies operate at an accelerated pace than what they may be used to or used to seeing in other companies. The threat of competition in this environment is an ever-present reminder to the small start-up that development cycles must be rapid. A solid product and presence on the Internet, among other things, is vital to its success. The questions explored in this paper are questions that any software company faces in the new Internet-based competitive market.

The environment at IDV affords the writer the opportunity to study a software development process from the ground up and with rapid prototyping as the chosen development style. The company is growing quickly, both in the area of new staff hires and in the area of ISP contractual agreements. The experience presented in this paper reflects the changes that have occurred over the course

of six months (June – November, 1999), during which time the number of employees has grown from 12 to 50.

The development process will be studied from two separate but related viewpoints. The first will focus on the team-based system that produces the product, both in terms of information flow and workflow. The second will be concerned with the Web environment in which the product will be implemented and how best to represent the product in this environment. Having a Web-based product, IDV must consider issues relating to usability and navigation, among other things, as the product is prepared for the Internet. As suggested, there are some persistent themes that remain relevant throughout this paper. One such issue is concerned with the evolution of informal communication and design processes into a system of structured and documented development procedures. Tied to this larger idea is the relationship between communication flow and design processes. There is an ongoing challenge for the development team to translate information exchange, whether formal or informal, into specific design decisions. The first part of this paper is an analysis of the communication dynamics, the second focuses on product implementation. However, the broader theme, which relates to the integration of the two, is of primary importance throughout the paper.

III. Literature Review

Literature from a range of subject areas informs the analysis of IDV's software development process. A discussion about the importance and complexities of communication and network building within software development teams opens the paper. In Communicating in Organizations: A Cultural Approach, Pepper describes communication at the workplace as a cultural event. Taking a sociological viewpoint, he stresses the need for team members to find shared meanings, semantics, and terminology in order to reach consensus about sometimes vague or confusing concepts (1995, p. 19). Albrecht and Bach focus specifically on development teams and elements that contribute to a strong team structure. In their book, Communication in Complex Organizations, they focus on ways of managing and monitoring the work and information flow within teams (1997, p.3, 123, 156). They also, like Pepper, stress the importance of shared meanings. They argue that the evolution of a "symbol-referent system", or a documented body of common terminology relating to common tasks, encourages cooperative teamwork and greater productivity (p. 156). The environment is the most productive when the information flow is in sync with the workflow.

A substantial amount of work has been concentrated on defining the ISP product at IDV. This involves frequent conversations with customers, collection of their feedback, and analysis of the gathered data. Holtzblatt and Beyer offer insights into effective ways of handling data collection and analysis. They stress that is takes a special skill to truly get at the meaning behind customer

responses. It is also essential, they argue, to visit the customer's workplace to better understand the unique values, problems, and standards that affect what the customer will expect to see in their customized product. The data should be collected, developed into a customer profile, and then analyzed by a small group (1998, p. 6).

However, in today's economy companies do not always operate along traditional lines. Especially within the e-marketplace, there may be no physical space to visit. This will often be the case with telecommuting companies and other organizations whose workforce is dispersed and which lack a central office. In these situations, the product manager may meet with one or more employees from the company wherever convenient. Additionally, due to keen competition and the changing nature of the Internet, this "in person" relationship is often not possible. Conference calls and email messages become the sole communication channels for data collection. This reality is further evidence for the need to ask direct, pointed, probing questions during the data collection process.

After the collected data has been analyzed, a product definition is generated, which often involves an iterative process, as is the case at IDV. A product is defined, although continual refinements are made to that definition during the product development process. The project manager at IDV is responsible for monitoring product development, ensuring that it is aligned with the product definition throughout the development cycle. According to Conger (1994), project management also involves mapping out the task and staffing

requirements. In The New Software Engineering, she discusses the importance of developing a scheme for teamwork flow. One specific way of targeting time and staffing requirements is to develop a task dependency diagram. This schematic shows relationships between tasks, and those that are independent of other processes. She situates her discussion on project management within the context of a rapid prototyping environment (1994, p. 60). West and Norris (1997) focus on task management but within the particular context of web development. In Media Engineering: A Guide to Developing Information Products, they offer specific strategies the web developer can adopt as she translates the information product into a format for the Web. They also give suggestions for good website management, including methods for handling volumes of files that must move from server to server on a regular basis (p. 139).

The rest of the literature cited in this paper centers around the implementation environment for the product. Usability testing plays a central role during the development of a Web-based product. Nielsen offers some usability principles that, he argues, are the most important to attend to while creating a site. He has conducted numerous usability studies and posts weekly columns on the Web. Some of his usability suggestions include the use of keywords, meaningful subheadings, bulleted lists, and single idea paragraphs instead of the more traditional printed format for text. He argues that many of his respondents have indicated that they have less patience scanning a web page than if they were reading a printed document, and that relevant information should be easy to

find. He also cautions against the use of too many graphics because of download time, but also because overuse of graphics can make a site seem cluttered and difficult to sort through (1994, pgs. 1-15).

Rosenfeld and Morville are information architects who also publish extensively on the Internet. They address issues related to good website construction and management. They emphasize the need for a site blueprint during the planning stage (1998, p. 53). They distinguish between global and local navigational schemes, both essential to a usable website as together they facilitate both vertical and lateral movement through the site. They stress the need to test for usability on multiple platforms, since the Web is accessible from numerous browsers, each of which has numerous versions (1998, p. 53). Shiple also publishes information architecture literature on the Internet. He suggests breaking your site design into parts based on pages that perform a function or transaction, pages that are generated dynamically, and pages merely comprised of static text. By breaking them into categories, like tasks can be performed all at once in an efficient manner (1998, Lesson 3 pgs. 1-3).

Burger and Jackson (1997) add to the body of literature on website usability. In the article, "Usability techniques for large-scale websites", they suggest the use of simple and natural dialogue to minimize user memory load (p. 571). Among other suggestions, they also stress the need for user feedback, clearly marked exits, and built in shortcuts and error messages (p. 571). Caro poses the idea of "chunking." She is referring to the use of hidden but known

submenus that decrease the toll on user memory and reduce the need for valuable screen space, so often an issue during the design of a webpage (1997, p. 573).

Morris places a special emphasis on <HTML> frames in the article "Navbars, Frames, Site Maps" (1999, pgs. 1-5). He is mainly opposed to their use, the reasons for which do not strike the author of this paper as being as problematic as he contends, especially after having worked with frames extensively for the past six months.

Finally, Pilgrim's asserts in the article, "Enhancing WWW Navigation, that scroll bars often add difficulty to the user's navigational experience. He sites the results of an empirical study that suggests that users perform suboptimally on tasks that require frequent scrolling (1997, p. 644).

The writer considered the above usability topics while designing the IDV product site and much commentary on her experiences during the development process is integrated into this paper. Additionally, the guidance offered in the literature has provided the starting point for many useful conversations within the development team. Conversations dealing with navigational elements, browser compatibility, and the use of frames, among other topics, have often grown out of reading an article or scanning a site for relevant information. This paper shows the link between effective communication and a well designed Web product. It would be impossible to design a useful product based on Nielsen's usability principles if ongoing dialogue were not possible using a common syntax, as

suggested by Pepper and others. It would also create barriers when planning the product site based on Morville and Rosenfeld's website planning suggestions if the web developer was not able to talk with the systems engineer and project manager about large scale considerations, such as server resources and website content approval.

Pepper and Albrecht & Bach both stress the need for shared meanings. At IDV, in particular, the writer has noted the need for a common terminology to discuss developing concepts. Because IDV's product is undergoing many changes and refinements, new ideas are often generated. So the need to establish new labels arises continually. This literatures helps support the argument that a common terminology is fundamental to precise communication.

Conger and West & Norris focus on management aspects of application design and development. Whereas Conger is concerned with the larger processes involved in project management for a software development process, West and Norris concentrate more specifically on the management of the web development process. Both are concerned with the implementation of standards and procedures to streamline design and development. Their viewpoints share an emphasis on the management of operations. These suggestions are relevant to a young start-up that is striving to establish documented procedures for software development.

There are many similarities among the authors cited to support website usability and navigation. Several deal specifically with different elements that

can be built into a website. Pilgrim discusses the cons of scroll bars, while Morris cautions against the use of frames. Other authors deal with the larger issues involved in the development of a website, which will be the end result of IDV product development. Rosenfeld and Morville write about information architecture and the need for thorough planning before website construction begins. One of their many suggestions is the development of a site blueprint, which helps the web developer get an overall sense of the planned site . With a completed blueprint, decisions related to more specific facets of the site will be easier to make when the time comes. that the processes of communication and development are integrally related during the development of a Web-based application. Along with Nielsen, Caro, and Burger and Jackson, Rosenfeld and Morville emphasize important usability considerations and principles to bear in mind as the site is being designed. Nielsen, in particular, lays out specific principles based on numerous usability tests. There are countless issues to bear in mind during site development. These authors' suggestions help the web developer identify problems that the end user might have when navigating through the site. Since IDV's product is Web-based, the contributions of these authors can serve as guidelines during the development of the end product.

The next section moves into a discussion about information flow and the communication dynamics that help or hinder the development process. It has become quite clear to some at IDV that it is not a simple task to establish

effective communication patterns and habits among the product development staff.

III. Software Development Process

A. Communications Section

Communication and interpersonal networking are inherent to the success of a software development process. Numerous people are working on different pieces of the same product and communication is necessary to integrate these pieces. Networking facilitates the creation of shared meanings for developing concepts. Once shared meanings are established, there is the possibility of a team-wide workflow, where group members operate in tandem on parallel development efforts (Pepper, 1995, p. 19). Although this is an ideal situation, perhaps difficult to achieve, common ways of describing new ideas is fundamental to successful communications. For example, "interface" at IDV has come to mean all development efforts concerning the Web-based product. This may be a bit misleading to a newcomer, who may think of an interface as a shell that holds something else. However, once an employee understands the intent of others when using "interface", he/she can use the term appropriately in this IDV development context.

The “interface group”, as it is loosely called, is the focus of this study of communication, interaction, and networking. This team involves both IDV

employees and outside consultants who are working for the company on a long-term basis. Thus, relationships have been established and interaction occurs over an extended period of time between the same groupings of people. The interface group can be thought of as a series of concentric ripples, much like the pattern a stone makes after hitting the water's surface. (See Appendix A for an illustration.) The innermost circle is where the majority of the communication must take place. This is the figurative location of the primary interface team. The outer circles show other employees who are not as essential to the network but who are, nonetheless, important points of communication, especially when questions arise as to whether the product under development is in accord with research emerging from other areas of the company. For example, one of the marketing employee's main focus is to research what IDV's competition is offering as products. Networking with her must occur to ensure that the completed software is a valuable product, a consumer offering that has a unique appeal. However, very little communication takes place between a representative from the development team and her. This can keep the development group somewhat isolated from the newest trends in the competition. In this scenario, IDV runs the risk of offering a product that lacks an original offering. IDV does have a safety net of sorts, though, since the level of data granularity we are offering has not been done before. With IDV it is a matter of establishing itself before other companies can match our product.

Although it is easy to understand the need for communication, it can be difficult to establish effective information flow patterns. Communication disconnects have been a stubborn problem at IDV as this fledgling company struggles to develop an effective operational process for its rapid growth. For example, there is a marketing employee whose main focus is to research what our competition is offering as products. Networking with her must occur to ensure that the completed software is a unique product, a consumer offering that has a unique appeal.

The communicative culture at IDV is, in large part, developing informally, as suggested previously. When the company was 15 employees, the CTO could meet with the entire technical staff on a weekly basis to monitor progress and keep everyone working within an organized system. This is no longer the case as his responsibilities have expanded. There are no “conscious, persuasive strategies of upper management” to create a company culture, which would include establishing paths of communication (Pepper, 1995, p. 32). Rather, channels are being developed and sustained by the “everyday communicative acts of all employees” (p. 32). Standards at IDV are being set by smaller groupings. As a result, IDV's is a “self-managed” team for software product development (Albrecht and Bach, 1997, 123). When an information need arises, numerous people are sought out until the knowledge source is found. Once established as the “expert” on the particular question, he/she is contacted again when a similar need arises. For example, IDV now has four system

administrators on staff, each with different server responsibilities. When there are problems with product prototypes on the Web, any number of servers might be responsible since database servers as well as web servers interact with the webpages. Trial and error has taught the web developer who can handle a particular problem the fastest. In some instances, another web developer has proven more helpful with server problems than the system administrators, perhaps because he is more aware of the immediate development issues. Sometimes the most effective lines of communication are not what would make sense by looking at an organizational chart.

This next section will take a look at more structured methods to facilitate knowledge sharing, information flow, and product innovation among the IDV interface group. The heart of this issue is how best to share essential information on a team wide basis about the application being developed.

Albrecht and Bach (1997) assert that there are four critical elements of good team structure. First, roles and responsibilities should be clearly defined. This first point does not seem to target IDV's communication disconnects. The roles in the group are fairly well understood, mainly because each member is working on tasks that do not spill over into others' responsibilities. For example, IDV has a GIS employee working on the map component of the product, and a programmer working on the charts and graphs that are being created as Java applets. There are clearly differentiated roles requiring distinct skill sets. Other roles also seem self-contained, which encourages autonomy and control over

one’s tasks, but may also strengthen some of the communication barriers. Although tasks do not “bleed” from one employee to another, interaction is obviously critical since these pieces must be integrated in the end (Albrecht & Bach, 1997, p. 123). In fact, more overlap in task responsibility would be helpful at times and would encourage more communication flow. This may suggest that IDV still has some work ahead in terms of hiring new employees. The lack of task overlap may suggest that more staffing is needed.

The second group feature is the establishment of an information system. This idea gets at one of the main problems within the IDV interface group, as discussed above. Since roles are well defined and participants can often work autonomously, members are quite productive working independently but sometimes fail to be productive as a group. This developing culture of independence, although in many ways beneficial, must give way to a degree of communal cooperation. A pressing issue for IDV employees is the importance of working in larger team groupings. Original company employees became accustomed to few staff members and were individually responsible for larger pieces of the company's business process. Now they need to be flexible enough to see where another employee may lift some of the burden. How can an employee's job responsibilities shift to take advantage of new staff "resources?"

The lack of available information as to how development should proceed for the IDV product necessitates team brainstorming. The somewhat fragmented network gives a false sense that all aspects of product development are being

handled. In reality, however, if someone has a lingering question about an aspect of development and wonders if another is grappling with it, oftentimes the question is not being addressed (Albrecht & Bach, 1997, p. 123).

At a recent ISP trade show, one of the maps used in the demonstration did not show highly relevant demographic combinations. Thematic maps of income levels alone give little useful data. However, if the map had shown income levels and areas where xDSL potential is high (i.e., high bandwidth use) then the geographical representation would have had more of an impact on potential customers who are wanting to expand their DSL subscriber base. In the end, the map had to be reworked during mid-trade show with the GIS staff under pressure to produce a usable map. This is the kind of situation that creates last minute crises before a deadline. Healthy and frequent networking is crucial to give group members an accurate sense of what others are and are not handling. Team members quickly realize that there is no one source of information. All are uncertain about product direction to a greater or lesser degree and frequent contact is critical.

It is essential to build an information system into the development process, as networking does not always evolve organically. An information system can effectively "increase the speed of information flow and the accessibility of each team member " (Albrecht & Bach, 1997, p. 123). For example, an email list was created several months ago for interface team members. This has allowed an efficient way of dispersing messages to all who may be concerned with the issue

at hand, including consultants whose home base may be in another state. Additionally, there are weekly management meetings among operations and development personnel. A new strategy is the larger scale meeting every six weeks at an off-site location. This includes all operations and development employees. A disconnect still exits between these groups and the sales and marketing staff. This problem is expanded in the "Discussion and Conclusion" section at the end of the paper.

The third feature for effective team interaction is another area that deserves special attention within the product development group: routinized performance monitoring and constructive feedback on performance. The importance of this to IDV is not aimed so much at informing management of employee performance or behavior as it is done for the benefit of the employee. In other words, team members are feeling unsure whether they are devoting their time to the most appropriate tasks. They need regular feedback to remain sure of the direction they are pursuing. The GIS employees have, on numerous occasions, asked the web developer if the maps they are producing will represent our data relevantly. This is a topic that the sales and marketing staff need to advise on. Since there are few standard checkpoints in place between the sales and marketing group and the development group, the GIS staff often produce what they understand to be needed, and the sales and marketing staff sometimes run into problems demonstrating the product to potential customers

as some representations do not show useful patterns (Albrecht & Bach, 1997, p. 123).

A weekly meeting, which includes the right people, could solve in a simple some of the performance monitoring problems. The key is to get the important players and then get them to agree on a regular day and time. This way they begin to expect this interaction each week. Appendix B maps each major team member to other team members with whom they must interact and shows why each point of communication is necessary.

The final team structure characteristic deals with value judgments and objective decision-making. "Effective teams need members who agree to form judgments and make decisions based on reliable data and evidence so as to avoid capricious impressions and to minimize errors" (Albrecht & Bach, 1997, p. 123). This strikes the writer as an important point but one that is not as helpful in targeting the communication problems within the interface group. Perhaps it is taken for granted that team members are using sounds judgments. It is also an atmosphere of respect. It is assumed that fellow team members have the expertise to manage their realm of the project.

This process of socialization reduces team member uncertainty about the product and development process. At IDV, and probably elsewhere, there is a need to brainstorm as a group in order to work through some of the undefined space while defining the product. IDV's product is unique, although other companies have offered less informative types of data. IDV data is

collected at an ISP's point of presence, extracted to an Oracle database, then analyzed and combined in ways that prove statistically significant to prospective and current customers. Additionally, the way the data is presented can also influence the customer's perception of its usefulness. It is a continual challenge to decide which are the most revealing and meaningful combinations and how they will be visually represented.

IDV employs statisticians, database administrators, a system engineer, GIS specialists, system administrators, and web developers who must be aware of what all others are doing. If has frequently been observed that confidence levels seem to increase when members feel welcome to express half-formed ideas with each other and which often culminate in conceptual consensus. It may mean more work or a setback in progress, but this seems to be more desirable than uncertainty. This is often the case when observing interactions between statistician and GIS specialist. During preparations for a recent ISP trade show at which IDV presented its product, a statistician and a GIS specialist were in a continual communication loop trying to get a better handle on what the Vice President of Marketing was requesting. Frequent interaction gave the two members a clear idea of what could be done for the show because each got a strong sense of the limits under which the other was working. The statistician could only supply certain types of data to the GIS specialist because the data must be tested to guarantee its accuracy. And the GIS specialist had to specify what kinds of maps could be created based on their time constraints. This was

one situation where communication was relied upon and which demonstrated how effectively if can be used to rectify a confusing issue.

Another issue that has begun to show a pattern has to do with barriers to communication, even when staff make overt and ongoing attempts to be accessible and to interface frequently with other team members. There are three main problems here, which involve disconnects in the form of linguistic, conceptual, or semantic misunderstandings. There is frequent dyadic, or two-person, interaction between one of the Java programmers and others on the development team. He has a great deal of knowledge to share and is a valuable resource for others. However, his Russian accent is so thick that there is a dual challenge for the listener: reaching a conceptual understanding of his explanations by, first, simply understanding the words he is speaking and, secondly, processing the technically-specific nature of the ideas he is conveying. The listener must be prepared for a lengthier instructional interchange, however his willingness to assist others balances out the difficulty.

At other times, the native language used by both employees may be English, however, problems still arise due to semantic disconnects. The project manager and web developer often talk about specific design choices with regard to the interface. The two may be imagining the same concepts, however an impasse sometimes occurs because of different terminology use. For example, the web developer uses the term “select box” for an <HTML> drop-down list, but the project manager uses the term “drop-down list.” This is not much of an issue

until JavaScript components are added. The web developer makes a distinction between the <HTML> and the JavaScript terms by using “drop-down menu” for the JavaScript-specific functionality. The issue is complicated within JavaScript by the use of such terms as “pop-up menus”, “mouseOvers”, “pop-up boxes”, help boxes”, “floating menus”, “tool palettes", and so on. These differing terms elicit opposing conceptual understandings in each person.

Mutual clarification of these concepts is critical because the agreed upon term becomes the goal of a development effort. It would be useful, when time permits, to add to the development standards document, accessible to all via our intranet, a section on term use and visual examples of the terms when applicable. By developing a “symbol-referent system”, it is more likely that members’ “perceptions, beliefs, and possibly their values are congruent as well” (Albrecht & Bach, 1997, p. 156).

This discussion has shown how vital communication is to a successful product development cycle. It has also shown how easily problems arise when information flow is lacking. People need to exchange information in order to manage the execution of a task (Albrecht & Bach, 1997, p. 3). The communication network that forms among the group determines the nature of information flow, the knowledge levels of individuals, and the amount of participation and involvement of team members. IDV has made some progress with communication problems. However, a closer inspection of the issue is needed. Specifically, where and who are the main intersections of

communication exchange? And where do these points occur between sales and marketing, who are, in turn, the direct links to our customers? The development team can become somewhat isolated from the latest set of customer input and requests. (This issue will be discussed further in the section on data collection.) The main communication channels need to be targeted and group meetings should be frequent, but individual responsibility comes into play as well. Each employee is responsible for keeping daily communication patterns intact. Occasional meetings are not the antidote for poor communication. Rather, the informal, daily interactions add up to form the network backbone by which information flows.

B. Product Section

The next part of this paper focuses on the product aspect of the development process. Communication and information flow, as discussed previously, must develop in parallel with workflow and product definition and development. Issues, such as data collection, prototyping, benchmarking, the balance of innovation with concrete progress, and the maintenance of momentum toward product completion, are some of the product management considerations. IDV has not yet developed a body of standards to monitor these issues. Agreements are formed in process and need to be compiled by the newly hired project manager. This next discussion will explore ways of codifying the product development process at IDV, particularly within the interface

development team. The overarching issue that affects the coordination of tasks is the degree to which the product as it has been defined matches the product being developed. Holtzblatt and Beyer (1998) give a high level walk-through of the design process from data collection through implementation:

1.) Talk to specific customers

2.) Interpret the data as a team

3.) Consolidate across customers

4.) Design a system for this new work

5.) Mock up the interface

6.) Design the implementation (Holtzblatt & Beyer, 1998, p. 6)

A good starting place is to ensure that the team is quite familiar with the product, at least as it has been defined thus far, and the gap it fills in the market. In other words, before launching into development, each team member needs to understand the product's value. This is a way of laying a meaningful foundation before employees begin planning their workflow. Perhaps one can view it as a motivational briefing.

During initial interviews, the product vision is discussed at length, along with the usual questions to determine if employee and employer would work well together. Each IDV employee begins work with an understanding of product direction and potential, giving each prospective employee the opportunity to buy into the vision or opt out.

It is important to clarify that the product development process at IDV has not yet become a smoothly orchestrated endeavor, with neat, orderly steps following one after another. In the first place, new employee hires have been happening concurrently with refinements, some major, to the product definition. Employees are certainly well versed in current conceptions of the product, but continual customer feedback requires that product definition and development follow an iterative process, whereby previous points in the cycle are revisited. Product definition is as experimental as the prototypes that are generated as a result. Undoubtedly, there are many other development issues that require iteration of previous steps, but IDV's challenge of developing while learning customer needs creates particular difficulty maintaining deadlines.

This ongoing process of defining and refining the product requires that at least one employee devote the majority of his/her time to data collection at the customer end and then to data analysis once back at IDV. To an extent, all of the sales and marketing staff are involved in interfacing with customers to gain a clear notion of individual needs. (At times, too, IDV staff must pose possible scenarios to give customers a broader understanding of how IDV's data may improve their effectiveness in the market.) However, a well organized and documented data collection process must be ongoing. At IDV, the product manager is the vehicle for this process.

Each ISP customer has unique needs. It is the job of the product manager to work with customers to "uncover the meaning and implications of

customer action and language" (Holtzblatt & Beyer, 1998, p.12). Again, the issue of shared semantics is paramount to understanding customers needs. Does the customer have a different set of terms for concepts with which both are familiar? Or perhaps the same term may be used in different ways by each. Shared meanings must be established before development begins.

In order to get past potential impasses, the product manager must "inquire into the meaning of customer action and words" and then "offer interpretations, not just open-ended questions" (Holtzblatt & Beyer, 1998, p. 15). It is also important to understand subtle nuances about the culture of the ISP partner. How do aspects of their culture constrain how work is done? What are possible standards and values that constrain ISP workflow (p. 38)? Additionally, if problems at the ISP can be captured, this could lead to valuable scenario development that can be fed back to the ISP to clarify how IDV's data can help them with their challenges. In essence, it must be assumed that with each ISP there are particular characteristics that set them apart from others in the ISP market. These qualities need to be captured in order to tailor the product to their particular business model.

The product will be customized to reflect a ISP's specific needs. For example, one ISP may want to know which of their customers tend to download large files, thus giving the ISP the potential for increasing their xDSL customer base. This ISP may have newly acquired technologies that allow for an expansion of more sophisticated service. This ISP wants to target those

customers who are likely candidates for this newer type of service. Another, smaller ISP just entering the market, may be more concerned with acquiring new customers for any type of service. The second ISP would like to see a map indicating concentrations of potential customers within their service area. (This is done in the aggregate, so no individual customers are indicated. These are thematic maps in which differing color gradations indicate higher or lower concentration levels.)

Once customer data collection is accomplished, the product manager, or "informant" returns to IDV and works closely with the project manager to analyze the data and to make refinements or additions to the product definition. It is essential to include others as well because there are certain strengths to interpreting a customer interview as a group. First, all team members learn about all customers. Second, multiple perspectives emerge on the data. Third, team members learn each other's perspectives. The meeting should take place within 48 hours of the customer interview and the group should be limited to between 4 and 6 people. If more are involved, create more than one group (Holtzblatt & Beyer, 1998, p. 31). This way, impressions are still clear to the product manager and they can be discussed more thoroughly in a small group where each person's thoughts can be contributed.

Ideally, there are other roles to be filled in this kind of meeting. The informant introduces the customer profile. The recorder captures important issues in an electronic format, so it can be accessed by all via the company

intranet. Work modelers draw diagrams or other visual representations of customer needs, scenarios, and typical tasks. Participants clarify what happened during the interview, identify important points and generate implications for design. And the moderator makes the whole meeting work smoothly by keeping the team from digressing from the most relevant issues (Holtsblatt & Beyer, 1998, p. 32). This type of meeting has not been officially built into the IDV process, although it may be considered as an addition to the business model. Currently, the product manager, project manager, systems engineer, and, sometimes, statisticians conduct these meetings in a less structured manner.

Then the systems engineer and project manager map out the workflow process and tasks to be completed. There are many aids that can be used to identify tasks and develop a schematic for workflow and time management. For example, a project plan developed at the outset of a new undertaking creates the foundation that allows for system of periodic checks and well-structured flow of work and information. "A project plan is a map of tasks, times, and their interrelationships ….a rule of thumb for level of detail is to define activities for which a weekly review of progress allows the SE and project manager to know whether the schedule is being met" (Conger, 1994, p. 58).

> The general methodology of planning is as follows:
> List tasks.
> Include application development tasks, project specific tasks, interface organization tasks, and review and approval tasks.
> Identify dependencies between tasks.
> Assign personnel either by name or by skill and experience level.

> Assign completion times to tasks; compute the most likely time for each.
> Identify the critical path (Conger, 1994, pp. 58-59).

(Conger's use of "interface" in this context differs from the use of the same throughout this paper. With regard to project planning activities, she describes an interface as "data that is sent or received between applications" (p. 60). At IDV this would refer to, for an example, the necessary interaction between Oracle database applications and web application charts that show the data in a graphical format for customer consumption.)

As elucidated previously, the two team members at IDV who are responsible for developing and maintaining the project plan are the project manager, as would be expected, and the systems engineer. The SE's more precise title at IDV is Interface (as in web product interface) Manager. The SE is responsible for a knowledge of all tasks relating to the application being developed. The project manager must be aware of all organizationally related tasks. The project manager's tasks relate more to work flow and schedules within the product development group.

A task dependency diagram is a useful way of mapping out all tasks and their relationships. These include sequences of tasks, which are grouped because they must be performed together to reach a goal, and independent tasks (Conger, 1994, p. 60). Tasks that are dependent upon one another must be defined, with special attention given to those that are time intensive. The critical path is the

sequence of dependent tasks that together take the most development time. "If any of the tasks in the critical path are delayed, the project is also delayed. So, the critical path tasks are the greatest source of risk for project completion" (p. 60).

Once the required tasks are defined, time estimation should be done for each task. "Times are assigned to each task based on complexity and amount of work. Three times should be estimated: an optimistic time, a realistic time, and a pessimistic time" (Conger, 1994, p. 60). No deadlines should be finalized before pessimistic time frames are considered.

With task and time requirements determined, the project manager and systems engineer are ready for staff hiring and/or assignment of tasks to employees. This involves defining the skill sets and experience levels required to fill a particular team role. Next the systems engineer and project manager use the finalized resource and time requirements to create schedules, perhaps in the form of Gant charts, in which a time line is defined and tasks are assigned to portions of the time continuum. The Gant chart gives a temporal glimpse of tasks and when they overlap. At a recent IDV Operations meeting, a Gant chart was presented by the interface development manager (SE), project manager, chief statistician, chief database administrator, and the operations director. Together they showed the staff an integrated look at development efforts for the next year.

Rapid prototyping typifies the nature of the development cycle at IDV, especially with regard to Web interface samples. "Prototyping is the development of a system or system component in a short period of time without formal written

specification “(Conger, 1994, p. 29). The interface samples are the best way of visually demonstrating to anyone in the company the design concepts and functionality under consideration. This is important for two reasons: 1.) Sales and marketing staff use some of the prototypes when making presentations to potential customers. It is important for these employees to familiarize themselves with both the content and navigation of these prototypes beforehand. 2.) The Web developer needs feedback about prototypes under consideration. IDV will soon have beta testers in some of our ISP customers, but for now the best usability and other feedback is coming from in-house responses. These samples are put in a directory on a web server so they can be viewed by anyone within IDV’s firewall through a web browser.

Prototyping can be quite useful:

1.) When an application must be developed and the requirements of which are not well understood.

2.) As a way of demonstrating a proof-of-concept.

Quickly developing numerous versions is useful when the planning and design phase has generated murky and unsolidified ideas. Prototyping allows designers to fill in the conceptual gaps by, for example, bringing missing aspects of the product to light. IDV finds itself in a sort of limbo, at a mid-way point between idea and final product, although the beta version of the ISP product has recently been developed by using the well documented product definition produced by the new project manager. It would be a mistake to pursue a highly structured development process.

Perhaps this style would be better suited for an established company with a solid conceptual understanding of its product. However, as suggested previously, high technology companies are faced with frequent changes from the marketplace and development cycles must be flexible enough to accommodate time and product changes. IDV product development and product definition evolve side by side, at least during this first phase of product design. Prototyping allows the relationship between definition and development to remain dynamic.

Prototyping, as discussed, is not a highly structured development model. However, thorough task and workflow monitoring is as important in this environment as it is in any other. The project manager is responsible for much of this, yet individual team members must also formulate a “game plan” or strategic sequence of steps and monitor their own efforts throughout the process. There are many potential difficulties that may arise during a rapid development process. Monitoring development efforts on a continual basis improves the chances of maintaining compliance between the original product design and the developing product.

One issue, which can pose problems on a daily basis is version control. The web developer has had to develop a file management system whereby files from different versions are kept in correct locations, even as work is being done on multiple versions at once. One version may have some features that are carried over to a subsequent version. This may mean that some files may be almost identical from version to version. However, differences in JavaScript code, for example, are quite important. Saving one file for another may result in hours of lost

work. When the first version of our web product is complete (as opposed to the paper reports already being sent out), the web developer will spend time evaluating version control software to become informed about the tools available that can be used to help safeguard development efforts during rapid prototyping.

One of the earliest practices IDV adopted to safeguard the customer product from the many “under-development” versions was to create two distinct environments for each. There is a development environment for both the database work and for web development. In order to avert file synchronization problems within web development, a complete, functional, tested system (i.e., the set of files and directories) should be created in the development environment and transferred as a whole to the production environment using an FTP-based file transfer utility (West and Norris, 1998, p. 139). As for the database environment, all the scripts, SQL commands, and procedures are written and tested in the on the database development server before they are transferred to the production database. (Each should have similar data, however the development database sometimes lags behind the production database where the recent ISP data loads occur. This sometimes causes some problems as the graphical representations of the data in the development environment differ from what they end up showing once in production.) Each time significant changes are made and tested in the development environment the files and directories are FTPed to the “live” environment.

The implementation environment for the final product is the World Wide Web. As such, IDV has developed an approval process whereby the

appropriate team member evaluates each part of the product interface before being uploaded to the external web server (i.e., not behind IDV's firewall). The Chief Technical Officer recently sent an email to all IDV employees (37 at the time; now close to 50) outlining the process to follow when a change is needed to the website. This plan is being incorporated into the larger business process so that all content, graphics, and functionality that are included in the product site will have gone through the proper screening channels before reaching Internet publication. This gives the web developer a contact person for each content area of our website.

A statistician must review the way the data is represented to ensure that is accurate and that it is portraying the data the intended way. For example, if a set of data is represented as both chart (graph) and table, the data must agree. Additionally, much of the data is represented in relation to usage by site type. IDV's site type classification system is still in flux and gets redefined from time to time. Sometimes, the latest version of the product does not reflect the newest changes made by the statisticians in this regard. The product manager must also review the structure. The product manager must also review the structure and contents to make sure they accurately reflect the ISP definition documentation as a whole. Finally, it is the web developer's responsibility to find any problems with functionality, whether there is a bad link, a problem with one of the portions of JavaScript code when using Internet Explorer, an old version of one of the files has crept into the new version, and so forth. Oftentimes, the web

developer will also ask others on the technical team to double check her work before putting the version into production. Additionally, since the Internet is the environment for delivery, attention must be paid to the changing nature of this space. "The Web currently changes so rapidly that a major redesign is needed at least once per year simply to avoid a completely outdated look and to accommodate changing user expectations. Additional maintenance is needed throughout the year to bring fresh content online, reorganize and revise old pages, and avoid linkrot" (Nielsen, 1997). The writer finds the first part of Nielsen's statement to be, perhaps, a bit exaggerated, however, in essence, the point is well taken regarding the need for continual maintenance of and updates to the site.

Monitoring the development process has much to do with communication. Without going too deeply into this topic again, it is important, nonetheless, to point out a few of the essential information channels that keep team members in sync during the development process. As long as there is at least one link between database developer and web developer, between web developer and GIS developer, and between project manager and all of the above mentioned, then information can get disseminated to the rest of the team. The database developer enables access to the data by providing SQL for special views that pull the appropriate data from numerous and often lengthy tables. These views simplify the process of extracting data from database into charting software. The web developer creates the charts and tables (interface tables as opposed to database tables), and

creates the interface that will house this data. The GIS developer creates the maps that will also be included in the interface. And the product manager must make certain that each person who represents a different segment of development has the same understandings about daily changes and frequent decisions that may alter the direction of development. All team members must be working from the same documentation and must be receiving the same messages from day to day.

To formalize the process a bit further, IDV now holds operations meetings every six weeks at an off-site location. All employees (except sales and marketing staff) attend. A representative from each section of development or operations summarizes progress and makes projections for the next six weeks. This daylong “retreat” brings everyone involved back to a place of common understanding. It also provides an opportunity to hash out different opinions and resolve other difficulties.

V. Product Implementation Environment

The implementation environment for the product is the Internet. As such, some of the design process is in the area of web development. The final section of this paper will focus on the process of creating a web interface that satisfies the product definition specification and that accommodates the development efforts that have already occurred. Although there are inevitable changes to be made to IDV's product definition, as suggested previously, the main categories have been elaborated. Enough detail has been generated to allow for development of the first version of the ISP product. However, this does not mean that continued interaction

with team members can decrease. Once working in the implementation environment, the web developer becomes more intimately involved with specific product definition issues. Questions that arise from this more involved relationship will need to be clarified by other team members. Additionally, unexpected problems will occur that will require some research into other fingers of the development process. For example, the web developer was recently involved in making some of the data views, or charts and graphs, and was held up by some issues at the database end. After working with an Oracle developer to determine how to draw the data from the appropriate database and server, the web developer was able to access the correct database tables to produce the charts and graphs. This type of interaction is a typical, daily occurrence as development progresses. The relationship between communicating product definition and designing the product remains at the heart of the development effort.

The first step in designing the interface is to decide on and implement the global navigation system for the product site. “A global or site-wide navigation system often complements the information hierarchy by enabling greater vertical and lateral movement throughout the entire site. At the heart of most global navigation systems are some standard rules that dictate the implementation of the system at each level of the site” (Rosenfeld & Morville, 1998, p. 53). With this framework in place, it will be easier to go back and make changes to more localized sections as the product becomes better defined and as the it is expanded to appeal to e-merchants and advertising agencies. Much of the

creation of the navigation system has involved interactions between web developer and project manager. The project manager has a vision for IDV's "weblication", based on the product definition documentation, and has provided guidance about the specific look and feel of the product as it is being designed.

As suggested by Rosenfeld and Morville, the web developer has "employed a graphic bar for global navigation and a textual menu for local navigation " to balance form with function and to limit page download time (Rosenfeld & Morville, 1998, p. 59). (See Appendices B and C for two interface samples showing this type of global and local navigation.) Additionally, text descriptions of images in the <alt> portion of each image tag have been included to accommodate users with text-only browsers. A further site-wide consideration is to ensure that the pages are viewable with screen settings and monitors of differing sizes. "Because user's platforms may vary greatly, the site should be specifically tested for usability on the minimum platform environment specified….test scenarios should also represent the wider context of use, for example home or work tasks" (Burger and Jackson, 1997, p. 572). The web developer has frequent conversations with the project manager, the systems engineer, and a graphic designer contractor about cross platform compatibility and screen resolution and size. It is easy to forget one or more of these considerations along the way, and it is important for the web developer to get feedback about how the interface appears on various computers screens throughout the company. Even though IDV's computers are probably at the high

range of performance in comparison to the rest of corporate America, these varying environments for viewing the interface allow for valuable input. ISP customers will, more than likely, be seasoned computer experts using relatively powerful machines. However, that is not an assumption that can be made, and as IDV expands its services to include other customers, the web developer may not have the luxury of designing for high-end systems.

Once much of the planning has been done and major categories of the site have been determined, it is useful to create a visual layout of the site in the form of a blueprint that summarizes the structure and general flow of the site. It is suggested by John Shiple in his “Crash Course in Information Architecture" that the developer

“make up a legend that defines how…links, page components, pages, and groups of pages are represented in the blueprints. You might want to distinguish among parts of the site that perform a function or transaction, parts of the site that are generated dynamically, and pages merely comprised of text" (Shiple, 1999). (Appendix E is a blueprint of the IDV product site.) Distinguishing among the pages allows the web developer to group like tasks more easily. For example, those pages requiring CGI scripts can be grouped at a glance by looking at the blueprint and then developed at once, if all the data to carry this out has been collected. Tasks are completed more quickly and efficiently if they are done together in one concentrated block of time.

The next step in the development process is the topic of human-computer interaction. Inherent in this discussion is the topic of usability and navigation. Most sites are at least partially interactive, giving the user choices to make and tasks to perform. The IDV product site is no exception. Once the online version of the ISP product is released, customers will navigate through menus and drop-down lists to get at the desired data and to view it in a customized fashion (e.g., according to selected preferences). There is much discussion at IDV about the product interface's usability. There are factions that prefer that local navigation always be along the left side of the screen. Others favor drop-down menus below the global navigation categories that are across the top of the page. Still others prefer that local navigation be placed on the right side of the page. Additionally, prefers an expandable tree structure for local navigation, while the project manager disagrees with this approach as the left menu takes up the main content areas' screen real estate. Based on the preferences gleaned from these in-house conversations, usability principles and discussions in recent literature are serving as guidelines while developing numerous examples of the product site. According to Nielsen and Molich, the most significant usability principles are the following:

a. Use simple and natural dialogue
b. Speak the user's language
c. Minimize memory load
d. Maintain consistency
e. Provide feedback

f. Use clearly marked exits
g. Build in shortcuts and error messages
h. Prevent errors

(Burger and Jackson, 1997, p. 571)

The following section, which addresses some of the above categories, outlines design decisions being incorporated into the IDV product site. The use of "simple and natural dialogue" is a difficult usability consideration when applied to the ISP product site. Currently, the company is targeting the ISP as customer (not the same as ISP customer). So the language is going to be fairly technical in nature, and the labeling system will become increasingly complex as more customized and specific reports are requested ISPs. Although the choice of wording may not be simple, it is appropriate to the audience. The following data view title, "User Activity – Usage by Site Type – Unique Visits – Weekend versus Weekday Hours" (hierarchically broken down in a menu), is a lengthy one but relevant to the targeted customer. Recently, however, it was decided that the following simplified title would suffice to describe the same data: "Usage by Site Type, Weekend versus Weekday Hours." Additionally, there is a IDV database of terms that will be accessible to customers while viewing their data. (See Appendix F for an example of definition pop-up boxes.) This also addresses Nielsen and Molich's second usability principal, "speaks the user's language."

A collapsible and expandable menu is one design choice aimed at minimizing the user's memory load. (See Appendices D, F and H for examples.)

Another menuing scheme that has been designed for the same purpose is the drop-down menu. (See Appendices C and G for examples.) Each local area of the product site has submenus, sometimes multiple levels. These designs have been adopted because they hide secondary level data until needed. When the page first loads the user can quickly scan the higher level choices and then expand or "pull-down" the menu for more specific information.

The menuing system will grow in complexity as the product matures. This does not mean, however, that the menus should become more difficult to use. Rapid prototyping is especially well suited to IDV's development as it allows the design of numerous menuing systems as new pieces of information are communicated and better arrangements for navigation are discussed. As labels change and expand in number, the navigation scheme must be revisited to determine the most usable system with the strongest visual appeal. This issue is of central importance because the rest of the site is built off of and based on the menuing scheme.

Jacob Nielsen argues that ”people rarely read Web pages word by word; instead, they scan the page, picking out individual words and sentences” (Nielsen, 1997). He and his colleagues found that measured usability was considerably higher for concise and “scannable” versions of websites (Nielsen, 1997). (http://www.useit.com/alertbox/9710a.htm for more on their usability studies)

Based on these findings, Nielsen concluded that web pages have to employ “scannable” text using:

- Highlighted keywords
- Meaningful subheadings
- Bulleted lists
- One idea per paragraph
- The inverted pyramid style (starting with the conclusion)
- Half the word count (or less) of conventional writing (Nielsen, 1997)

The product site is divided into four sections:

1. Executive Overview
2. Sales and Marketing
3. Business Development
4. Network Operations

These categories are akin to the global navigation framework as described previously. Within each of these areas are the local subheadings, which give a meaningful way of finding a needed data view or data view grouping. In the latest version of the interface these categories are represented in the form of tabs across the top of the page. (Refer Appendices C, D, and G for tab illustrations.)

The final aim of a customer search is the charts, maps, and tables that display relevant information specific to their service area and customer base. The most content-rich areas of the site, then, are in the form of graphical displays, sometimes tabular, so some of the Nielsen's principles for scannable text do not apply to the product site, although the focus on usability shifts to clarity of graphical representation. Issues that become important are:

- Spacing and positioning of visual elements
- Colors used

- Size of images and Java applets
- User customization/manipulation options
- Type of representation (chart, map, table) employed to convey a particular concept

Alternatively, the menus were designed using a multi-tiered list format and are textual in nature. (Refer to any of the product website figures in the Appendix section.)

This type of menu with “hidden” submenus, but clearly indicating how to access sub-levels, also addresses another of Nielsen’s usability principles: minimization of memory load. The user has the option of limiting the display to subsections of the menu at any given time. This “chunking” technique limits the user’s need to process information. Since web-based information seekers "read the minimum of non-pertinent information before finding the pertinent”, hidden but known secondary menus effectively reduce valuable screen space and the toll on user memory (Caro, 1997, p. 573). Caro conducted a study in 1997 in which pop-up windows and expandable lists were shown to facilitate faster retrieval of sought after data than systems where all secondary data were contained within bracketed information blocks, accompanying the “main textual units” and visible at all times (p. 574).

Frames have also been incorporated into the product site. There is much documentation on the danger of their use. “If someone (or a search engine) links to a page that is not a frameset, it will not come up the way you intended ….All hyperlinks on a famed site must use the TARGET attribute to ensure that a page

comes up in the correct frame. Getting the TARGET attribute right can be quite complex, and every single link must be tested to make sure that the frame scheme works out right" (Morris, 1999). Morris has a point: proper linking using frames increases the potential for headaches during development, but his opposition to frames is not convincing. Initially, the use of multiple frames may be like a maze. But this learning process does not strike the writer as any more taxing than many other web development issues. Once the developer has figured out "targets" and has some experience using frames, their use can offers numerous benefits. Frames can eliminate the need to reload an entire page when one portion is changed. This is essential since the user has created a series of "footprints" of their path through the site. The main content frame will change when new data views are chosen but the menuing will remain intact. This may help keep the user oriented in hyperspace. If the left navigation frames (global and local) changed without the user initiating the action, consistency, "scannability", and user orientation would suffer. Essentially, the developer has more flexibility with frames when he/she wants individual control of various sections of the page. Frames have also enabled the maintenance of consistency throughout the product site, and consistency is another usability criterion offered by Nielsen.

The concern about frames has been discussed over the past few months by the development team. Although at times it becomes difficult to incorporate new design ideas into frames, the project manager, web developer, and systems

engineer agree the positive features outweigh the negative features when frames are used for the IDV site. For example, drop-down menus are “cut off” if they extend into another frame, but the user’s path through the site is important to retain. Other options for menus have been discussed to address this limitation.

There are two final issues to mention relating to information use: scrolling and history lists. “Researchers (Beard and Walker II, 1990) have provided empirical evidence suggesting that users perform suboptimally with scroll bars in tasks that require navigating a large two-dimensional space” (Pilgrim, 1997, p. 644). Fortunately, this has not been too much of a challenge during development of the ISP product site. (The issue figures more prominently into the design of the main IDV site, which is not the focus of this paper.) Most of the meaningful content is represented in graphical displays, which fit within one non-scrollable screen. Tabular views of the graphical views have been added recently, however there is a clearly indicated link to the table and scrolling should still not be a nuisance. (There are a few that require minimal scrolling, but as the web developer has decreased the amount of real estate devoted to navigation, the main content area can now capture a larger amount of data in one screen.)

The area where scrolling is an issue is within the left menu frame of the first prototype. (See Appendix H.) The menu can be expanded and collapsed, but it still becomes somewhat unwieldy, at times, and necessitates that the user scrolls. The top of the menu may not be visible as the user scrolls to and expands the lowest portion of the menu. Subsequent prototypes have solved

this problem. (Refer to any of the other figures for an example of a more compact menu design.) With the first prototype, multiple sections could be expanded at once. The second prototype only allows one expansion at a time. As one is expanded, all others automatically collapse. The third prototype addresses the navigation difficulties of both previous prototypes by the introduction of drop-down menus across the top. (See Appendix C or G.) This eliminates the need for any scrolling, although with this design there is a new problem. The menus are layers but do not fit within the top frame. As a result, some of the sub-menus, when pulled down, are cut off because they would extend beyond the specified frame space. Suffice to say that possible navigation designs for the menus are still under development.

As Pilgrim points out in the article, “Enhancing WWW Navigation”, “many browsers provide a history list of pages previously visited, which enables the user to establish some notion of location and also provides the ability to backtrack” (Pilgrim, 1997, p. 644). The web developer decided to incorporate this idea into the product site interface as an orientation and navigation aide. The history list, to be developed using JavaScript, will consist of a drop-down list of choices. These choices will be the titles of the data views already visited during that user session. This will allow the user to backtrack more easily by choosing from a more limited set of possibilities.

The discussion on the implementation environment for the product has focused thus far on usability as it relates to navigation. Usability is also

concerned with the way information is represented, and thus, presented to the user. What is the clearest way of representing a particular data set to the user via the Web, especially statistical data. These considerations tie in closely with the ISP product itself, which is the content that is housed by the interface and the goal of navigation. (Refer any of the figures for an example of the content, mainly graphical, in the ISP interface.) In reference to one of his usability studies, Neilsen notes that “several users expressed an appreciation for graphics with a small number of colors because they looked clean and (users) felt like they did not waste a lot of bandwidth (and user time) when they were transmitted” (Nielsen, 1997). There is the issue of icon versus thumbnail use to represent a concept with regard to the ISP product. If the image is small (e.g., 1x1 inch), the use of thumbnails may be risky because at that size they may appear cluttered and may lack clarity. It is better to use icons with few colors for the smallest graphics. Thumbnails seem to work well when they are 1x2 or 2x2 inches. If an image can not be clearly presented using either icon or thumbnail, then it would be better to use a textual description (Nielsen, 1997).

Design of the product and its interface within the implementation environment is a primary activity in the overall development process. There is continual coordination with other team members as the web developer seeks to translate others’ work into something that can be appropriately displayed on the Internet. The web developer starts the planning phase by creating site blueprints. The work done at this point results in a high-level concept of the site,

including global and local navigational schemes. Then as the larger foundation is either conceptually or physically in place, the developer moves on to more specific issues, such as consistency, use of labels, graphical versus textual representation, user feedback mechanisms and so forth. Several iterations of the product site have been developed. This repeated prototyping has been necessary to reach an acceptable degree of alignment between the final product and the original product definition, which include the data view specifications and expectations about the look and feel of the site.

VI. Discussion and Conclusion

This paper has tracked the development of IDV's ISP product from the start of the planning phase through the final stages when the end product is put on the Web. This process was tracked for close to six months, and the development group is only now beginning to benefit from the beginnings of an organized development process. Some of the information and workflow problems discussed in this paper have been diminished as a result of new staff hires. A new Director of Operations ensures that we use our resources in the most efficient ways possible and alerts the staff to operational changes, either physical or technical, that may affect work completion. The project manager has helped with team network building and elaboration of development goals. As this paper is being completed, a graphic designer has also joined IDV. This will allow the web developer to focus on more programming related issues that have to do

with Web database integration, while the graphic designer can rework many of the graphics being used for the product site.

During the last two weeks of November, 1999, IDV has begun to adopt more sophisticated guidelines for monitoring product development. Firm timelines have been established and documented and more explicit expectations about task and product prototyping are also being elaborated. The web developer was able to use a thorough ISP product definition document as her guide during development of the latest prototype. It is difficult to make comparisons between an experience in which most of the product specifications are given to you and an experience in which the developer attempts to define and build a product with very little guidance from other employees or documentation. The latter situation had been the norm for many months. Only recently has the situation begun to change.

The relationship between team communication and design implementation has strengthened but there are still some gaps. The GIS employees continue to be unsure about others' expectations of them. They also continue to feel that timelines are not solid enough. There is more information flow between database developers and web developers, however. For example, a website on IDV's internal server has been created to give everyone on the development team admittance to the SQL code needed to access tables containing the raw data that is IDV's product in its most essential form. Interaction among web developer, project manager, and graphic designer is one of the most promising

hubs of information flow. These employees interact on a daily basis and use each other as springboards for new ideas. This is the kind of ideal situation in which employees are given continued feedback so the final product will match others' expectations.

The essential issue of communication pervades all stages of product development, whether it is done between product manager and customer, between individuals on the development team, or between an interface team member and a sales and marketing employee. As suggested in this paper, IDV is lacking communication leadership. The company's leaders have not encouraged the development of a culture of networking within the company. On November 30, 1999, however, it was announced that IDV will be transitioning to a new CEO. Part of the motivation for this change is due to the need for more assertive leadership from the head of the company. Although progress has been lacking, at least the board members and upper management recognize the need for better communication.

As it stands at the present time, the responsibility of integrating individual's concepts into the common knowledge base rests with each employee. Healthy communication requires a kind of "grass-roots" effort from each employee. There is no one who has the job of teasing information out of team members. A start-up company poses a challenge to its employees since they will often be the ones who establish common practices. It is the task of each employee to be proactive in finding out information that may affect his or her work. Large,

company-wide meetings are seldom, although product development is an ongoing, rapid activity with strictly scheduled deadlines. Interpersonal networks are crucial means of creating the informal communication backbone of the company.

There are a few areas that do require assertive leadership, however. While other problems are solved, there continues to be a divide between the development group and the sales and marketing staff. There is little reason for the two groups to interact based on daily responsibilities, but in the longer term interaction is quite important. The development team needs to be informed about many things that the sales and marketing staff are concerned with. For those employees involved in researching the competition, their findings need to filter to the development end of the company. It is vital that the current conception of the product fit with what has been gleaned from the marketplace.

The next year of IDV's life will bring with it even more change and growth. The company has recently gone through another round of funding from investors and was approved for far more than was anticipated. This paves the way for new employee hires and expansion into other markets. The company plans on doubling with the next 12-month period and has begun to establish relationship with advertising agencies and businesses that have a Web presence. As the development process continues to grow in complexity, these fundamental communication and development issues must be handled and revisited

frequently. One of the many new staff hires should be an internal communications officer.

References

Albrecht, T. & Bach. Communication in Complex Organizations, Harcourt Brace College Publishers, Orlando, FL, 1997.

Burger, K. and Jackson. "Usability techniques for large-scale web sites." Human-Computer Interaction, INTERACT '97. IFIP TC13 International Conference on Human-Computer Interaction, 14th-18th July 1997, Sydney, Australia, Chapman and Hall, London, 1997.

Caro, S. "Pop-up Windows and information retrieval." Human-Computer Interaction, INTERACT '97. IFIP TC13 International Conference on Human-Computer Interaction, 14th-18th July 1997, Sydney, Australia, Chapman and Hall, London, 1997.

Conger, S. The New Software Engineering, Wadsworth Publishing Company, Belmont, CA, 1994.

Cook, M. Building Enterprise Information Architectures, Prentice-Hall, Saddle River, NJ, 1996.

Holtzblatt, K. & Beyer. Contextual Design (seminar materials compiled from book by same name and authors), InContext Enterprises, Inc., Harvard, MA, 1998.

Morris, C. "Navbars, Frames, Site Maps". Available: http://www.webdevelopersjournal.com/articles/navigation_navbars_frames.html (1999, April 2).

Nielsen, J. “Report From a 1994 Web Usability Study” (with an introduction from 1997). Available: http://www.useit.com/papers/1994_web_usability_report.html (1994).

Pepper, G. Communicating in Organizations: A Cultural Approach, McGraw-Hill, Singapore, 1995.

Pilgrim, C. “Enhancing WWW Navigation.” Human-Computer Interaction, INTERACT ’97. IFIP TC13 International Conference on Human-Computer Interaction, 14th-18th July 1997, Sydney, Australia, Chapman and Hall, London, 1997.

Rosenfeld, L. and Morville. Information Architecture for the World Wide Web, O’Reilly, Sebastopol, CA, 1998.

Shiple, J. “Squishy’s Crash Course in Information Architecture”. Available: http://www.hotwired.com/webmonkey/design/site_building/tutorials/tutorial1.html (1998, July 13-17).

West, W. and Norris. Media Engineering: A Guide to Developing Information Products, John Wiley & Sons, Chichester, England, 1997.

Appendices

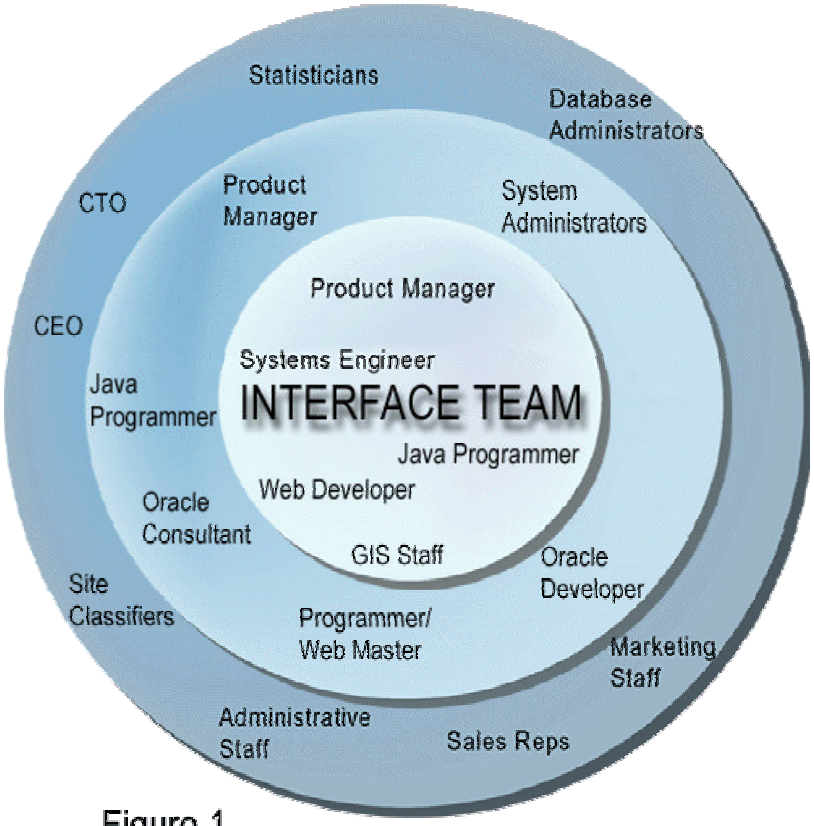


Figure 1

Appendix A

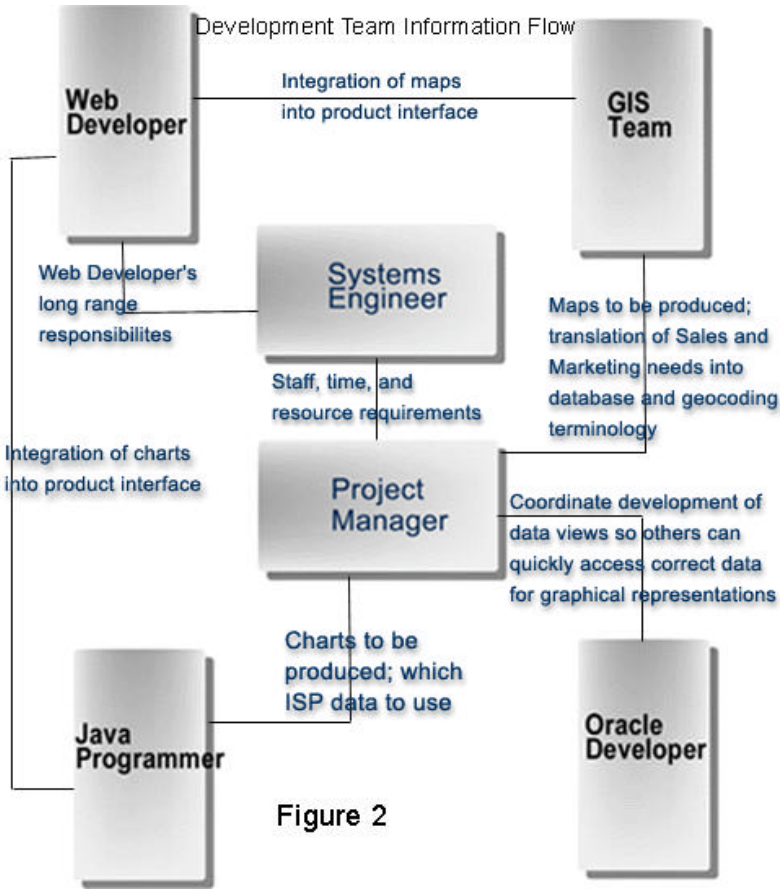
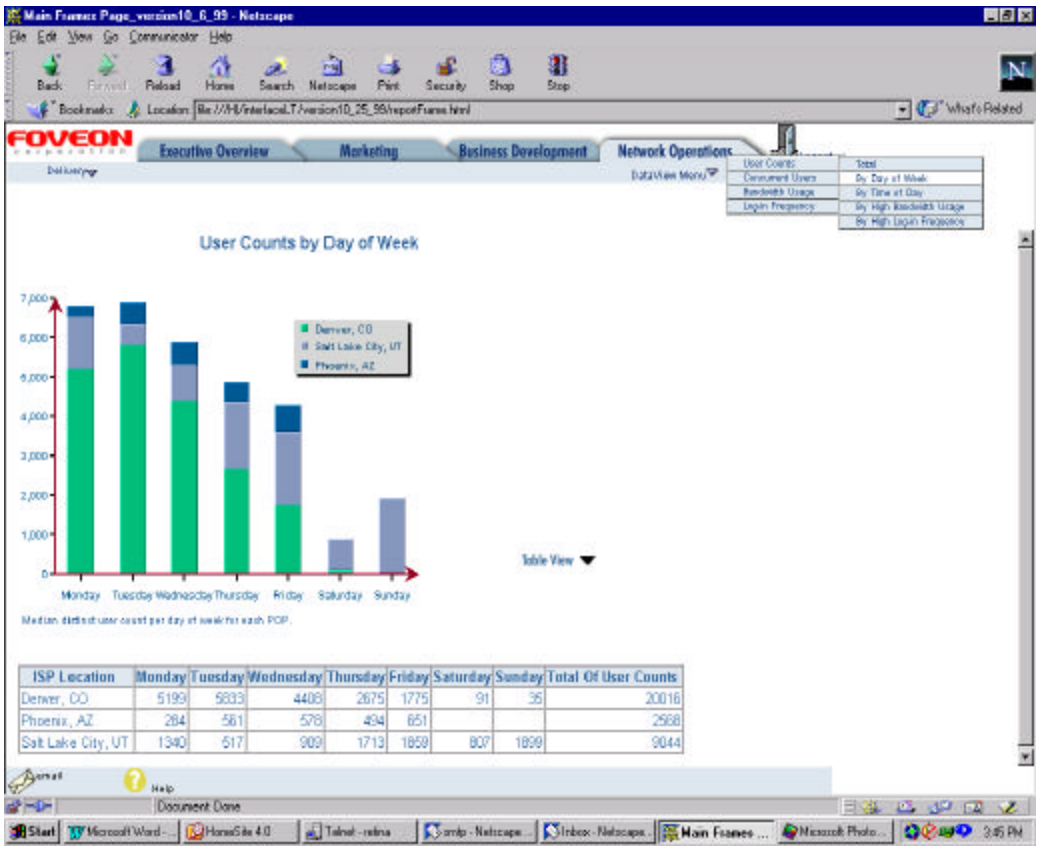


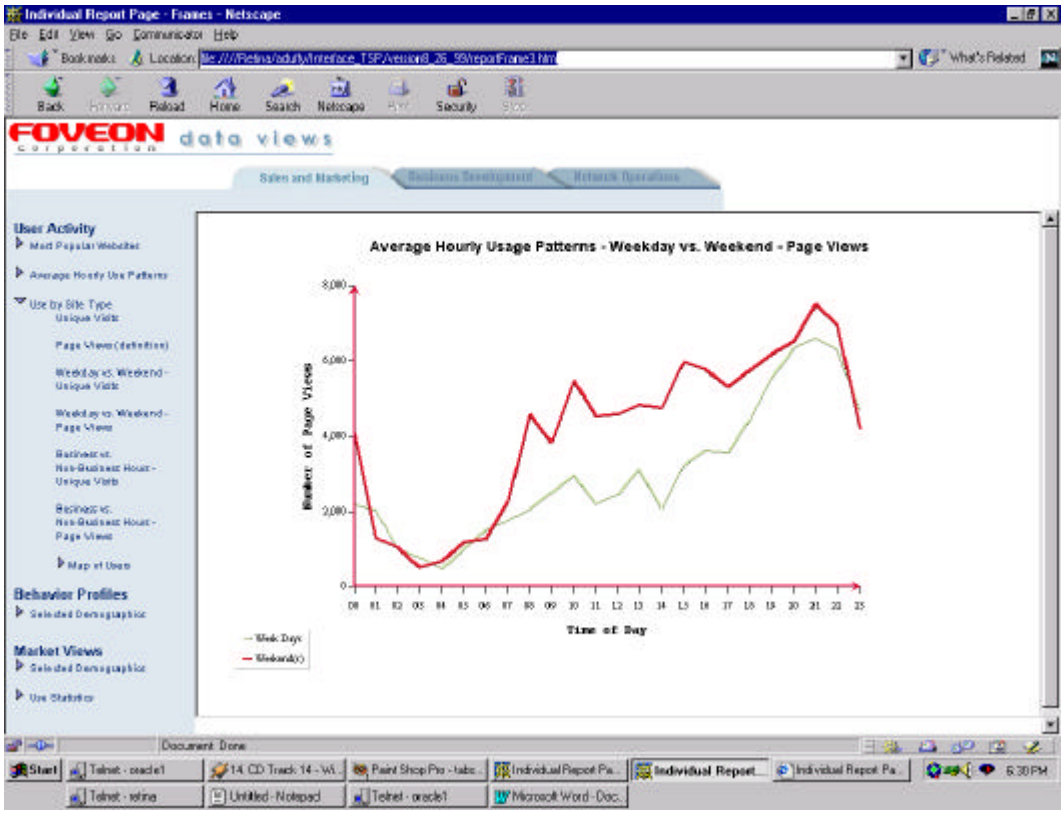
Figure 2

Appendix B



ISP Location	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total Of User Counts
Denver, CO	5199	5833	4408	2675	1775	91	35	20016
Phoenix, AZ	284	561	578	494	651			2568
Salt Lake City, UT	1340	517	909	1713	1859	807	1899	9044

Appendix C


Individual Report Page - Frames - Netscape
FOVEON corporation
data views
Sales and Marketing
User Activity
Behavior Profiles
Market Views
Average Hourly Usage Patterns - Weekday vs. Weekend - Page Views
Number of Page Views
Time of Day
Document: Done

Appendix D

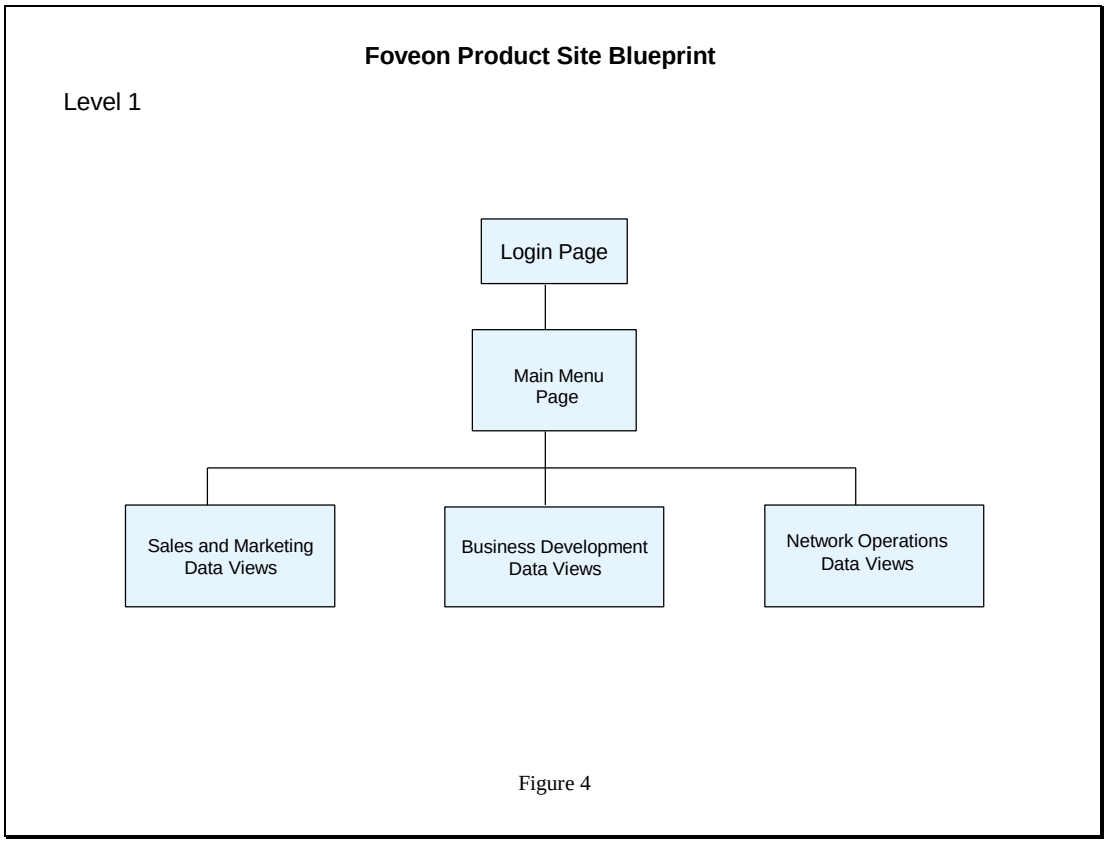


Figure 4

Appendix E

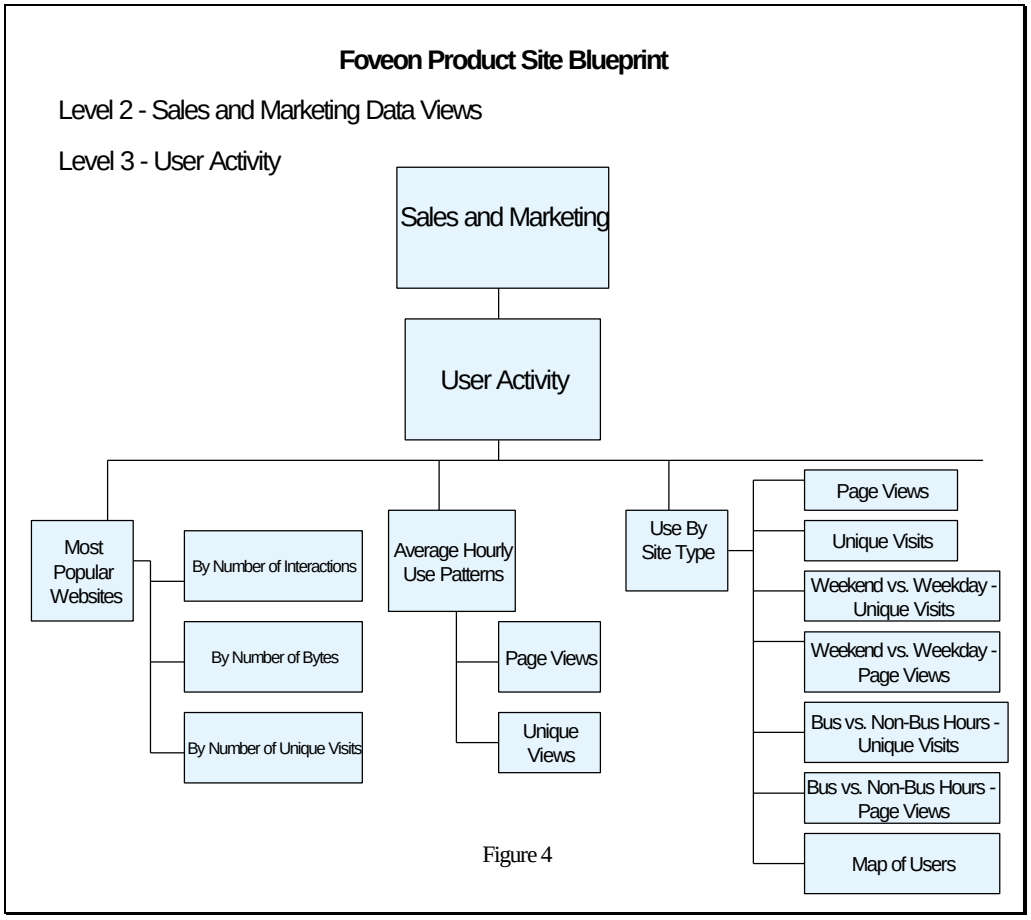


Figure 4

Appendix E

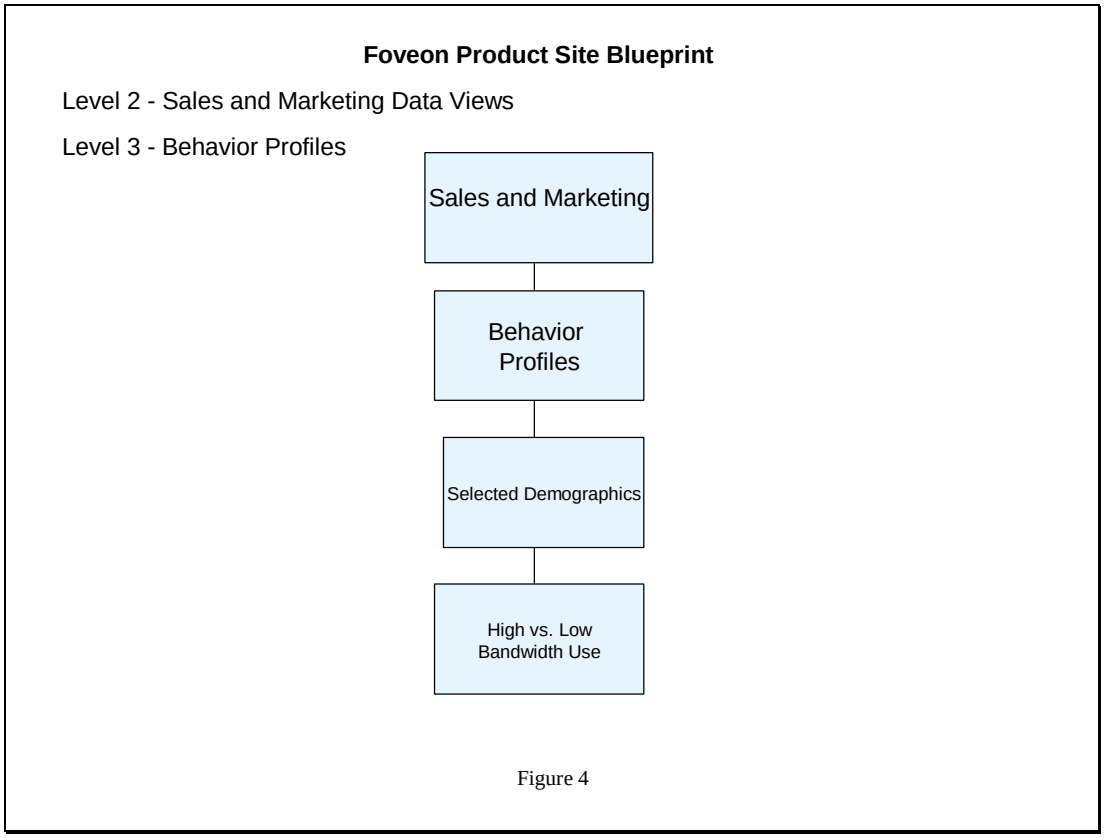


Figure 4

Appendix E

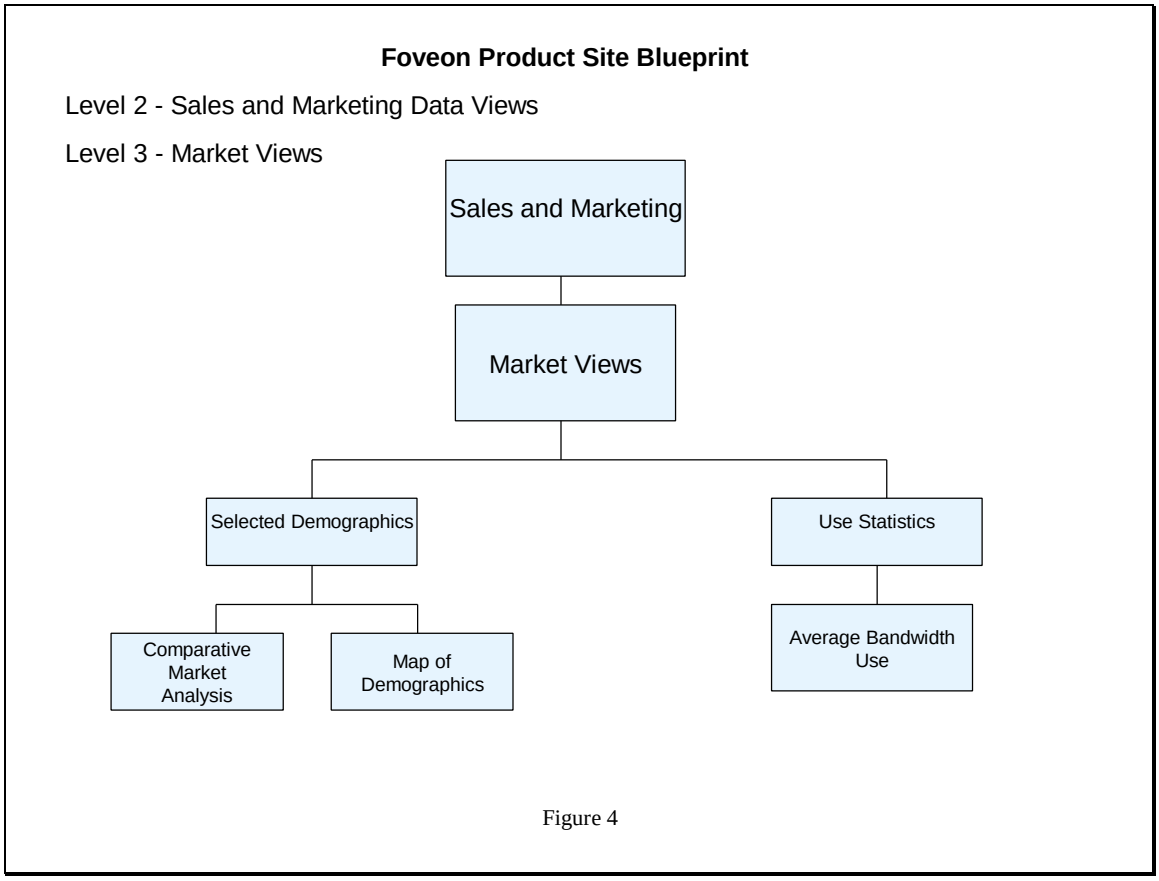


Figure 4

Appendix E

Foveon Product Site Blueprint

Level 2 - Business Development Data Views

Level 3 - User Activity, Behavior Profiles, Market Views

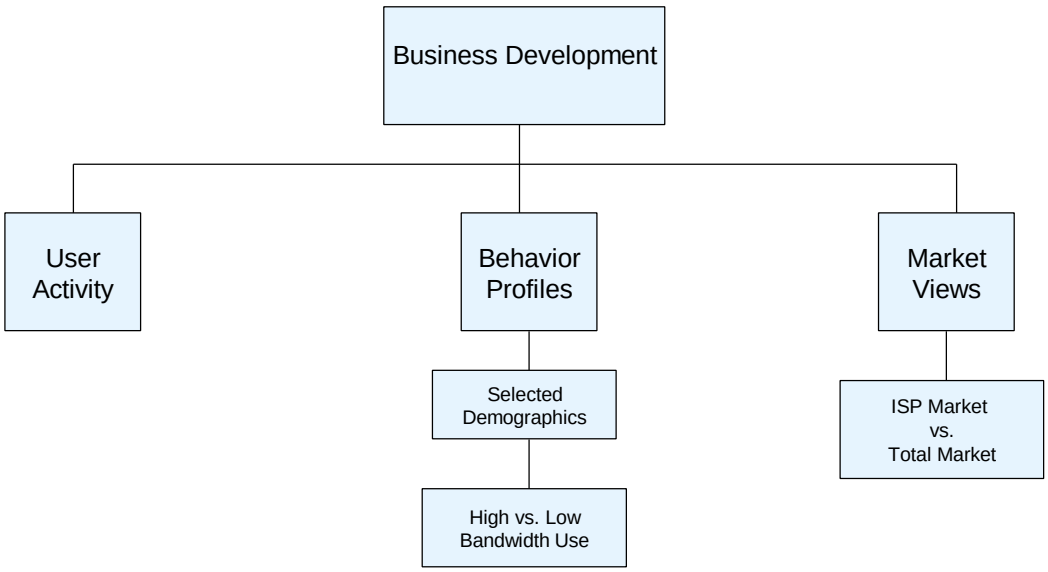


Figure 4

Appendix E

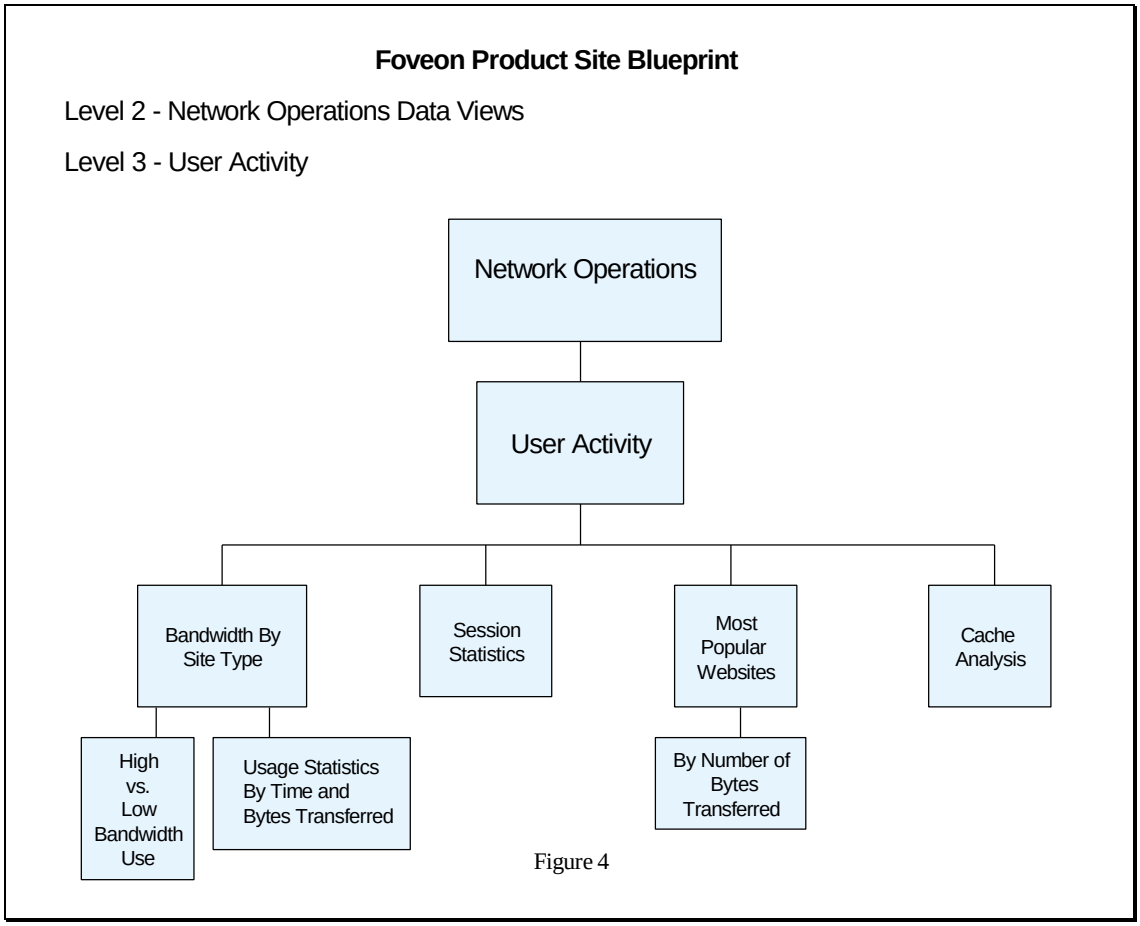


Figure 4

Appendix E

Foveon Product Site Blueprint

Level 2 - Network Operations Data Views

Level 3 - Behavior Profiles, Market Views

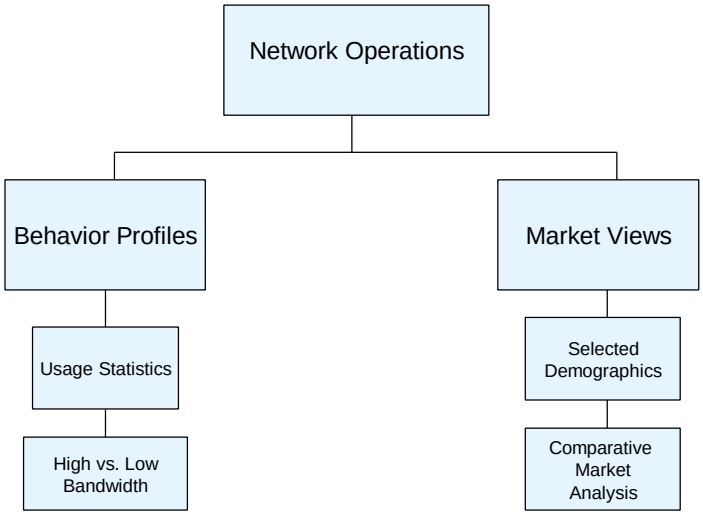
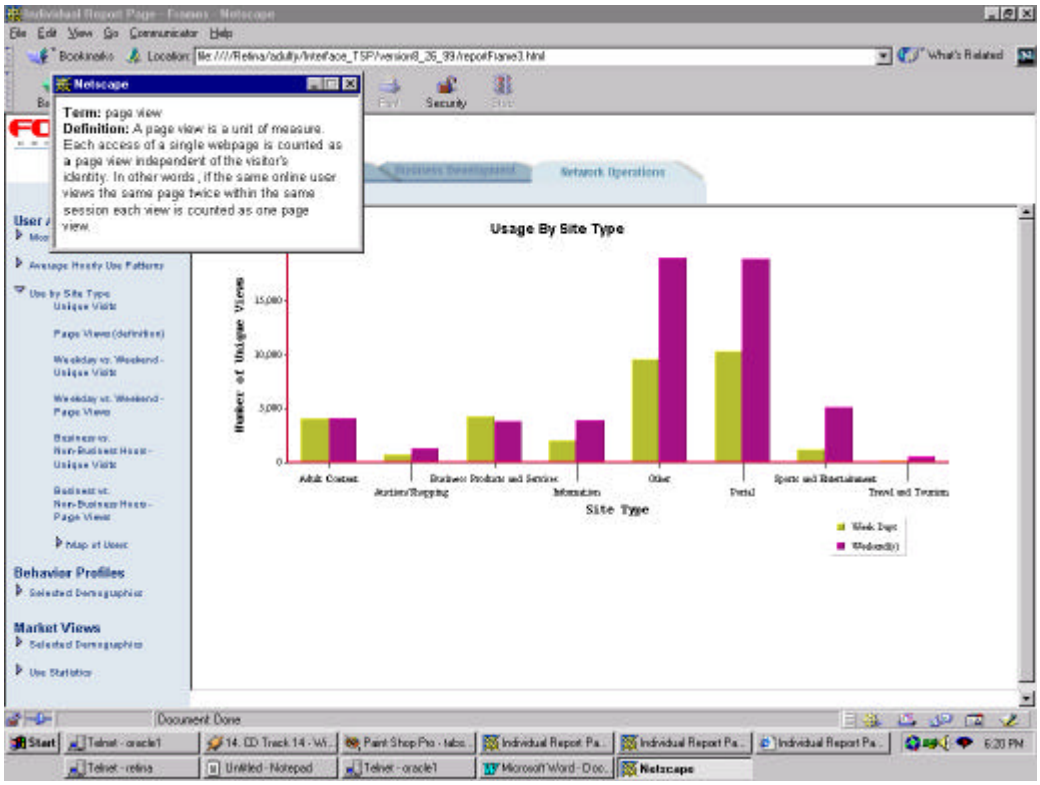
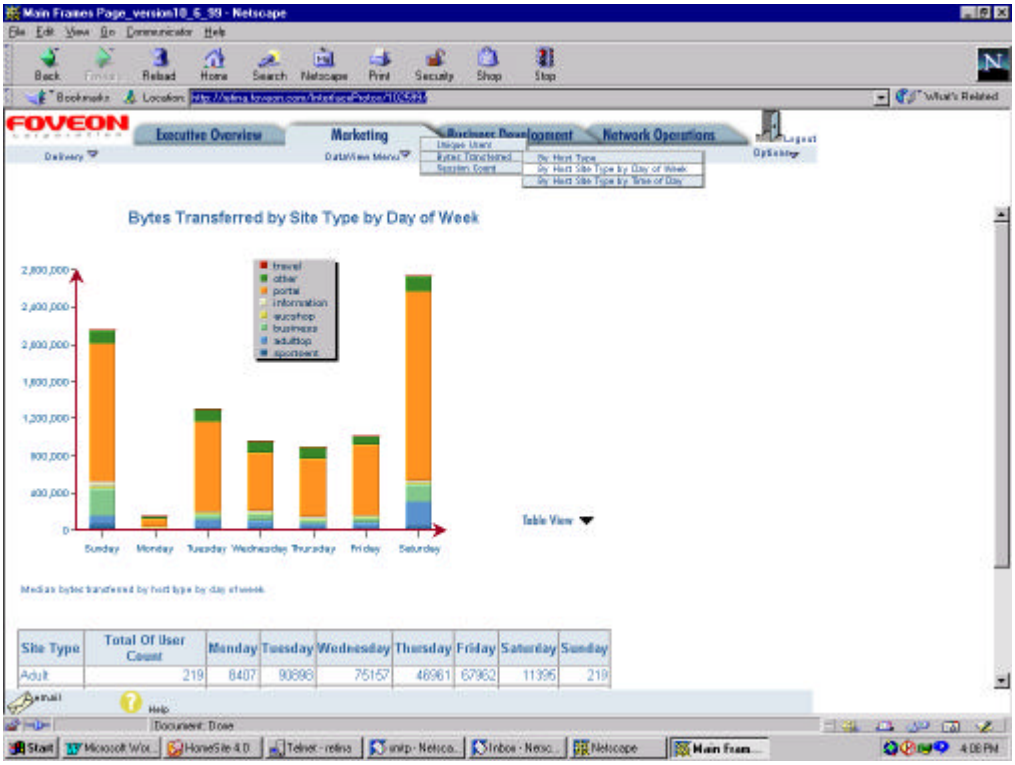


Figure 4

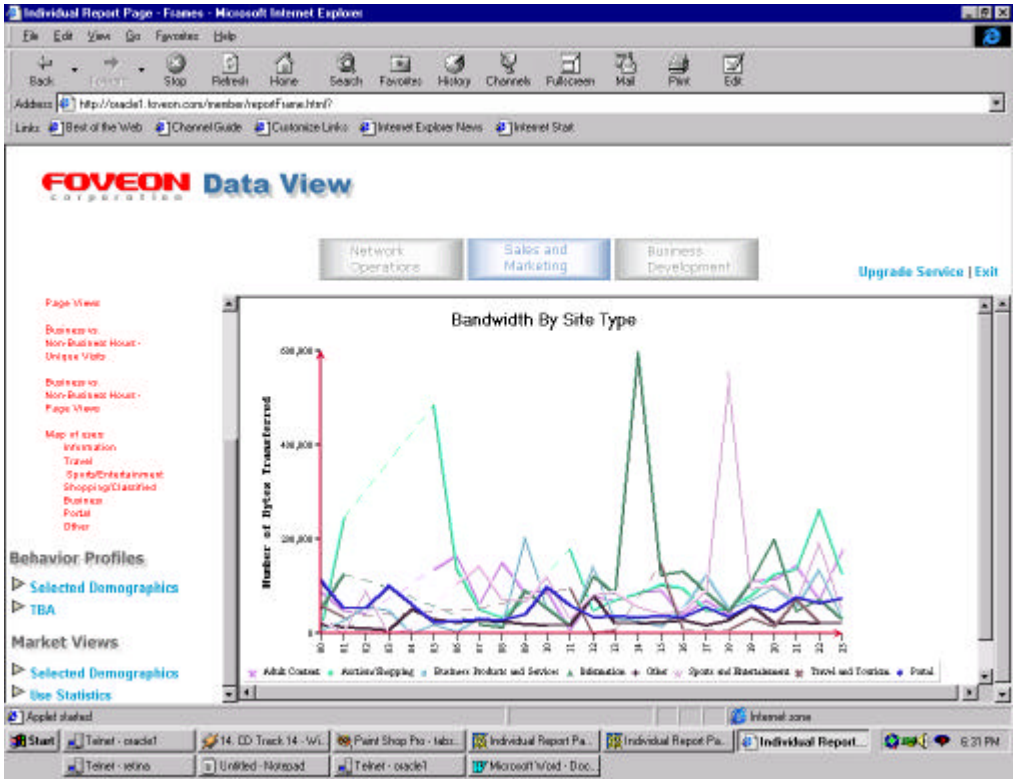
Appendix E


Netscape
Term: page view
Definition: A page view is a unit of measure. Each access of a single webpage is counted as a page view independent of the visitor's identity. In other words, if the same online user views the same page twice within the same session each view is counted as one page view.
Usage By Site Type
Number of Unique Views
Site Type
Behavior Profiles
Market Views

Appendix F


Main Frames Page_version10_6_99 - Netscape
FOVEON
Executive Overview
Marketing
Network Operations
Bytes Transferred by Site Type by Day of Week
travel
other
portal
information
eucshop
business
adultop
sportsent
Sunday
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Table View
Site Type
Total Of User Count
Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday
Adult
219
8407
90898
75157
46961
67962
11396
219
Document: Done

Appendix G


Individual Report Page - Frames - Microsoft Internet Explorer
FOVEON Data View
Network Operations
Sales and Marketing
Business Development
Upgrade Service | Exit
Bandwidth By Site Type
Number of Bytes Transferred
Behavior Profiles
Selected Demographics
TBA
Market Views
Selected Demographics
Use Statistics

Appendix H