

USER-CENTERED SYSTEMS ANALYSIS: AN EXAMINATION OF CASE STUDIES AND
NEW MEASUREMENTS OF SUCCESS

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This study examines the literature to identify seven key steps to user-centered systems analysis. Five case studies are then examined to identify how closely they followed these seven steps during analysis efforts. The case studies and the literature are then used to support five new products of success that are possible outcomes of analysis efforts. These products of success demonstrate that an analysis does not need to result in an implementation in order to be successful.

Headings:

Systems Analysis -- Information Systems.

Data Modeling.

Systems Design.

Evaluation -- Information Systems.

Table of Contents

Introduction.....	4
Literature Review.....	7
Methodology.....	22
Case Studies.....	24
Measurements of Success.....	37
Discussion.....	40
Conclusions and Recommendations.....	42

Introduction

Systems analysis methodologies have evolved immensely in the last twenty-five years. New technologies, new strategies for managing information, expanding requirements for technical systems, and substantially diversified business needs with regards to applications, storage, accessibility and infrastructure have all contributed to the development of more precise and effective systems analysis methodologies.

Despite the standardization of systems analysis methods and their continuing refinement, the percentage of large project implementations that fail or at least remain functionally challenged has remained virtually the same. In 1998 the Standish Group reported that 28% of all software development projects failed and 46% were functionally challenged. In 2000, a similar study revealed that 23% of all projects were failing and 49% remain functionally challenged (Digital Infrastructures). These alarming rates are ultimately attributable to failed analyses. With the growth of the systems analysis field and standardization of techniques, there must be concrete explanations for these figures.

Notwithstanding the growing appreciation of systems analysis methods, many organizations do not employ these techniques when implementing or refining a system. Iivari and Maansaari (1998) have studied several recent empirical studies of systems analysis and development methods. Despite the limited number of studies

available, Iivari and Maansaari conclude that “many organizations claim that they do not use any systems development method and, as far as they are used, methods are not used literally but adapted.”(1) There are many reasons why companies skip proper analysis techniques. The organization must be dedicated to providing the necessary resources to provide proper, in-depth analyses that will result in scalable, user-centered, but business-focused systems that will be capable of integration with existing systems and future expansion as technological and business factors require it. These costs may be significant at times, but the cost of an off-the-cuff implementation can be much greater. Since most companies do not want to publicize failed implementations, there is very little literature that accurately reflects the number of attempted systems implementations, the methods of system analysis employed, and the ultimate success or failure of the implementation. However, this author’s personal experience has sparked a desire to attempt to analyze the current state of systems analysis further.

This author has experienced first-hand systems implementations at several companies that have employed less than perfect analyses. As one example, Company X decided it needed to purchase and implement a helpdesk software application that would be capable of tracking every request that comes to the Information Technology department. This would include both menial tasks that the helpdesk handles like password resets and high-level tasks that network architects would handle like remote office network access issues. Once the decision to buy this package was made and a vendor was selected, a small group was created and tasked with deciding how to

implement the application. Since it was not an out-of-the-box application, there would be significant programming and customization required. The application was highly scalable and capable of great customization. This small group met several times over the course of three months and was eventually informally disbanded as the members would quibble over details. Political struggles interfered with the analysis process. Eventually, one manager took over the project entirely and handled the analysis and implementation within his own unit with very little analysis. There were no inquiries to gather data about the way people were currently working. There were no attempts to create usable work models, and there was only very limited user testing before the implementation. After implementation, the other members of the former task force were adverse to using the system because they had been cut off entirely from the implementation process. What could have been a very effective system became a waste of resources. The application remains unused by all but the manager's group that performed the installation.

While political issues will always be difficult to overcome, the analysis was not even performed correctly. Not only is the application unused for political reasons, but it fails to fix many of the issues it was originally purchased to resolve. The system was implemented from one unit's point of view with no consideration of all of the others who would be using it. Therefore, it really only meets one unit's needs. A frustration for many involved, and an embarrassment to the IT department of Company X, this failure was a major motivator for the author to perform this study of proper systems

analysis methods, how they have been applied in specific situations, and the resulting successes or failures.

The intent of this study is to examine whether or not the resources required to perform correct, recently evolved, user-centered systems analysis methods will outweigh the resource savings of performing an implementation or system alteration without the use of such methods. The study will be carried out through the examination of five case studies.

Literature Review

The exact definition of systems analysis and its related methods is not always clear and multiple definitions exist. One commonly accepted definition of systems analysis is provided by Osborne and Nakamura (2000). They define systems analysis as a practice that fills the “need for information professionals to determine problems, decide among potential solutions, design improved systems, and implement those systems successfully”(xvii). An older, but still very pertinent definition comes from Semprevivo in his 1982 book Systems Analysis: Definition, Process, and Design. Semprevivo asserts that systems analysis is “the process of studying the network of interactions within an organization and assisting in the development of new and improved methods for performing necessary work”(8). Both of these definitions reflect the two overall goals of system analysis: study and action. It is first necessary to properly examine an environment, all of the influencing factors, and the needs that

are to be fulfilled by the proposed system implementation. After a thorough analysis, a design can be created, a plan can be configured and an implementation can be executed. The details of how these steps are performed will be discussed in further detail later.

Before documenting specific instances in which proper systems analysis methodologies have produced successful implementations, or cases in which the failure to use proper systems analysis methodologies has resulted in negative consequences, it is first necessary to describe the evolution of the systems analysis field. Ever since there have been systems to implement in a pre-defined environment, there has been some form of systems analysis. Analysis rapidly expanded through the Industrial Revolution as costly machines were being built to automate tasks. It quickly became clear that it was imperative to plan properly for the implementation of any system. The costs of failure could be disastrous. Lederer and Sethi (1992) discuss the origins of analysis in another form, Strategic Information Systems Planning (SISP), defined as the “process of creating a long-range plan of computer-based applications to enable an organization to achieve its goals”(1). Further, SISP was originally used through the late 1970's to identify high payback computer systems and applications. The virtual explosion of high-tech business solutions in the mid 1980's through the Internet boom of the 1990's demanded an even more stringent, well-defined process for systems analysis and proper system implementations. Most recently, SISP or systems analysis has grown into a tool to assist in developing enterprise-wide data architecture and to implement strategic

information technology applications. The idea of systems analysis, in fact, has become synonymous with the development and maintenance of computer-based information systems.

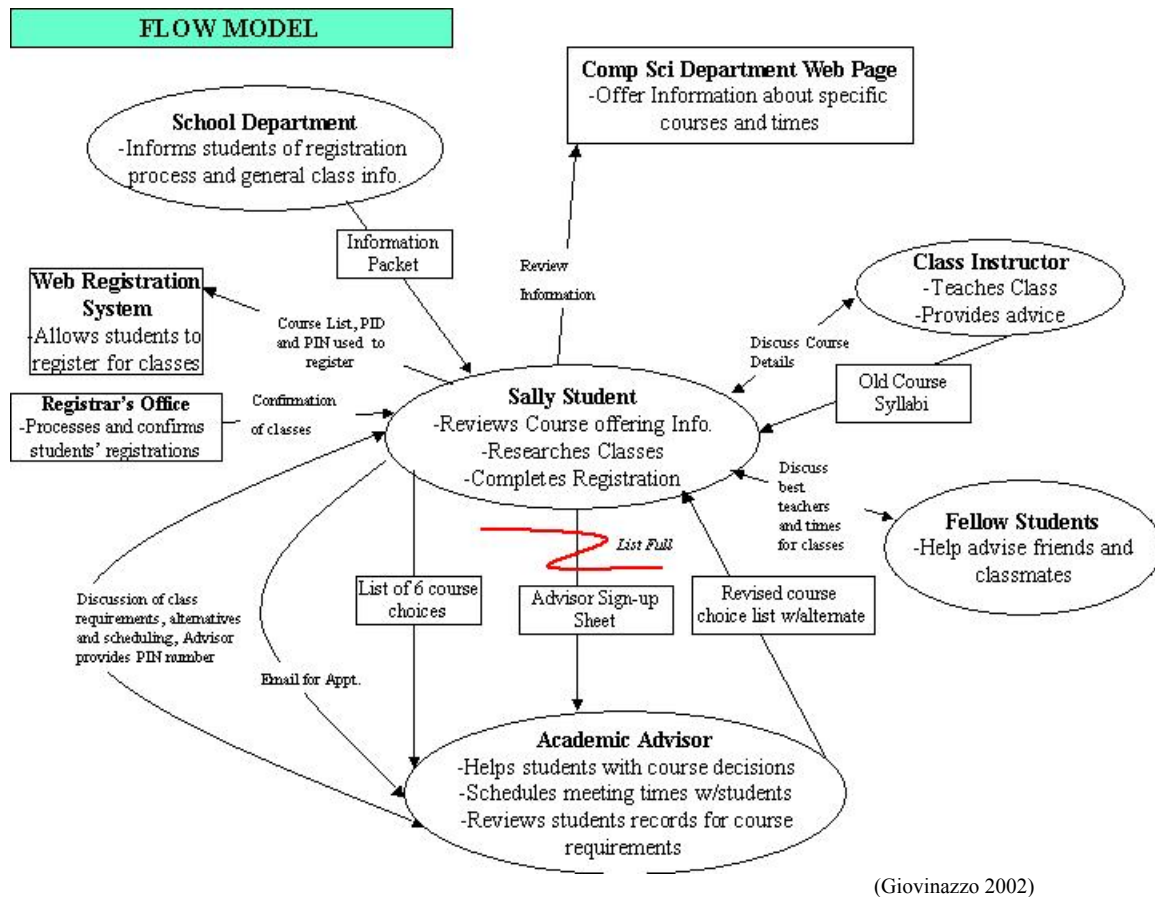
In analyzing the importance of employing system analysis methodologies it is crucial to identify clearly what these methodologies are. The advancements in the systems analysis field are the result of changes in the business and technical world and the ways in which humans interact with each other and with information systems. These innovations are evident in new analysis techniques, creative diagramming schemas, and novel user-centered approaches. The most obvious and critical change in systems analysis techniques has been the shift to user-centered design. Systems design used to be solely a systems issue. The problems would be defined as purely technical issues. For example, an organization twenty years ago might have been attempting to implement a storage network system into which data processors could enter and store various types of data. This challenge would have been likely identified as, “How can we integrate this new system so that data can be properly stored and retrieved as needed?” With today’s user-centered focus, the same system implementation and challenges associated with it might be identified as “How can we design a storage system that will allow users to effectively and intuitively store and retrieve data with the widest range of flexibility options for the later usage of this data?” The two questions may not seem all that different, but the approach to solving them and thus the related result will differ significantly. Antiquated approaches would study information process charts (IPCs) that focused on the technical issues of the system to

be implemented (Couger 46). While this is certainly an important part of design, it ignores the vast amount of pertinent information that can be gathered by specifically monitoring user behavior and information interactions. Beyer and Holtzblatt (1998) note that, “anyone’s real work practice is intricate and complex; understanding it in depth leads to an overwhelming amount of immensely detailed information”(3). It is now commonly accepted that user behavior must be studied in order to truly understand how a system should function in order to maximize efficiency and ultimately further the business needs and goals of an organization.

User-centered design, then, is the thrust of modern systems analysis. New methodologies and diagramming techniques have come far and can now more accurately capture the useful information that is exuded by users as they perform their daily tasks and interact with systems that analysts are seeking to improve or replace or invent. This approach is also sometimes termed as contextual design. Contextual analysis involves examining first-hand how people work. This data collection process is intended to facilitate an optimal design for a system that will allow work practices to at least continue in their current state, or to be improved upon further. Beyer and Holtzblatt (1998) identify seven key components of contextual design. These are: the contextual inquiry, work modeling, consolidation, work redesign, user environment design, user testing, and implementation (22-25). These key elements are critical to modern systems analysis and will be examined from the Beyer and Holtzblatt perspective as well as those of other leaders in the analysis and development life cycle field.

Contextual inquiry is the first step in analysis after a project has been identified. Analysts attempt to meet with users, their managers and others involved with the current or proposed system in an effort to discover what individual information and workflow needs are, as well as how users approach and execute their work as part of a daily routine. Analysts observe the ongoing experiences of users and collect concrete data. It is important to focus on actual, first-hand data and not users' explanations or memories of their experiences (Tec-Ed 1). This is why a thorough first-person investigation must be completed. It is not enough to assume that users' accounts of their experiences with a system are sufficient. Beabes and Flanders (1995) explain the value of the contextual inquiry further: "As the users work and talk aloud about what they are doing, and as we engage in an inquiry with them, they are able to articulate many details about their work that they would not remember if we were to interview them when the tasks are not so present"(409). This open dialog between the analyst and the user will more accurately identify usability issues that may have been previously unrecognized. Users should not be led by the analyst but observed objectively. The goal is to watch the user work as naturally as possible and gather information about this process. Questions to clarify user actions further are important, but analysts should not attempt to conduct a standard, formal interview. Although such inquiries and interviews still require a resource commitment in the form of employee time, managers and users alike must be educated to realize the value of contextual inquiries and how their input may affect future systems.

The work modeling portion of current systems analysis methodologies has seen perhaps the most expansion and consideration in recent years. While there are dozens of different work models currently used in systems analysis, many are very specific or even proprietary. Some companies adapt modeling techniques to form their own methods. For this reason, this study will describe four of the more common work modeling methods. These will include the communication flow model, the artifact model, the cultural model, and the sequence model. Modeling involves diagramming events, or information flows, or interactions between people and systems. According to Taylor and Hobday (1992), “An effective work modeling program provides an excellent means of increasing communication between the management team and production teams in team-based operations”(6). The communication flow model is an excellent example of how detailed interactions can be mapped in a useful manner. Roles and responsibilities, physical objects that may move between the groups, and information that is passed from role to role are all identified. The following is an example of a communication flow model:



The communication flow model is perhaps the most valuable and widely used of the previously mentioned modeling techniques. It is able to identify roles, responsibilities, and information flows in a manner that might not have been previously considered.

The artifact model seeks to collect and identify specific objects that are used in information transactions. These may include forms (paper or electronic), or other objects like paper documents or electronic documents that are a part of the workflow of an organization. These artifacts are collected and then analyzed to determine their exact specifications and their detailed implications on a particular system.

The cultural model can be equally important in organizations where there are political and cultural overtones that may invisibly affect the way people perform their work. Schein (1985) describes workplace culture as, “a pattern of basic assumptions - invented, discovered, or developed by a given group as it learns to cope with its problems of external adaptation and internal integration - that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems”(9). This definition is worthwhile because it explains that culture is constantly reproduced and new members or employees are quickly indoctrinated. An employee who is used to working with a system in a particular manner may come to a new organization and quickly realize that their old style of interaction is no longer acceptable; the culture of the new work environment promotes and demands its own style. The cultural model uses a bubble-type diagram to identify influencers, individual influences between roles, breakdowns between relationships and the overall pervasive culture (Beyer, Holtzblatt 109). The success of the cultural model depends on the level of observation and openness that an analyst can manage to achieve during contextual inquiries.

The sequence model is the last major work model that will be described. This model is very similar to a task analysis that is often performed in other areas of system development and user-centered designs. Essentially, an analyst “merely [has] to write down everything the user does. Sequence models supply the low-level, step-by-step details on how the work is accomplished” (Wood 1). A sequence model will generally

focus on one task that a user will perform. Each event or part of the task has a trigger, or an initiating factor, and then the sequence of events that follow is documented along with the various iterations as a user runs into challenges along the way. Sequence models are generally adopted for high-level tasks like completing a marketing report or running a particular query on a database. It is important to record all intents and triggers that initiate the information seeking task as well as any errors or complications that a user might experience in executing each step of the task. This model, like the others, is designed to assist an analyst and the supporting team of system developers in visualizing the needs of users, the business, and the system so that a design and implementation plan for a new or revised system can be utilized as effectively and efficiently as possible.

Once a series of work models have been created, consolidation is the third logical step once a series of work models have been created. Often, work models examine very specific pieces of a system's functionality or an individual user's experience with a particular system. Communication flow models, sequence models, cultural models, artifact models, and any others that an analyst team might create during the modeling phase need to become unified and assimilated to provide a more general view of a work environment. Osborne and Nakamura (2000) note that with individual models, "The level of complexity is suitable and even necessary for documenting the logic of a computer program; it would, however, be confusing in a management report"(Osborne, Nakamura 83). This is an excellent reason for consolidating models into a more generalized diagram. Systems are rarely designed for a single user.

Instead, most systems are created for entire departments or organizations. While analysts will never want to lose the individualized data that has been collected from interview sessions and microanalysis of system functionalities, consolidated models will help engineers and managers to conceptualize the framework of current and proposed workflows. Consolidated models often also serve as marketing tools. Most system implementations require the support of upper managers who may not be technically familiar with the tools and results of systems analysis. Still, these individuals are most likely to sign off on the resource commitments that enable competent analyses. So, consolidated models that show generalized information can also serve as intermediary type documents that can inform non-technical team members.

Work redesign, the fourth step, is a common follow-up to the consolidation of work models. The goal of almost any system implementation is to somehow redesign a work flow or process to make it more effective or cost-efficient. This means that systems analysts are responsible for redesigning the work practices of employees and departments with which they may be initially quite unfamiliar. This is why the contextual inquiry, work modeling, and consolidation steps are so important. Much intimate knowledge of existing work practices should be collected before a work redesign is attempted. While traditionally, work redesign involves using consolidated models to suggest technological solutions to improve work practices, in user-centered design technical solutions are not always the focus. The analysis team should suggest technologies that could support new work practices, but the team should concentrate

on designing new ways to structure the work (Beyer, Holtzblatt 23). While work practices are often incredibly complex, involving multiple departments and roles, analysts can draw from their variety of consolidated models to begin to identify common themes and issues in the workflow process. Perhaps a document is being routed inefficiently and no one has noticed it before. Or, perhaps the process of an administrative assistant providing certain information to a manager is redundant as another administrative assistant is already gathering and disseminating the same information in another department. Minnick and Pischke-Winn (1996) suggest that a virtual task analysis be performed during the work redesign effort. Several questions that they suggest asking are: “How were the tasks determined?”, “Who defines the services and tasks?”, and “What data exist regarding the frequency and timing of the tasks?”(61). These questions or others like them will help analysts to examine the effectiveness of current work processes and to suggest new work designs that may or may not require technical implementations for support.

The user environment design, the fifth logical step, should be an implicit system design that either mirrors or supports the workflow design. After a system has been selected to support a certain work need, the system functionalities are mapped in relation to each other. This system work model is often very different from the user work model. Most notably, it maps the same work functions from a system perspective. The system work model describes what a system will accomplish and how it will be organized, but not how it will look (Balasubramanian et al. 8). This is

very similar to the way that technical blueprints or floor plans are used in industrial architecture to map the layout of a structure.

Once the system work model is established, then work on the user environment design can begin. The user environment design is similar to the system work model but it shows only the parts of the system that a user would care about or interface with. There is no regard given to the exact user interface design at this point. Only the portions of the system that a user would manipulate and the relationships between these elements are mapped in the user environment design. As Beyer and Holzblatt (1998) point out, “The representation shows all parts of a system that the user knows or cares about, what aspects of work each part supports, and how the parts of the system relate to each other”(306). This user-focused system blueprint forms a critical foundation for the actual creation of the system and the user testing and implementation that are to follow.

As the sixth step, user testing is an important part of any effective system. It can, however, be one of the most neglected areas of systems analysis. Multiple iterations of a system are required to flush out inconsistencies in design or complications in the system work model. User testing, often and early, will force these issues to rise to the surface. Paper prototyping, or “lo-fi” (low fidelity) prototyping, is a cost-effective, but worthwhile form of early user testing. Lo-fi prototypes are paper representations of a user interface. During user testing, users are given some sort of information seeking task and they navigate through the paper prototypes to find the desired object.

This may not be an entirely new idea, but as Rettig (1994) points out, “Paper prototyping is potentially a breakthrough idea for companies that have never tried it, since it allows you to demonstrate the behavior of an interface very early in development, and test designs with real users”(22). It is also quite valuable to encourage users to think aloud during testing sessions. As users vocalize internal thoughts, analysts can discover the intentions behind various user actions. Still, analysts need to remember to watch people work instead of listening to user explanations of how they work. Forcing the users to perform specific tasks will allow analysts to collect real data. As Nielsen (2001) states, “If the users have not actually tried to use the designs, they'll base their comments on surface features. Such input often contrasts strongly with feedback based on real use”(1). The results of these user tests will provide data to improve the system and help to create an effective user interface design that supports all required tasks.

Implementation is the final step of user-centered systems analysis. Many systems eventually reach the implementation stage, but most do not have the design benefits that are provided by the first six steps. Any implementation can be challenging. In some cases, virtually every part of an organization is involved with or affected by a new system implementation. The adoption of a new system that redesigns work processes can be a particular challenge. Generally, in order for a system to reach the implementation stage, there is a project champion who drives the analysis process and markets the system and its benefits to other internal employees. Beyond that, “The relative costs of implementation, such as retraining employees and building a

necessary interface between the software and the current materials management system, dwarf the cost of adoption” (Hausman , Stock 2.3). Resource cost estimates may fall short during the implementation stage. Well-executed planning is critical to providing proper estimates to management to prevent the obvious problems that result when resources run dry.

In further consideration of how to perform a proper implementation, Gottschalk and Hogskolen (1999) have identified four major concerns: (1) management commitment, support, monitoring, and competence; (2) resources, especially of Information Systems specialists and an implementation champion; (3) quality of plan documentation; and (4) user involvement in implementation (1). If an analyst team can consider these four factors throughout the planning stages and properly perform the first six steps of user-centered analysis, the implementation should be considerably facilitated.

The value of these user-centered methodologies is not always self-evident. Commitments of time, effort and money are required. This multilevel commitment can often contribute to corporations deciding against advanced theoretical systems implementations. Instead of following the steps of proper systems analysis methodologies, companies instead modify or integrate new systems in a less structured and haphazard fashion. For example, a company may decide to implement a large, scalable human resources application that offers a wide range of functionalities. The company, or maybe just the team responsible for the implementation, may have a set of business objectives or goals that the

implementation must achieve. However, by focusing merely on the narrow set of goals, the application may be integrated into an existing environment in such a fashion as to conflict with other applications or to limit the new system's functionality. Many new enterprise-wide applications are not out-of-the-box type programs. Instead, they are frameworks that offer a substantial degree of customization and flexibility. Less sophisticated or even non-existent systems analysis methods may not be sufficient to implement the new system to its fullest potential. This deficiency will be manifested in wasted resources, lost functionality, conflicts with other systems, and/or inefficient or ineffective user interfaces.

Even with acceptance of the value of user-centered analysis methodologies, there may be other barriers to success. Management involvement and commitment are crucial to success. Without management's support, resources may run dry, authority to implement proposed changes may be lacking, and organization or department-wide acceptance of the effort may falter. The actual implementation of a system requires many more individuals than those who work on the design or analysis teams.

Management, functionally diverse departments and end users all participate in an implementation. Without the backing of management and the allocation of proper resources any system implementation is likely to fail or at least remain functionally impaired. All of the involved individuals must be committed to the implementation. Creating this unity is usually the job of the project champion who will continue to market the system implementation from the first steps of the analysis to the last stages of implementation. A project champion is necessary to keep the effort visible when

managers' attention may be elsewhere. But, the project champion must not be allowed to become the project owner. Political interactions can sometimes foster this type of action. A champion may take over a project and force his or her will upon it despite the best interests of the organization. Political and cultural environments should be taken into account when planning analysis efforts. Sometimes confrontations cannot be avoided, but considering conflict during the planning phases can help reduce cost. Organizations may have other characteristics that are unique that may affect the usage and effectiveness of user-centered systems analysis. Analysts and others involved with a particular project would do well to examine potential barriers to success before attempting any analysis or implementation.

Methodology

In order to evaluate the benefits of systems analysis methodologies and contrast them to the possible negative effects of ignoring such methodologies during an implementation, a case study methodology is be employed.

Five case studies have been selected and are examined to determine how well each utilized the previously discussed seven steps of user-centered systems analysis that have been supported by the literature. The selection of these studies was primarily the result of a search for published cases that provided the amount of data necessary to

ascertain whether and in what way each case followed the seven steps of user-centered systems analysis.

Four of the cases were selected from a single work by Goodhue et al. (1992) entitled, “Strategic Data Planning: Lessons From the Field.” This study focuses on the effects of strategic data planning in large organizations on the goal of enterprise wide data integration. While the “Strategic Data Planning” study focus is different from the current study of systems analysis, the detailed case studies that the authors present contain a wealth of pertinent data regarding the systems analyses performed in each case. Each company in the four case studies was attempting similar efforts to fix a common problem. According to Goodhue, et al, “Access to data from various organizational subsystems is often required to respond to the demands of an increasingly competitive global marketplace. Yet many large organizations today are finding that even if they can access data from multiple functions, the lack of logical data integration (common data definitions and codes) across information systems makes it difficult or impossible to answer cross-functional or cross-divisional questions”(11). This was the goal for each of the four companies in their respective case studies.

Another study was selected from a work by Senn and Loomis (2000) entitled, “A Case Study Success of an OSA Implementation.” The study examines the implementation of the Oracle Sales Analyzer by Pioneer Balloon Company. Pioneer needed to implement this Enterprise Resource Planning software to facilitate *ad hoc*

analysis and reporting of data across the organization's departments. Senn and Loomis have provided enough information to examine this case in light of the seven steps of user-centered systems analysis.

Case Studies

Case Study #1 – Logistics and Supply Agency

“The Logistics and Supply Agency (LSA) is a federal government agency that furnishes spare parts and other consumables to other agencies”(Goodhue, et al. 16). The LSA acts to coordinate logistics of contracts and the agencies and contractors to whom they are bound. The LSA employs over 25,000 people and maintains an annual budget of over \$500 million. Much of the data infrastructure at LSA is piecemeal. That is, it has been developed to support specific operational needs without the potential of future data sharing. This study focuses on an effort that began in 1979 to update hardware and computing facilities. This initiative floundered for several years before a planning committee was finally formed in 1985. A form of contextual inquiry was first performed to identify all of the different business areas of LSA and their functional data requirements. The result of this inquiry was a classification of business areas as either essential or non-essential to LSA's external mission. An extensive work and data modeling process began next. According to Goodhue, et al., “Data modeling was by far the largest single component of the planning effort. It used between 70 and 80 percent of the person hours spent on all activities”(17). Despite

this extensive modeling effort, many of the analysts were concerned that the resulting models might not be useful or completely accurate because of the interdepartmental make up of the analyst team. In an attempt at consolidation, these models were reviewed and summarized in non-technical documents. The summary documents were then further consolidated into a “Concept Paper” which discussed business goals, data support requirements, and system support requirements.

At the time of publication of the Goodhue study, the implementation still had not been completed. A work redesign was underway across the departments. The redesign had fallen back to the individual business areas and was not centralized in any way. The champion of the implementation was continuing to struggle to keep the original vision alive. This initiative, started in 1979, was still struggling in 1987.

While the initial steps of proper user-centered analysis were performed, barriers such as the diversity of departments, organizational logistics and politics, and the commitment of management kept the implementation from progressing in a timely manner. A user environment design, user testing, or implementation phase was not reached due to the inability of the organization to come to a consensus about how to proceed.

This analysis effort was generally accepted as successful by LSA, but there were differing individual opinions. The “Concept Paper” was praised by some as an effective document for identifying functional goals and the overall direction for LSA systems. Other groups argued that the “Concept Paper” did not provide detailed

enough information to serve as the basis for redesigning systems. Perhaps some of the technical detail was lost in the consolidation process. The analysts struggled internally to accept their data and work models. Some thought that the models were inconsistent, and this belief most likely crept into the resulting consolidated reports and papers. Overall, LSA's analysts made a valiant attempt at performing a proper user-centered analysis and implementation. However, the company's underlying structure and lack of a central vision for the project hindered the advancement of the implementation.

Case Studies #2 and #3 – Ventura Products

Case studies two and three were both performed at Ventura Products. One study focused on the Finance division and the other on the Support and Service division. Ventura Products manufactures and distributes health care and industrial products. Annual sales revenues exceed one billion dollars. A few systems are centralized within the company, but most individual departments are responsible for systems that require function specific operations. An overall Corporate Information Systems (CIS) group supports common functions across the company. However, both Finance and the Support and Service divisions undertook separate attempts at new system implementations. The details of each and the analysis steps used follow.

Case Study #2 – Ventura Finance Division

The Ventura Finance division consists of four departments: Tax, Controller, Internal Auditing, and Treasurer. Over 1,000 employees (of which 60 are IS dedicated) comprise the Finance division. The operations of the Finance division are constantly affected by changes in legal requirements, government regulations, and technology. This environment has resulted in an IS department that focuses more on keeping up with these changes and day-to-day crises than designing and following any sort of long-term plan. This meant that Finance was facing problems with incompatible data across systems and rapidly escalating costs. Finance managers decided that a long-term vision must be created to help in creating standards and guidelines that would facilitate a more stable environment and logical resource allocation. An initial contextual inquiry revealed that since Finance is a central hub for all of Ventura's operations that a complete analysis would produce an unusable volume of information. So, the business functions that were to be examined were limited to forty. Even these forty provided so much information that the analysts had to work at a higher level than desired. This high-level examination could only produce loose architectures and few work or data models.

The analysis process resulted in two products eventually being developed. The first was a type of work model that identified 11 "logical locations." This was a type of conceptual map that facilitated an understanding of data organization and system

interactions. The second product was a list of 18 high-level recommendations and guidelines. This consolidation effort attempted to logically analyze all of the data that had been collected and provide some useful conclusions. A sample recommendation is, “We recommend that a data resource manager (DRM) be appointed for the Finance Organization. The DRM would be responsible for integration of data at the organizational level”(Goodhue, et al. 20). This recommendation is a result of the work redesign attempts that the analyst group made. By looking at the models and information collected during the inquiries, the analysts were able to see a need for a new work practice. The appointment of a Data Resource Manager would centralize the integration of data at the organizational level and possibly eliminate redundancies or inefficiencies.

Another document, the final plan, identifies on a very broad level what systems should be upgraded or developed in the future in order to fulfill divisional business needs. From the final plan, each department within Finance was expected to execute its own planning efforts including work modeling. Finance then collects these efforts and consolidates them to form a master plan for system development. The user environment design, user testing, and actual implementation stages were not reached during the duration of this study.

The nature of the Finance division created considerable obstacles in the analysis process. As the hub for all financial operations of Ventura, Finance was dealing with an enormous amount of data coming from many different systems. A proper analysis

of each stream of data and the corresponding system would have been an enormous task and was beyond what Finance was willing to attempt. Limiting the business functions to forty helped to focus the analyst group. The contextual inquiry, work modeling, consolidation and work redesign steps of user-centered design were fairly closely adhered to considering the volume of data that was being examined. The work modeling step appeared to receive considerable effort as it resulted in the creation of the first product, the conceptual map with the 11 logical locations. The 18 recommendations and guidelines as well as a fill-in-the-blanks type of final plan were also valuable outputs from the analysis process.

It seems to have been beneficial to allow the individual departments of finance to take the final plan, examine it in light of their respective functions, and create plans and work models for specific systems. The greatest challenge to the Finance division appeared to have been the fact that they were dealing with data from every direction of the organization. Since there were few centrally controlled or standardized systems within Ventura, Finance had to interact with a multitude of different systems. This problem is difficult to fix once it is established. Although the effort was considered successful internally, only serious and ongoing analysis efforts, as well as commitments from management, can succeed in slowly integrating the various systems of the company. It is best to plan for integration and standardization from a company's inception. Unfortunately, the quick rise in the availability and functionality of technology made this impossible for many companies that had been

conducting business since long before data integration and cross-platform compatibility were real issues.

Case #3 – Ventura Support and Service Division

The Support and Service Division (SSD) of Ventura Products employs over 1,000 people in the U.S. This includes 15 regular IS employees and 25 IS contractors. SSD was created between 1979 and 1982 when Ventura pulled in multiple smaller divisions to facilitate managing customer service contracts at the corporate level. It took over five years for the newly created SSD to stabilize and define its business mission. Development of IS systems or even integration of the individual departments existing systems was not a priority during this five year period. However, once a clear business mission was identified, IS was quickly recognized as critical to the success of these business objectives.

SSD wanted to shift its focus from supporting and servicing products to supporting and servicing customers. This meant that instead of tracking serial and part numbers, SSD wanted access to information about service requests, equipment histories, etc. The conglomeration of pre-existing IS systems could not support this and also suffered from serious data integrity issues. So, managers quickly agreed that an environment of integration and planned development was necessary. The specific goal and focus of the systems analysis was to design a set of completely integrated

systems. The contextual inquiry identified 60 business functions and 20 data entities. Detailed data and work models were consequently developed to define the relationships among these elements. A work redesign effort revealed a need to change from a mixed vendor environment to a single vendor. SSD then spent one year validating the designed technical architecture by prototyping the systems through the use of user testing. A final product of the analysis was a Gantt chart that prioritized and detailed the future development projects.

Implementation of one of the systems began shortly after the analysis completed. The *revenues* system sought to integrate with other corporate systems. In fact, during the implementation, SSD spent considerable time in reconciling the data definitions of over 500 elements of the *revenues* system with Ventura's existing corporate data dictionary. This process was identified as valuable by SSD, but they did not attempt the same definition reconciliation with the *logistics* system because of the resource commitments it required. Although this effort was considered successful internally, at least one difficulty encountered during the implementation was the result of a problem during the prototyping and user testing phase of the analysis. Apparently one of the data models created by users was inaccurate. The project manager and his team spent considerable effort in redesigning the model and the affected portion of the system. This was attributed to the use of a work model that relied too heavily on user input. The project manager is quoted as saying, "We are the experts, not the people doing the [testing]. We have to sort out and correct the errors made by the [testing]"

people anyway”(Goodhue, et al. 20). This difficulty resulted in wasted time and efforts.

The literature supported steps of user-centered design appear to have been followed although not all steps were reported upon. The contextual inquiry, work modeling, work redesign, user testing, and implementation were all discussed, but the consolidation and user environment design steps were not mentioned. Although some form of consolidation and user environment design must have occurred, it is unclear whether or not they adhered to the best practices of systems analysis. Overall, the implementation of at least the *revenues* system within Ventura’s SSD department employed the major principles of user-centered systems analysis.

Case Study #4 – Cedar Industries

Cedar Industries offers a diverse base of products and services to other business and consumers. Specific information about Cedar’s products is not available, but the organization was a major force in an industry that was deregulated during the 1980’s. This deregulation caused considerable upheaval in the company’s structure, culture and business. A reorganization of Cedar Industries followed, and it was discovered that many of the company’s departments that were previously independent now needed to share information that their current infrastructure did not support. The problems were so paralytic that a high-level internal task force and an external

consulting firm were tasked with fixing the systems issues. An analysis was to be completed to uncover the critical data needed to run the business, create an architecture around which future systems could be built, and identify key strategic systems.

Cedar's Consumer Services was the first division to begin the analysis process and is the focus of the study. Consumer Services was accustomed to focusing on existing products instead of consumer needs, but the deregulation placed the division in a much more competitive environment that required the anticipation of consumer needs and quick responses to those needs. The manager of Consumer Services was a firm believer in data management and created specific goals for the analysis process of creating a division-wide data architecture and identifying and prioritizing future systems development projects. A contextual inquiry in some form was performed to identify all of the business functions, processes and activities. These were further explored in a business model that contained 16 business functions, 88 processes and 530 activities. Also, 20 to 40 different user types were identified, and both the type and location of user was associated with each of the 530 activities. This analysis produced ten potential projects. Of these, four were selected for a more detailed analysis. Of those four, three were eventually implemented. While there was no explicit discussion of Cedar's use of work redesign, user environment design, or user testing, it is likely that some form of each step was completed.

Perhaps the most useful of the user-centered analysis elements to Cedar was work modeling. The blueprint of business functions, processes and activities became an architecture that was consolidated into about 200 “business modules” that were groupings of the 530 activities and 40 data entities. The analysis and architecture development were considered a success but with a high cost. Even the manager who acted as the project champion was unwilling to perform another full strength analysis due to the high financial costs. For the time required and the money spent, the analysis “does not seem to produce a much better plan”(Goodhue, et al. 21). Another issue was that many of the analysts had become overly involved in attempting to automate existing business processes instead of remaining creatively objective enough to rethink or redesign business processes. This speaks to a problem with the work redesign portion of analysis. While the analysis was considered successful within Cedar, perhaps a more effective work redesign process would have created a more useful architecture or analysis that would have justified the high cost of the effort.

During the contextual inquiries, some of the more critical issues arose quickly. These issues were immediately acted upon by managers before the analysis was finished. With the major problems having been addressed, there was little incentive to continue the rest of the analysis and implementation process. Overall, Cedar managed to create a useful architecture from an analysis that probably consisted only of contextual inquiries, work modeling, consolidation and muddled work redesign efforts.

Case Study #5 – Pioneer Balloon Company

The Pioneer Balloon Company manufactures latex and foil balloons and other related items like mugs, ribbons, etc. In 1999, Pioneer decided that it needed to implement some form of Enterprise Resource Planning (ERP) software to facilitate ad hoc analysis and reporting of data across the organization's departments. J. D. Edwards OneWorld application package was selected as the ERP. Still, Pioneer would need a new reporting application to take data from OneWorld and reconfigure it to be more conducive to reporting and analysis. The Oracle Sales Analyzer (OSA) was selected after Pioneer studied several vendors with similar products. A contextual inquiry of sorts followed in the form of requirements gathering. A series of work models, mostly in the form of information hierarchies, were created and included in the appendix of the Senn and Loomis (2000) case study. These models identified 62 descriptive measures used for reporting and 30 attributes that mapped descriptive values to dimension values in the database. No explicit of any consolidation steps taken by the analyst team was made. A work redesign followed that reordered some of the hierarchies according to new data uncovered during the inquiry. Also new attributes and measures were created to facilitate in-depth reporting. Although it was not specifically discussed, there is evidence that a user environment design process did occur before user testing. The first round of prototypes that users were asked to evaluate only tested basic data access and the structures that were created. This indicates that the user environment design was considered in that certain prototypes only reflected the portions of the system that users would care about or interact with.

User testing as a whole was quite extensive. A group of seven pilot users was created to help determine possible difficulties before implementation. The pilot users were trained on OSA and then asked to use the reporting system for various tasks. A feedback database was created for these users to ask questions and provide pertinent feedback. Two weeks before the implementation all end users of the new system attended training sessions. The implementation followed and, although it was cited as a success internally, several challenges arose. Security became a problem as there was a conflict between the Novell network and NT servers that were running the applications. A special NT group which granted specific permissions to network users had to be created and all end users were added to it with permissions to log on locally to the server. Other difficulties regarding Pioneer's off-site users surfaced. Access for Macintosh users was a problem so a web interface was created to allow cross operating system usage. Also, technical consultants needed a way to control servers remotely from off-site locations. Eventually, Microsoft's NetMeeting (a free product) was chosen to allow this functionality.

Despite these issues, Pioneer considers the OSA implementation a success. One of the first cited keys to success was an implementation champion. In Pioneer's case, the champion was the company's Chief Operating Officer. This sponsor marketed the implementation and participated in high-level design discussions. Many changes to the original plan and design specifications occurred as the implementation progressed. The flexibility of the original design plans and analysis determinations, and the scalability of the technology being implemented allowed for effective

navigation through these challenges. A post-implementation analysis was also performed. Creating a pilot group of users for extensive pre-release testing and the performance of the project champion were cited as two of the major contributors to success (Senn and Loomis 6). Although there was no report of a consolidation step, the other six steps of user-centered systems analysis were performed. Pioneer recognized the vast resources that were being committed to this project and planned accordingly, and although it was not recognized in the case study, the analyst team performed practically all of the literature supported steps of user-centered systems analysis.

Measurements of Success

It is difficult to measure the success of a systems implementation. There is a bias in the literature to only report case studies that are at least internally considered successful or at least semi-successful. Most companies shy away from publicizing failed implementations. Even when an organization considers an implementation successful, is it successful by an industry standard? Or does an industry standard of implementation success even exist? Will a proper, user-centered analysis that completes all seven steps always lead to a successful implementation?

Goodhue et al. (1992) measure the success of their four case studies based on an assessment of production. Although their study measured the effects of strategic data

planning (SDP), the measurements of success used may still be applicable to systems analysis. According to Goodhue et al., (14) the result of SDP could be:

1) Implementation of Integrated Systems

2) Creation of Data Architecture Capable of Guiding Future Integrations

3) Identifying Systems Priorities

4) Rethinking Business Processes

5) Education Across Organization and Improved Communication

None of these products is given greater weight than the other in the Goodhue et al. study. They are seen as possible positive outcomes of a SDP effort. The outcome will vary based on the commitment to the SDP process and the scope of a particular project.

With regard to systems analysis, a similar listing might be created. Not every systems analysis process will run from contextual inquiry to implementation. Degrees of analysis must be recognized. Perhaps an analysis is performed regarding a particular system and the contextual inquiries, work models and consolidation efforts reveal that the system is not appropriate for the organization. This analysis is not unsuccessful because there was no implementation. Bearing in mind fluctuating business needs, constantly evolving technology, and structural differences of organizations, the following list of products from a user-centered systems analysis should be present to demonstrate some degree of success:

1) Implementation of an Integrated System – This would be characterized by a system implementation that meets the main goals and objectives that were defined at the project's inception and that is integrated to some degree with pre-existing systems.

2) Detailed Documentation of Current Systems and Relationships – This documentation would consist of models and information that have been created through contextual inquiries. The documentation would provide a complete mapping of an organization, or a portion of an organization's systems structure and the relationships between separate systems.

3) Work Redesign Recommendations – These recommendations would be the result of contextual inquiries, work modeling, consolidation, and work redesign efforts. The recommendations would identify key work processes that should be changed and how the changes would specifically improve business objectives.

4) Work Models that Identify the Flow of Work and Data – These models would accurately reflect the work processes of an organization, or a portion of an organization. The work models would identify complete flows of work and data from the beginning of a task to its completion and all of the systems, processes and individuals involved.

5) Future Systems Guidelines – These guidelines would reflect clear efforts of user-centered systems analysis. The guidelines would account for current work processes, current systems architectures, and current business objectives while allowing for the future integration of systems designed to improve work processes, systems architectures and the achievement of business objectives.

Discussion

The five case studies examined achieved differing levels of success using the measurements of success suggested in this study. All five of the systems analysis efforts discussed in the case studies were considered successful within their respective organizations. However, it is necessary to examine the studies as units. How many of the steps of user-centered systems analysis did each organization perform and were any of the products of success described above produced? The following chart examines the five case studies with these points in mind:

Five Case Studies – User-Centered Analysis Steps Followed and Products of Success					
	Case Study #1- LSA	Case Study #2- Ventura Finance	Case Study #3- Ventura SSD	Case Study #4- Cedar Industries	Case Study #5- Pioneer Balloon Co.
Contextual Inquiry	YES	YES	YES	YES	YES
Work Modeling	YES	YES	YES	YES	YES
Consolidation	YES	YES	NO	YES	NO
Work Redesign	YES	YES	YES	YES	YES
User Environment Design	NO	NO	NO	NO	YES
User Testing	NO	NO	YES	NO	YES
Implementation	NO	NO	YES	NO	YES
<u>Products</u> <u>Of</u> <u>Success</u>	Detailed Documentation Of Current Systems and Relationships	Future Systems Guidelines	1)Implementation of an Integrated System, 2)Work Models that Identify the Flow of Work and Data	1)Work Models that Identify the Flow of Work and Data 2)Future Systems Guidelines	1)Implementation of an Integrated System 2)Work Models that Identify the Flow of Work and Data 3)Work Redesign Recommendations

Several conclusions can be drawn from this chart. First, it is not necessary to complete all of the steps of user-centered analysis to produce products of success.

Second, an implementation of an integrated system can possibly occur without following all seven steps of user-centered analysis. Third, organizations that do complete the same steps may not end up with the same products of success. These differences allow for the opportunity for an effort that follows some of these steps to result in several products of success or none at all. These differences can be accounted for by differences in organizational structures, business objectives, analysis teams, resource commitments, management commitments, immediacy of initiatives, data needs, pre-existing system differences, project goals or other factors. Also it can be concluded that the implementation of an integrated system does not predetermine what other products of success might be produced. A successful implementation may or may not be achieved in combination with other products of success. These conclusions should help to identify the biased nature of “success.” Organizations may perform analyses that some would consider unsuccessful. However, if products of success are produced as part of user-centered systems analyses, those same analyses may be considered successful.

Conclusions and Recommendations

Some other generalized conclusions have been made clear by this study. First, it would be highly valuable to the rest of the systems analysis community for organizations to publish the results of systems analysis and implementation efforts. Little literature is available that examines individual instances and attempts at analysis. The existing literature is predisposed to positive results. If organizations

would be willing to share the results and steps taken in failures or less successful attempts, further analysis and examination of the state of systems analysis and the factors affecting execution and success could be made.

Second, it would also be helpful to the systems analysis community if a standard measure of success were adopted. Perhaps the measures suggested in this study or some form could be recognized by professional organizations to further their standardization and acceptance. It has also become clear that many other factors besides the steps taken in a user-centered systems analysis can have a great effect on the results of the effort. Organizations should become aware of barriers to success and attempt to reduce their impact on analysis endeavors.

User-centered systems analysis is an accepted technique for approaching the implementation of a new system. Its steps are intended to generate enough data to allow analysts to design systems that will integrate with existing systems in the most efficient and effective manner possible. While the steps are commonly accepted, creativity is not lost. There is considerable room for improvement and adaptation within the analysis field and within specific efforts to design systems, redesign work processes, and to meet the changing demands of business in an innovative way. There will never be a perfect implementation, but the ideas and concepts that have been analyzed in this study along with the creation of measurements of success for user-centered systems analysis efforts can improve the potential for success of any analysis endeavor.

References

Balasubramanian, Sridhar, and Krishnan, Vish, and Sawhney, Mohanbir, "The Implications of Digitization for Markets and Marketing" No Date. Accessed 6/23/03 at: <http://www.mcombs.utexas.edu/~balasrid/ug/digtab10.doc>

Beabes, Minette, and Flanders, Alicia, "Experiences With Using Contextual Inquiry to Design Information," *Technical Communication*, August 1995.

Beyer, Hugh, and Holtzblatt, Karen, Contextual Design: Defining Customer-Centered Systems. Academic Press, San Diego, CA, 1998.

Couger, Daniel. "Evolution of a Business System Analysis Techniques," *Systems Analysis Techniques*. From 1974 volume 17 p46.

Digital Infrastructures: e-Government for Development. "State of the 'Art': Challenges to IT Implementation," *Central Issues in Information Technology and Government Defining the Process*. No Date. Accessed 6/29/03 at: <http://www.abrivo.com/foundation/devX/di/ci/>

Gargeya, Vidyaranya, and Brady, Cydnee. "Factors Leading to Success and Failure in SAP Implementation", *Decision Sciences Institute 2002 Annual Meeting Proceedings*. Accessed 6/18/03 at: <http://www.sbaer.uca.edu/Research/2002/dsi/papers/137.pdf>

Goodhue, Dale, and Kirsch, Laurie, and, Quillard, Judith, and Wybo, Michael. "Strategic Data Planning: Lessons From the Field", *MIS Quarterly*, March 1992, pp11-34.

Gottschalk, Petter, and Hogskolen, Den, "Strategic Information Systems Planning: The Implementation Challenge," *Henley Working Papers*, 1999. Available at: <http://hsb.baylor.edu/ramsower/ais.ac.97/papers/gottsch.htm>

Hausman, Angela, and Stock, James, "Adoption and Implementation of Technological Innovations Within Long-term Relationships," *Journal of Business Research*, August 2003, pp681-686.

Iivari, Juhani and Maansaari, Jari. "The Usage of Systems Development Methods: Are We Stuck to Old Practices?" *Information and Software Technology*. Volume 40, Issue 9, September 15, 1998: 501-510.

Lederer, A L, and Sethi, V (1992), "Root Causes of Strategic Information Systems Planning Implementation Problems," *Journal of Management Information Systems*, 9 (1): 25-45.

Minnick, Ann, and Pischke-Winn Kathy, "Work Redesign: Making it a Reality", *Nursing Management*. October 1996: 61-66.

Nielsen, Jakob, "First Rule of Usability? Don't Listen to Users," *Alertbox*, August 5, 2001. Accessed 6/12/03 at: <http://www.useit.com/alertbox/20010805.html>

Osborne, Larry, and Nakamura, Margaret (2000) Systems Analysis for Librarians and Information Professionals. Englewood, CO, Libraries Unlimited.

Rettig, Marc, "Prototyping for Tiny Fingers", *Communications of the ACM*, April 1994: 21-27.

Schein, E. H. (1985) Organisational Culture and Leadership, San Francisco, CA, Jossey-Bass.

Semprevivo, Philip (1982) Systems Analysis: Definition, Process, and Design. 2nd ed, Chicago: Science Research Associates.

Senn, Donna, and Loomis, Karla. (2000) "A Case Study Success of an OSA Implementation," *Presented at IOUG-A Live! 2000*. Accessed 6/18/03 at: http://216.63.18.130/pls/portal30/docs/FOLDER/PAPERS/A+CASE+STUDY+SUCCESS+OF+AN+OSA+IMPLEMENTATION_0.PDF

Taylor, Don and Hobday, Gary, "Work Modeling Techniques to Bridge 'Management Gap' in Team-Based Organizations," *Industrial Management*, 34(5) (Sept-Oct 1992) 6(2).

Tec-Ed (2003) "Field Studies and Contextual Inquiry" *Usability Evaluation*. Accessed 6/14/03 at: <http://www.teced.com/ue-fs.html>

Wood, Shelley, "Designing to the Intent: Support Your Users' 'Whys', Not Just Their 'Whats'," *Design Corner*. June 16, 2003. Accessed 6/18/03 at: http://www.incent.com/community/design_corner/03_0613.html