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User Experience Engineering Adoption and Practice: A Longitudinal Case Study

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User Experience Engineering Adoption and Practice:

A Longitudinal Case Study

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ABSTRACT

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User Experience Engineering (UxE) incorporates subject areas like usability, HCI, interaction experience, interaction design, "human factors…, ergonomics…, cognitive psychology…, behavioral psychology and psychometrics…, systems engineering…, [and] …computer science," (Hartson, 1998). It has been suggested that UxE will be the main success factor in organizations as we enter the "loyalty decade" of software development, where the repeat usage of a product by a single customer will be the metric of product success (Alghamdi, 2010; Law & van Schaik, 2010, p. 313; Nielsen, 2008; Van Schaik & Ling, 2011). What is relatively unknown in the current academic literature is whether existing UxE methodologies are effective or not when placed in a longitudinal research context (Law & van Schaik, 2010). There is room for the exploration of the effects of long-term UxE practices in a real-world case study scenario. The problem, addressed in this study, is that a lack of the application of UxE-related processes and practices with an industrial partner had resulted in customer dissatisfaction and a loss of market share.

A three-year case study was performed during which 10 UxE-related metrics were gathered and analyzed to measure the improvements in the design of the customer's experience that long-term UxE practices could bring to a small corporate enterprise. The changes that occurred from the corporate and customer's point of view were analyzed as the customer's experience evolved throughout this long-term UxE study. Finally, an analysis of the problems and issues that arose in the implementation of UxE principles during the application of long-term UxE processes was performed.

First-hand training between the research team and company employees proved essential to the success of this project. Although a long-term UxE process was difficult to implement within the existing development practices of the industrial partner, a dramatic increase in customer satisfaction and customer engagement with the company system was found. UxE processes led to increased sales rates and decreased development costs in the long-term. All 10 metrics gathered throughout this study showed measurable improvements after long-term UxE processes and practices were adopted by the industrial partner.

Keywords: long-term, longitudinal, user experience engineering, UxE, human-computer interaction, HCI, usability, user experience, UX, case study, software, development, adoption, practice, agile, activity theory, Leontiev, DSRM, design science research methodology, Ken Peffers, Jay F. Nunamaker Jr., system development research model, SDRM, Victor Kaptelinin, Bonnie A. Nardi

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1 INTRODUCTION

Long-term User Experience Engineering (UxE) is a field that offers many benefits to practitioners and customers and has its roots in Human-Computer Interaction (HCI), Usability and related disciplines. HCI is a decades-old field that is described by the Association for Computing Machinery (ACM) as "a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them" (Hewett et al., 1992). Usability has been defined as "a quality attribute that assesses how easy user interfaces are to use" (Nielsen, 2003). When HCI and usability are combined together, they incorporate learnability, efficiency, memorability, errors, satisfaction, and utility, among other attributes (Nielsen, 2003). HCI and usability have now been extended into related fields like User Experience (UX) and User Experience Engineering (UxE), which incorporate subject areas like usability, HCI, interaction experience, interaction design, "human factors…, ergonomics…, cognitive psychology…, behavioral psychology and psychometrics…, systems engineering…, [and] …computer science," (Hartson, 1998). Overall, UxE involves an analysis of "…the individual's entire interaction with the [product, system, etc.], as well as the thoughts, feelings, and perceptions that result from that interaction" (Tullis & Albert, 2010, p. 4). (Jetter & Gerken, 2007, pp. 2–6; Neerincx, Cremers, Kessens, Leeuwen, & Truong, 2009, p. 110)

It has been suggested that UxE will be the main success factor in organizations as we enter the "loyalty decade" of software development, where the repeat usage of a product by a single customer is the metric of product success (Alghamdi, 2010; Law & van Schaik, 2010, p. 313; Nielsen, 2008; Van Schaik & Ling, 2011). This loyalty trend has emerged and become more visible with the development of mobile devices based on platforms like iOS, Android, Windows Phone, and BlackBerry operating systems, especially. What is relatively unknown in the current academic literature is whether existing UxE methodologies are effective or not when placed in a longitudinal research context (Law & van Schaik, 2010). There is room for the exploration of the effects of long-term UxE practices in a real-world case study scenario.

In longitudinal UxE, traditional testing metrics and methodologies are extended well beyond the initial design of the system, providing more data and opportunities for analysis over an extended period of time that can be utilized by UxE practitioners. Existing UxE design methods have demonstrated their effectiveness in improving systems by using traditional short-term, momentary, single-intervention design techniques, which measure usability at one point in time. This has allowed UxE to become a mainstream practice in software development. Looking toward the future, significant improvements may be achieved through extending the duration of UxE design methodologies into more longitudinal UxE processes.

The effective use of long-term UxE methodologies could give practitioners and researchers an advantage in developing more user-centered systems that will quickly evolve over time according to the constantly changing needs of end-users without requiring an entirely new system to be developed on a regular basis, as is the current practice in system design. Moreover, customer loyalty could increase, providing a higher return on investment in the form of increased

customer usage rates (also referred to as customer engagement) and product sales rates because of successfully applied UxE principles.

In order to determine whether a long-term UxE methodology can be effective, the research team decided to investigate the application of this philosophy within the confines of an industrial partner, through a case study approach. The research team, as well as the industrial partner, wanted to see if a company could effectively implement longitudinal UxE practices into their existing business processes. This approach had the added benefit of making it possible to see the weaknesses and strengths of long-term UxE by observing the changes in corporate and customer behavior while also measuring the performance of the business and customer satisfaction levels during and after UxE changes occurred.

This report describes a three-year period during which a local software company, known as Parlant Technology, Incorporated (Parlant), dealt with a number of challenges to their ParentLink Web services product. ParentLink works to facilitate education-related communication amongst various user groups (parents, guardians, teachers, students, administrators, and the community) by providing products and services that help to convey relevant information in a timely and effective manner. ("ParentLink Mission Statement," n.d.)

The study was done by a research team. Throughout this project the research focus and forward progress was entirely led by myself, but could not have been fully developed without the additional support of subject-matter experts from both academic and practitioner areas (e.g., professors and industrial partners) due to the nature of a real-world case study. For the purposes of this report and to avoid any confusion that every task described in this report was accomplished only by my own efforts, all references to the "research team" include those efforts

led by myself that still included supporting efforts from other stakeholders (e.g., software developers, corporate management).

1.1 Research Process

A structured approach to research is required to frame this long-term UxE study. This longitudinal UxE study used the following research stages to explore ParentLink's ability to incorporate long-term UxE principles into their daily work processes:

1.1.1 Define the Problem

The research team defined "longitudinal UxE" as it relates to this study. This longitudinal definition focused on the implementation of long-term UxE practices within Parlant and centered on the ParentLink system. Additionally, traditional UxE considerations were used to include a combination of the length of time the system was used, the actual usage or "touches" with the interface by ParentLink employees and/or end-user customers, and how well the user understood how to use the system. For example, a first-time user of a process cannot be considered to have the same level of experience with the process as another user who has been using the system for years. The feedback and test results of different user groups—whether internal or external to ParentLink—must be analyzed appropriately and organized according to relevant demographics in order to determine longitudinal trends within the system. Supporting definitions of related terms from existing academic literature were also used to clarify the analysis of long-term UxE in this study.

Long-term, in this context, extends beyond the design of a single product or a single product update. This research addresses the ongoing application of UxE to design environments extending over multiple product iterations and time periods of months to years or longer

The problem, addressed in this study, is that a lack of the application of UxE-related processes and practices within a client company has resulted in customer dissatisfaction and a loss of market share.

1.1.2 Choice of Research Approach

The research team extended an existing research methodology to the UxE domain. Specifically, the Design Science Research Methodology (DSRM) (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2008) (which has been previously extended to the Information Systems domain) with support from Aleksei Leontiev's Activity Theory (1978) (which has been previously extended to the domain of HCI (Kaptelinin & Nardi, 2009)) was chosen for this project. The application of these two theoretical approaches allowed the research team to change the perspective of the traditional short-term, one-time, momentary, single-intervention UxE testing paradigm into a longitudinal UxE process by relying on repetitive and iterative cross-sectional user tests over an extended period of time that could be implemented in the development of any ParentLink product. Additionally, the involvement of the same ParentLink employees over many feedback scenarios during this extended time period, combined with new employees, helped the research team to determine whether the corporate expectations of the practices, processes, and tools being developed for ParentLink were changing on a more general scale (e.g., socially, culturally), as should be a consideration when using the long-term ethnographic viewpoint of Activity Theory (AT). ParentLink employees, in turn, could gather similar data from their end-user customers to make strategic business decisions that would be more closely aligned with the needs of their end-users.

1.1.3 Application of Methodology

The research team tested the DSRM in a longitudinal UxE setting by gathering raw data from an industrial partner (ParentLink) that utilized both desktop and mobile user interface types throughout this three-year case study. User-centered metrics (user surveys, semi-structured interviews, task completion times, user testing scenarios, etc.) were recorded first-hand in order to gather long-term UxE data for this study. This project incorporated qualitative as well as quantitative data, and utilized longitudinal UxE data from automated data gathering tools as well (e.g., server logs and Web analytics systems – both internal and external to ParentLink).

1.1.4 Analysis of Project Results

The gathered data was analyzed throughout the three-year duration of the project through a progression of six testing cycles. Data from each cycle was compared to other cycles in order to determine the effectiveness of UxE methods and the adoption of UxE practices in this domain. This step was critical in order to determine whether the implementation of long-term UxE strategies, as informed by the DSRM and AT, resulted in any changes to ParentLink, their customers, or their systems.

1.1.5 Interpretation of Project Results

After analyzing the gathered data, the research team wanted to determine whether:

- The chosen methodology (DSRM) was appropriate for long-term UxE research.
- The chosen metrics were effective and efficient in studying the experiences of users.
- The chosen metrics were effective and efficient in studying the experience of ParentLink.
- The DSRM provided more timely (i.e., a decrease in the time required to gather customer feedback) and/or more relevant (i.e., discovering more specific customer requests rather

than general "improvements" to the system) information to make UxE changes that allowed the organization and its systems to adapt to user needs more quickly (i.e., continuous improvement from fast iteration phases) and more precisely (i.e., less development of non-essential improvements) from the perspective of the end-user. The incorporation of a continuous improvement mentality is a key tenant of AT.

- There was some way to be able to detect changes in the user's experience as they occurred over time.
- There was some way to identify when UxE system changes were needed, possibly even before users reported a problem themselves.

1.2 Research Question

The research questions for this study are as follows:

- What improvements in the design of the customer's experience can long-term UxE practices bring to a small corporate enterprise? What changes occur from the corporate and customer's point of view as the customer's experience evolves throughout a long-term UxE study?
- What problems and issues arise in the implementation of UxE principles during the application of long-term UxE practices to a case study in this domain?

1.3 Measures of Improvement

The successes and failures of these improvements were measured by a set of data relating to the combination of corporate success and customer relationships. These metrics were tracked through the use of traditional testing methodologies, relying heavily on semi-structured interviews, user surveys, and user testing.

Corporate success was measured in detail to help ParentLink gauge whether long-term UxE changes within their organization were effective or not. These included the following metrics:

- Metric 1 – Increased commitment level to long-term UxE by the studied organization (ParentLink)
- Metric 2 – Increased implementation level of mobile solutions
- Metric 3 – Decreased development costs

Customer relationships were measured in detail to help ParentLink gauge whether the long-term UxE changes effected on their customers (the end users) were effective or not. These included the following metrics:

- Metric 4 - Increased customer usage rates
- Metric 5 - Increased product sales rates
- Metric 6 - Increased customer satisfaction rates
- Metric 7 - Increased levels of modeling real-world user processes
- Metric 8 - Decreased number of Web site pages required to complete a task
- Metric 9 - Decreased time required for task completion
- Metric 10 - Increased usage of mobile and desktop applications

More details regarding each of these metrics and how they were gathered are described in the subsequent chapters of this report.

1.4 Limitations

The following limitations address some of the concerns that are specifically outside the scope of this longitudinal UxE study:

- This research project only includes a single long-term case study with a small software company.
- This research project focuses on the changes of the development processes within Parlant itself and doesn't focus on the analysis of end-user customer research.
- This research project does not propose a new methodology to be used in this domain, but modifies existing methodologies for application in this domain.
- This research project does not propose new metrics to be used in this domain.

2 REVIEW OF LITERATURE

Previous research in areas of interest to this project illustrate both the existing problems of longitudinal User Experience Engineering (UxE) and some theoretical approaches to case studies that are applicable to aiding in the development of this domain. Theoretical and application-oriented research and development work has been performed within the fields of Design Science (DS) and Activity Theory (AT), which will be discussed in this chapter.

2.1 Development of Longitudinal User Experience Engineering (UxE)

The earliest identified report of a long-term usability study in computer software was published over fifteen years ago (Cook, Science, & Science, 1994), but the subject has gained more popularity in the twenty-first century with various articles and conference papers discussing the topic. In 2002, for example, the results of a six-week evaluation of Microsoft Word were published, sharing a comparison of multiple interface designs that were tested and evaluated in a realistic field study, relying on twenty participants who were given seven questionnaires and three semi-structured interviews/orientations to gather feedback on the usability of Word (McGrenere, Baecker, & Booth, 2002). Several years later, a study of scientific databases was published that stressed the importance of having a usable system to "provide a basis for the assessment of data quality and [the] possibility of data sharing between scientists" (Hueni, Nieke, Schopfer, Kneubuhler, & Itten, 2009, p. 565). The Journal of

Engineering Design published a 28-day study on the usability of a home appliance, with participants ranging from 30-82 years old, that attempted to describe a methodology for tracking long-term user data by way of user diaries (Imai et al., 2010). These and other studies describe a variety of long-term UxE definitions and research methods, but none of these methods have been consistently applied across the studies found in the existing body of academic research, nor were there theoretical foundations found underlying these methodologies to allow the research projects to be easily comparable among each other.

In 2006, Hornbaek published an article in the International Journal of Human-Computer Studies (IJHCS) that analyzed the current status of usability research as defined by currently published works from core HCI forums and remarked that "[t]he studies reviewed show that users typically interact only briefly with interfaces under investigation…" (Hornbæk, 2006, p. 93). In fact, of the 180 studies he analyzed, only 13 of them lasted more than five hours (Hornbæk, 2006). In 2010, the necessity for long-term usability was stressed to the academic community once again explaining that further research is critical "because we are approaching the 'loyalty decade', where interaction experience will become the main success factor [for organizations] (Nielsen, 2008)" (Alghamdi, 2010; Law & van Schaik, 2010, p. 313; Nielsen, 2008; Van Schaik & Ling, 2011). The need for "a clear picture of how UX changes over time …[is necessary given that]… user-expectation and user-affect dynamically evolve with the actual usage of the product over time" (Law & van Schaik, 2010, p. 314). Searching through the ISI Web of Knowledge showed that only nine academic journal articles have even cited this call for research in the two years since it was published (Reuters, 2013).

The cited literature, in summary, shows that longitudinal UxE is an important field of interest to both academic and practitioner's areas of research and practice, but most UxE studies

still only capture brief periods of time (minutes and hours) and are not longitudinal in their duration. The reasons for this apparent lack in long-term UxE research are outside of the scope of this research study, but it is clear there is room for the exploration of the effects of long-term UxE practices in a real-world case study scenario.

2.2 Usability Methodologies

Because long-term UxE is a new field of study, the research literature indicates that more longitudinal methodologies are needed to test, refine, and produce more user-centric systems. Because there is a lack of long-term UxE methodologies and practices that are in popular practice in the UxE domain, an alternative approach must be found. One method of addressing the longitudinal UxE process is to begin with existing short-term testing methodologies and expand on them to incorporate long-term attributes. While there are many applications of short-term testing methodologies, there is very little research in longitudinal UxE and related methodologies for use in applied settings. The reasons for a lack of long-term UxE testing methods is outside the scope of this report, but the lack of many well established, tested, and proven long-term UxE methodologies indicate that short-term approaches are currently more popular in research and practice and most published research utilizes traditional, short-term, cross-sectional UxE testing scenarios. A rational approach to develop a long-term UxE methodology is to build upon existing short-term practices as a foundation to research and modify them for long-term use. This approach will be particularly effective if the chosen short-term methods lend themselves to continuous or cyclically repeated applications. In the latter case, it is useful if the last stage of one cycle flows easily into the first stage of the next cycle and if there are mechanisms to preserve and maintain long-term knowledge and trends. One strong candidate is the set of short-term testing scenarios proposed by Tullis and Albert (2010). Tullis

and Albert suggest that there are ten common usability study scenarios that can be used to collect and analyze usability data, as shown in Table 2-1: Ten Common Usability Study Scenarios (Tullis & Albert, 2010, p. 50):

Table 2-1: Ten Common Usability Study Scenarios

Scenario Number	*Scenario Title*
1	Completing a transaction
2	Comparing products
3	Evaluating the frequent use of the same product
4	Evaluating navigation and/or information architecture
5	Increasing awareness
6	Problem discovery
7	Maximizing usability for a critical product
8	Creating an overall positive user experience
9	Evaluating the impact of subtle changes
10	Comparing alternative designs

These methodologies are popular to use in cross-sectional UxE testing scenarios, but little data was available for review on long-term UxE studies that included consideration for these ten methods of gathering user data (Hornbæk, 2006). Because these scenarios have been successfully applied in traditional short-term UxE testing (Tullis & Albert, 2010), they provided a foundational testing basis for this long-term UxE study.

Some of the testing scenarios in Table 2-1 are more relevant to this study than others. In particular, Scenarios 1-4, 6-8, and 10 were most important due to the nature of ParentLink's corporate goals, and the practical application of the scenarios to long-term UxE testing principles.

2.3 System Development Research Model (SDRM)

One of the important research goals of this study is to extend the existing body of work in academic research into the domain of long-term User Experience Engineering (UxE). The domain of Design Science (DS) has proven very valuable in this respect, especially research published in the Information Systems context (Peffers et al., 2008).

In 1991, Nunamaker published the System Development Research Model (SDRM) in an attempt to address some of the concerns about the quality of theoretical DS research by standardizing the process that would be followed for future projects in DS. This model stressed a five-step iterative process with specific descriptions of what was to be performed at each point in order to standardize and better control the theoretical research process and its outcomes. Figure 2–1 shows the SDRM:

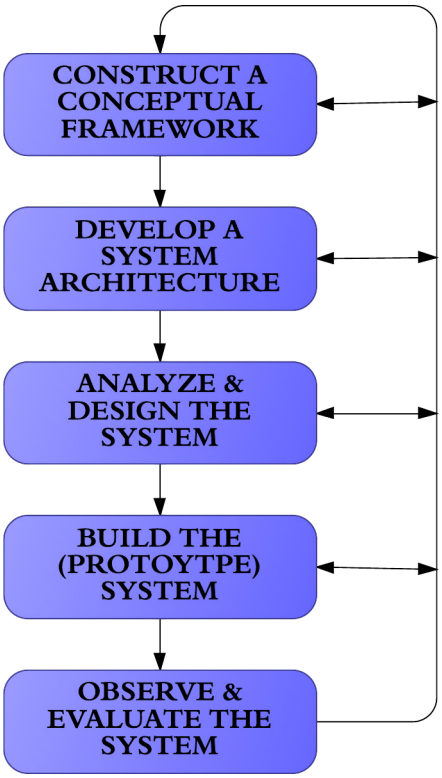

Figure 2–1: System Development Research Model

The SDRM provided a good conceptual and theoretical framework for use in long-term UxE testing, but further development of it was needed in order to address the concerns of a real-world case study in this domain. Later researchers added more application-level process steps to the SDRM, which made subsequent research models more relevant to this longitudinal UxE study. In particular, the SDRM did not provide enough focus on specific problem enumeration and resolution, a strong-enough focus on identifying the needs of users, and a prioritization of problem resolution. (Geerts, 2011; Österle & Otto, 2010; Otto, Hüner, & Österle, 2012; Paredes-Moreno, Martínez-López, & Schwartz, 2010; Peffers et al., 2008)

2.4 Design Science Research Methodology (DSRM)

While Nunamaker's SDRM was very helpful in the initial research phase of this project, an updated version of this conceptual framework was published in 2008 by Peffers et al. DSRM has many potential benefits for a longitudinal study of UxE. This well-structured research approach provides an outline with which the problems encountered during a UxE study can be intelligently solved. The six-step process of the DSRM further allows an iterative problem-solving approach where the last step from a single short-term project facilitates the first step of a following project. By repeating the DSRM in as many iterations as are required, a previously short-term project can quickly evolve into a true longitudinal study of UxE.

Peffers' team combined the findings of seven previous research papers in the DS domain in order to create the DSRM for use in Information Systems research, this model provided good research to the Information Systems domain and has been called "…the most comprehensive standard for design-oriented research in the IS domain" (Österle & Otto, 2010, p. 284). The seven previous publications analyzed by Peffers et al. yielded the following conceptual model portions to the DSRM, combining theoretical and applied principles from several research

sources to enhance the SDRM. The benefits Peffers et al. claimed for their improved methodology are as follows:

> Nunamaker et al. [33] and Walls et al. [55] emphasized theoretical bases, whereas engineering researchers [2, 14] focused more on applied problems. Takeda et al. [46] suggested the need for problem enumeration, whereas Rossi and Sein [40] advocated need identification. Hevner et al. [20] asserted that DS research should address important and relevant problems. (Peffers et al., 2008, p. 52)

Although the DSRM is not specifically designed for a longitudinal study of UxE, it is a good methodology to utilize because it provides a structure for communication and problem solving that can be exercised and repeated through many iterative cycles and throughout an extended period of time. Therefore, the DSRM was chosen to use in this study with subtle modifications that will address concerns when extended to a study involving a longitudinal duration.

Because of the identified benefits of the DSRM not found in the SDRM, the DSRM has significant advantages for this project. The result of Peffers et al.'s compilation and analysis of research gave a six-step process of the steps required to perform high-quality research:

- Step 1 - Problem identification and motivation
- Step 2 - Define the objectives for a solution
- Step 3 - Design and development
- Step 4 - Demonstration
- Step 5 - Evaluation
- Step 6 - Communication (Peffers et al., 2008)

A more detailed description of each Activity in the six-step DSRM and how it was adapted to this study is enumerated in this paper. The six-step process of the DSRM and the relationships amongst the model's components are shown in Figure 2–2:

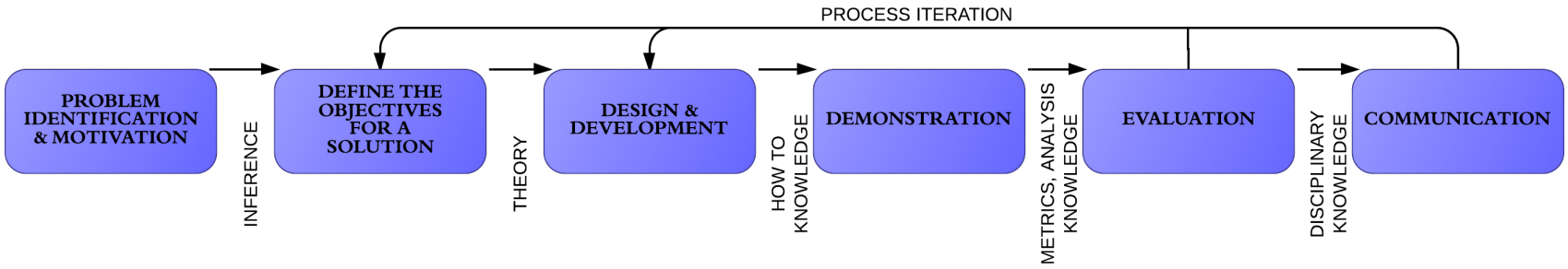

Figure 2–2: Design Science Research Methodology (DSRM)

Beyond the six steps of the DSRM, there are clear linkages amongst the steps with inputs and outputs (e.g., "Theory," as an input to "Design & Development," yields "How to Knowledge" that is used as the input of "Demonstration"). The following sections describe the six-step process of the DSRM in greater detail (Peffers et al., 2008).

2.4.1 Activity 1: Problem Identification and Motivation

This first Activity directs the researcher to not only define a specific research problem that needs to be solved, but also show the importance of resolving the identified problem and convey the value of a proposed solution in the research project. The solution will develop any number of "artifacts" that will contribute to the resolution of the problem. The purpose of this step is to motivate "…the researcher and the audience of the research to pursue the solution and to accept the results and it helps to understand the reasoning associated with the researcher's understanding of the problem" (Peffers et al., 2008, pp. 52, 55). Activity 1 gives the researcher a clear goal and helps to narrow the scope of the project and understand its potential real-world impact once resolved, which will help researchers infer objectives in the next Activity. (Peffers et al., 2008)

2.4.2 Activity 2: Define the Objectives for a Solution

The second Activity takes inferences from the problem definition in Activity 1 in order to determine the objectives of a solution. These objectives must be possible and feasible to accomplish, regardless of whether the artifacts are qualitative or quantitative in nature. Additionally, "[t]he objectives should be inferred rationally from the problem specification" (Peffers et al., 2008, p. 55). Activity 2 helps the researcher compare various artifacts

conceptually in order to determine which solution is the best option to pursue. This Activity produces a working theory that can be further explored in the next Activity.

2.4.3 Activity 3: Design and Development

The third Activity takes the working theory output from the previous Activity and uses it to physically create the artifacts needed to resolve the problem. The artifacts can be any number of "…constructs, models, methods, or instantiations…" in addition to informational resources (Peffers et al., 2008, p. 55). "Conceptually, a design research artifact can be any designed object in which a research contribution is embedded in the design" (Peffers et al., 2008, p. 55). This Activity produces the functional knowledge required in the next Activity and the artifacts used to solve the identified problem.

2.4.4 Activity 4: Demonstration

The fourth Activity takes the functional knowledge now developed from the previous Activity, along with the functional artifacts, and uses them to solve the problem. The demonstration can be shown "…in experimentation, simulation, case study, proof, or other appropriate activity" (Peffers et al., 2008, p. 55). This Activity uses the artifact(s) to solve the problem and produces the metrics and analysis knowledge required in the next Activity.

2.4.5 Activity 5: Evaluation

The fifth Activity takes the metrics and analysis knowledge from the previous Activity as it was implemented in a specific artifact, and then observes and measures how well the artifact can support the desired solution to the problem. "This activity involves comparing the objectives of a solution to actual observed results from use of the artifact in the demonstration" (Peffers et

al., 2008, p. 56). At the end of Activity 5, "…the researchers can decide whether to iterate back to Activity 3 to try to improve the effectiveness of the artifact or to continue on to communication and leave further improvement to subsequent projects" (Peffers et al., 2008, p. 56). Additionally, this Activity can also iterate back to Activity 2 in order to redefine the objectives required to provide a solution to the problem. This Activity therefore, produces the disciplinary knowledge that describes how effective the process was in solving the original problem.

2.4.6 Activity 6: Communication

The sixth and final Activity takes the disciplinary knowledge from the previous Activity and uses that information in order to, "communicate the problem and its importance, the artifact, its utility and novelty, the rigor of its design, and its effectiveness to researchers and other relevant audiences such as practicing professionals, when appropriate" (Peffers et al., 2008, p. 56). The purpose of this Activity is to share the results of the research project in order to further the knowledge and understanding for others to utilize within the specific research domain.

Additionally, it is important to note that although Activity 6 is the last step of the DSRM as described by Peffers et al., Activity 6 gives valuable insights into future problems that need to be solved within an organization. Activity 6 flows nicely into the creation of an entirely new project where the six-step process of the DSRM can be followed iteratively to solve many problems over an extended period of time; giving rise to a truly longitudinal research study. For the purposes of this study, the Possible Research Entry Points that Peffers et al. includes as part of the DSRM Process Model were not used due to the nature of the research project. When this constantly iterative approach was applied to this study, the slightly modified DSRM model followed in this project can be described graphically in Figure 2–3:

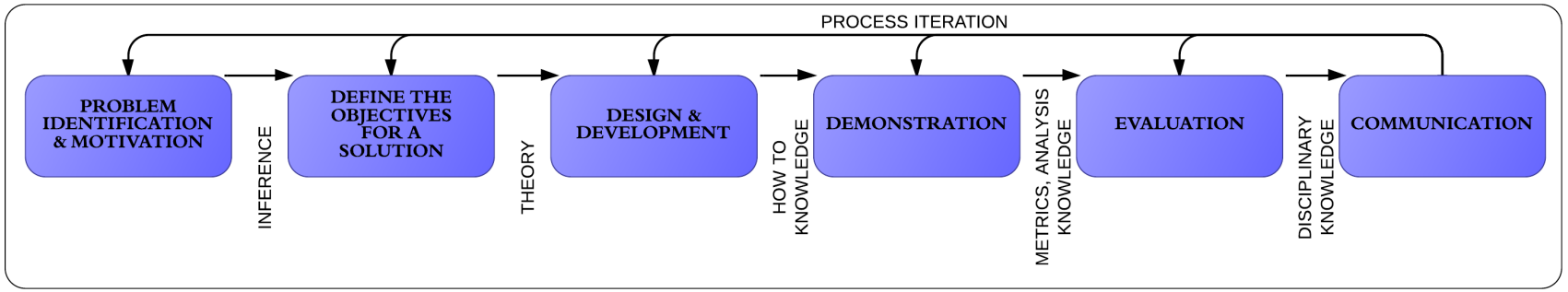

Figure 2–3: Modified UxE DSRM Process

The order and content of each Activity of the DSRM remain intact, but this longitudinal study of UxE required the ability to cyclically repeat the entire DSRM process once a single problem had been successfully resolved. This required Activity 6 of the DSRM to flow back to Activity 1 in order to begin the problem-solving process once again. Additionally, researchers and practitioners required the ability to move from Activity 6, within one DSRM cycle, back to any of the previous Activities in the same cycle, in order to resolve problems and make progress toward a solution. Throughout this continually repeating longitudinal DSRM process in UxE, the need for an over-arching retention of information was critical to the success of future process cycles. Without retaining, learning from, and acting upon the information gathered in one DSRM process, the lessons learned in the earlier DSRM iterations could not be applied to future process cycles.

2.5 Applications of the Design Science Research Methodology Model

Since 2008, the DSRM model has been tested and proven numerous times in the Information Systems domain (Österle & Otto, 2010). Google Scholar shows that the original DSRM 2008 publication has been cited by 494 other articles as of March 2013 (Google, 2013). The DSRM was republished in its entirety in a 2010 textbook by Hevner, an original contributor to Peffers' DSRM model, entitled "Design Research in Information Systems: Theory and Practice" (Hevner & Chatterjee, 2010, pp. 23–31). The DSRM process, therefore, gives specific structure to follow in performing academic and practical research that allowed the research team to solve various UxE-related problems throughout the three-year duration of this study. The structure provided by the DSRM was also closely followed during this research project to ensure an accurate representation of the process model. A detailed description of the extension of the

DSRM model to long-term UxE, including the encompassment of all six steps in the process model, is described in the next chapter of this paper.

2.6 Activity Theory

Activity Theory (AT) was developed by Russian psychologists in the 1920s and 1930s to explain how humans interact with tools in their natural habitat to achieve specific objectives (Kaptelinin & Nardi, 2009, p. 65). Modern AT experts explain that the theory incorporates two main ideas: "1. the unity of consciousness and activity, and 2. the social nature of the human mind" (Kaptelinin & Nardi, 2009, p. 65). By focusing on the relationship between subjects, their objectives, and their tools, AT "aims to understand individual human beings, as well as the social entities they compose, in their natural everyday life circumstances, through an analysis of the genesis, structure, and processes of their activities" (Kaptelinin & Nardi, 2009, p. 31). AT brings a unique perspective to a longitudinal study of UxE because of its consideration of the internal and external influences of "everyday life" that have an effect on a user's overall long-term experience with a tool. Without the consideration of long-term effects, a research study cannot be longitudinal.

AT continues to describe its purpose using four tenets: an emphasis on human intentionality, the asymmetry of people and things, the importance of human development, the idea of culture and society as shaping human activity (Kaptelinin & Nardi, 2009). Each tenet will be described and discussed in the next four sections of this report.

2.6.1 An Emphasis on Human Intentionality

This tenet is meant to describe the importance of considering that "…people deliberately commit certain acts with certain technologies" (Kaptelinin & Nardi, 2009, p. 10). In other words,

people act with the technology they have at their disposal. Technological tools can enable or inhibit acts depending on how they are designed and used. In a long-term UxE setting, it is essential to be aware of what a user wants to accomplish (short-term and long-term) before ever building a technological solution for them to actually use.

2.6.2 The Asymmetry of People and Things

This tenet helps describe the AT perspective that people are not the same as things. In some theories, like actor-network theory and distributed cognition, nodes are generalized to the point that an artifact can be a person or a thing, ignoring the fact that humans experience "…intention, imagination, and reflection as core human cognitive processes" (Kaptelinin & Nardi, 2009, p. 10). In a UxE setting, this is an essential belief. The entire purpose of a User Experience Engineer is to design a system that will most closely match the requirements of the people who are using it, thus differentiating what a person desires from what a thing can do. Taking long-term time periods into account as well, this tenet also reminds us that humans and tools will constantly change over time.

2.6.3 The Importance of Human Development

This is perhaps the most inherently longitudinal tenet of AT. "Activity Theory takes the long view: we cannot understand activity if we do not watch it cycle, grow, change" (Kaptelinin & Nardi, 2009, p. 11). One researcher continues to advocate: "It would be desirable to establish a practice of design in which the development of users—their ability to grow and change with technology—is of paramount importance" (Kaptelinin & Nardi, 2009, p. 11). Although this concept is quite simple (humans change over time), this is an important aspect of a longitudinal

study of UxE because those changes in human development must be addressed throughout the life of the research project.

2.6.4 The Idea of Culture and Society as Shaping Human Activity

The final tenet of AT involves looking outside of a single person to examine how cultural and societal situations influence human activity; humans have an effect on each other. Additionally, "…people have the capacity to radically restructure cultural conceptions, transcending culture in unpredictable ways" (Kaptelinin & Nardi, 2009, p. 11). In a longitudinal study of UxE, it is not only important to understand that people influence each other, but that those influences can be difficult to predict.

2.7 Applications of Activity Theory

AT has been applied in several studies to the field of HCI. "The underlying principles of AT were used to reconsider some of the most central concepts of traditional HCI, including concepts of transparency, affordance, and direct manipulation" (Kaptelinin & Nardi, 2009, p. 79), according to one study. Researchers extended AT to HCI for several reasons. For example, the "models of human-computer interaction…appear to focus on the same unit of analysis as Activity Theory" (Kaptelinin & Nardi, 2009, p. 33). Additionally, "Activity Theory requires that the scope of analysis be extended from tasks [the traditional metric of HCI] to a meaningful context of a subject's interaction with the world, including the social context" (Kaptelinin & Nardi, 2009, p. 33); referring to the study of the interactions between the subject and their information technology over time. "What Activity Theory does propose is a conceptual framework to bridge the gap between motivation and action" (Kaptelinin & Nardi, 2009, p. 33). They further explain that AT, combined with HCI models, can allow a researcher to focus on

"...formal representations of individual component parts of interaction (the user and the system)…" while also emphasizing "…the importance of studying the real-life use of technology as a part of unfolding human interaction with the world" (Kaptelinin & Nardi, 2009, p. 33). These cited aspects of AT (i.e., the same unit of analysis, the scope of analysis, and bridging the gap between motivation and action) all serve well for matching traditional HCI with AT. HCI and AT are precisely in-line with the goals of a longitudinal study of UxE; combining the traditional development of a technology with a greater importance placed on how the needs of the user are going to change over time.

AT uses a longitudinal perspective in its application, as previously described, when a researcher makes several qualitative and/or quantitative observations over an extended period of time during the life of an experiment. Figure 2–4 shows the multi-stage application of DSRM to a longitudinal study of UxE, which expands on the original DSRM model by adding more communication links between and amongst individual steps of the DSRM, in addition to including communication across individual single-intervention cycles of the DSRM.

Figure 2–4 shows that instead of making a single observation of the status of an experiment at one moment in time (e.g., Activity at time t), AT requires researchers to make many observations of the system throughout time (e.g., Activity at time t+1, Activity at time t+n) in order to track the progress of the system and determine how the system is changing throughout time, due to the ever-evolving nature of humans. A longitudinal study of UxE requires the same consistent observation and evaluation of the system over long periods of time in order to make long-term improvements in the system. Additionally, a longitudinal study of UxE requires the knowledge of previous DSRM cycles to be carried forward to subsequent cycles in order to make use of prior history and experience.

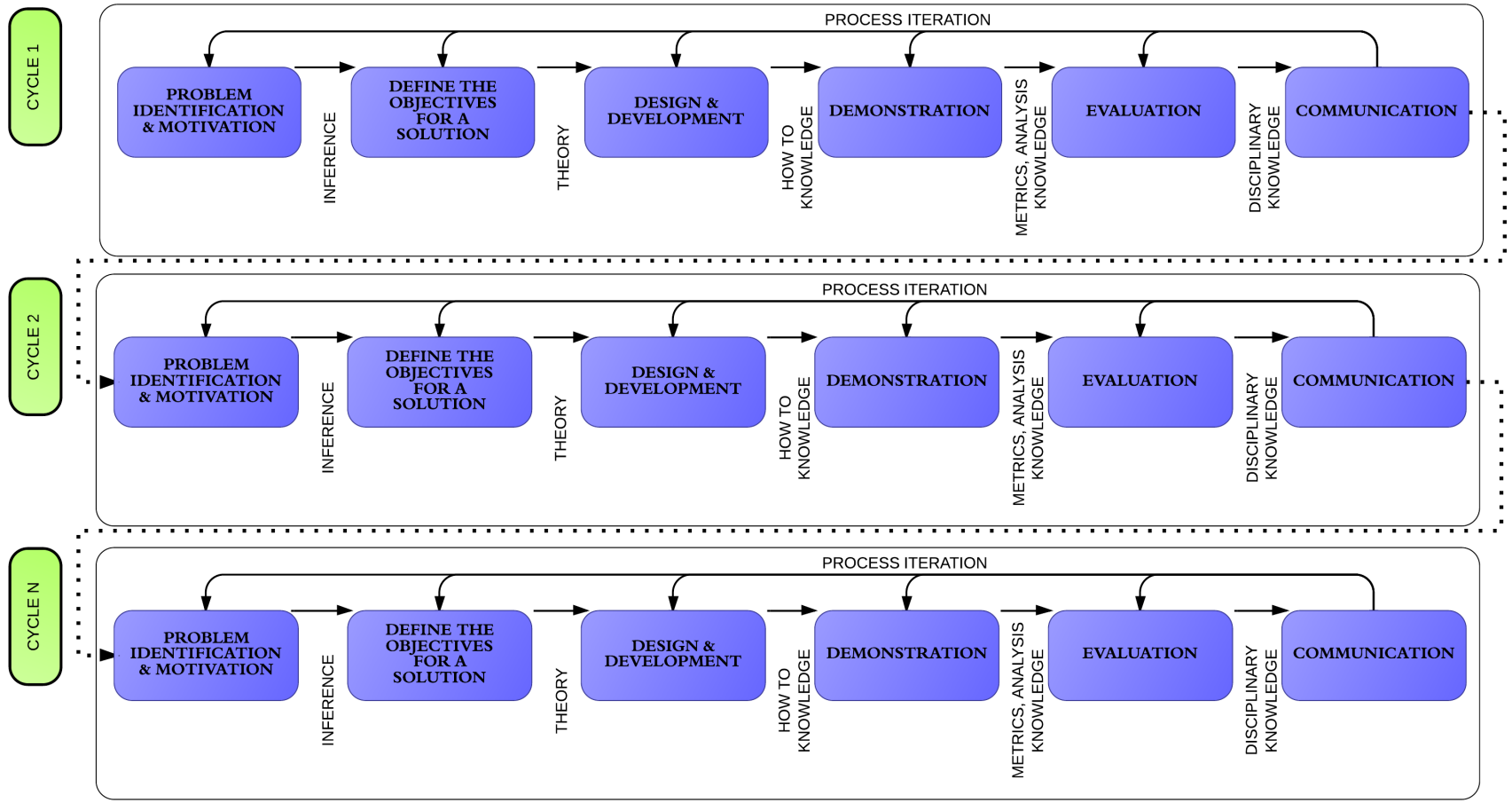

Figure 2–4: Long-term UxE DSRM

AT is also useful in this long-term UxE investigation because of the emphasis that it places on "studying the real-life use of technology as a part of unfolding human interaction with the world" (Kaptelinin & Nardi, 2009, p. 34). AT's perspective describes the reality that it will be difficult to implement long-term UxE due to the changing nature of human behavior and that the solutions implemented at one time may prove ineffective at another period in time. By studying the needs of the individuals used in this case study (both customers and employees) in a long-term ethnographic fashion, a theoretical basis has been utilized that provides an appropriate application of AT to long-term UxE. Furthermore, the iterative nature of DSRM and the environmental emphasis of AT aid in the effectiveness of long-term UxE process development to give proper motivation and guidance in solving user problems over extended periods of time.

2.8 Applications of the Design Science Research Methodology and Activity Theory

Following the six-step research process of the DSRM combined with the long-term perspective provided by AT resulted in a solid foundation for effectively studying long-term UxE during this three-year research project with ParentLink. AT encourages an ethnographic approach to observing users' interactions with technological tools in the actual work environment – something that can only be effectively accomplished over an extended period of time. This more ethnographic approach allowed researchers to study users outside of the rigid, often artificial, laboratory scenarios typically found in UxE research and, instead, to study peoples' natural work processes, tools, and interactions used in their real-life situations. Despite the well-published AT application in HCI (Bertelsen & Bødker, 2003; Halverson, 2002; Jonassen & Rohrer-Murphy, 1999; Kuutti, 1996) and the popular application of the DSRM in Information Systems (Österle & Otto, 2010), no substantial evidence has been found where the combination of the DSRM and AT have been applied to long-term UxE research.

3 METHODOLOGY

This research project investigated the effect of the design of long-term User Experience Engineering (UxE) practices, the changes that occur throughout a long-term UxE study, and the problems/issues that arise in the implementation of UxE principles during the application of a long-term UxE case. While the six Activities of the original DSRM (Peffers et al., 2008) along with the tenets of Activity Theory (AT) (Kaptelinin & Nardi, 2009) were used extensively in this study, the practice of a longitudinal study of UxE required a slightly modified DSRM model that included a longitudinal perspective, combined with the long-term ethnographic approach provided by AT, to effectively study the long-term effects of applying these theories in the context of a small company implementing UxE principles. In turn, a modified methodology was also needed to address longitudinal changes in organizational work processes that would better fit this case study. The long-term DSRM model used in this research project is shown in Figure 3–1.

As discussed in the previous chapter, this long-term DSRM model, adapted from Peffers et al. (2008), involves a recurring evolution of problem solving activities where Activity 6 from one cycle of the DSRM leads into and overlaps Activity 1 of the next cycle of the DSRM. This choice in longitudinal methodology was inspired by AT and its perspective of tracking changes over time by making repeated observations in an attempt to better understand a user's real-life

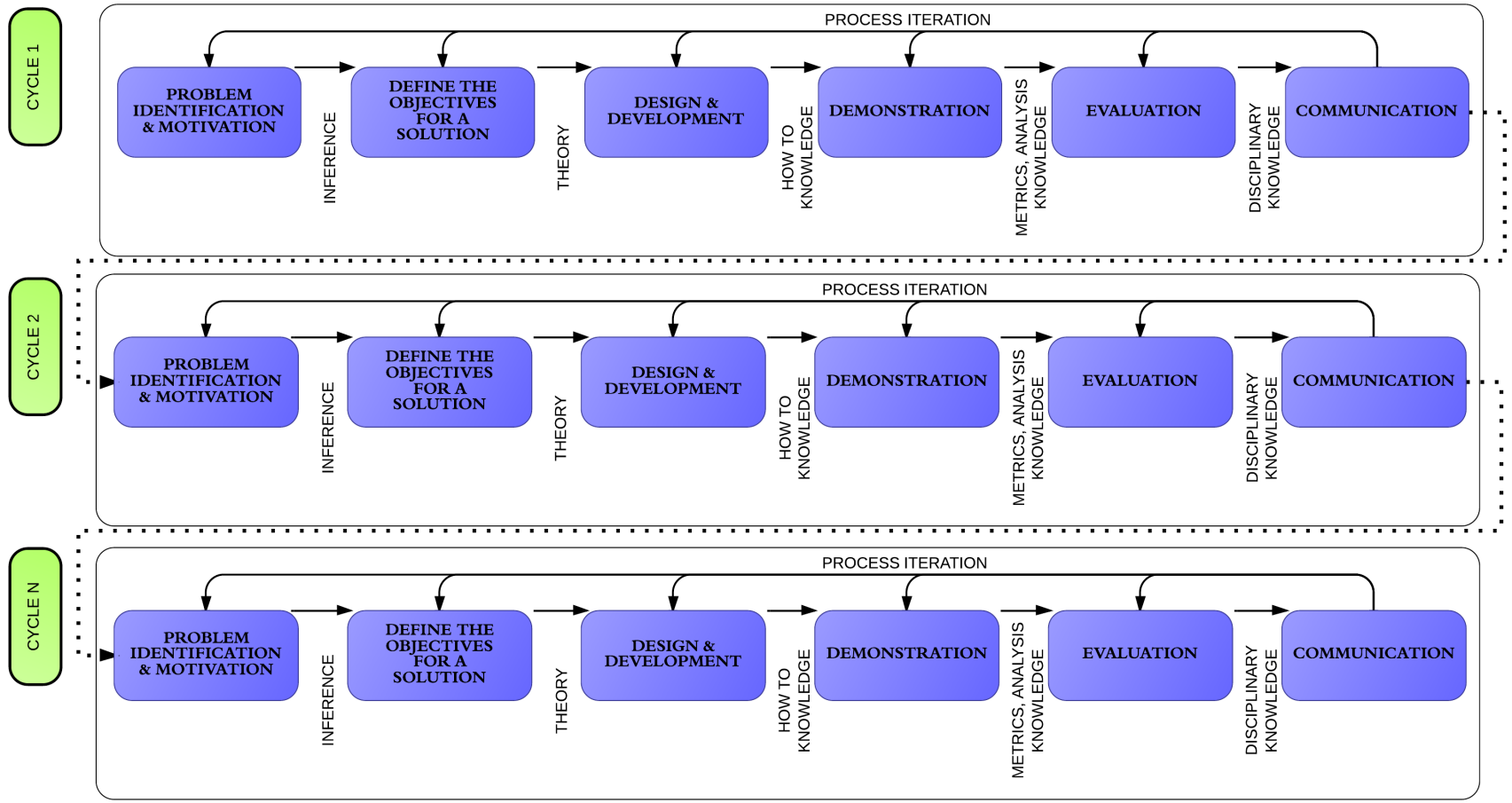

Figure 3–1: Long-term UxE DSRM

use of technology. Additionally, Activity 6 of a single DSRM cycle also allows researchers to return to any of the previous Activities in the same cycle in order to better refine and resolve the original research problem(s). Without this iterative and recurring evolution of problem solving across an extended period of time, this research project would fail to be longitudinal in its nature.

The details of the actions taken to ensure a loyal adherence to each Activity of the DSRM with support from AT are described in this chapter as applied to the UxE domain. As previously described, this longitudinal study is comprised of six shorter-term cycles (each spanning as little as two months and up to eighteen months) that led to the culmination of the three-year body of work. Each of the six activities outlined in the longitudinal DSRM process were considered throughout each cycle of the DSRM in order to solve each cycle's short-term objective, but in various cases, some Activities of the DSRM were omitted due to the nature of the cycle.

Applying the longitudinal DSRM along with AT in order to resolve the research questions can best be illustrated by a description of its application to the first cycle of the case study. The high-level description below relates each of the six Activities of the DSRM and shows how Activity 6 of the first cycle flows nicely into Activity 1 of the next DSRM cycle. Each DSRM cycle contributed to this longitudinal research project by creating a growing base of knowledge and understanding from previous DSRM cycles in order to address long-term problems and provide solutions based on previous experience in long-term UxE processes. AT helped address concerns with the real-life use of technology and the interactions between users and the system-at-large.

3.1 Activity 1: Problem Identification and Motivation

The purpose of the first Activity in the first long-term DSRM cycle was to interact with the users, discover their intentions, and learn about who they are. With regards to AT, this

Activity helps provide a meaningful context in which the needs of users can be addressed. In the case study, this was applied as follows:

A capstone team of four senior undergraduate students was assembled to meet with ParentLink and address their problem(s). When first meeting with ParentLink, the capstone team was presented with the problem of redesigning an aging Web site. ParentLink had begun to see an increasing number of complaints from their customers (existing and potential) that the Web site offering was perceived as old and unintuitive. From ParentLink's perspective, competing companies were gaining more business as a result of this decrease in customer satisfaction and ParentLink sought to remedy this by simply updating the Web site interface. Activity 1 gave the researchers a clear goal and helped to narrow the scope of the cycle and understand its potential real-world impact once resolved.

3.2 Activity 2: Define the Objectives for a Solution

The second activity of the long-term DSRM cycle required that researchers define objectives related to a real-world solution. In order to accomplish this, the capstone team needed to have further interaction with customers. This Activity is also part of AT's setting of meaningful context. Once again, this is illustrated by the following case study example.

After many meetings and gaining a better understanding of the status of the Web site, including the technology used to create and maintain it, the capstone team chose as objectives the combination of gathering qualitative and quantitative user data from end-user customers who were using the ParentLink software, along with data from employees working at ParentLink. The capstone team also looked for metrics that would demonstrate ease-of-use (based on a decrease in task completion duration times, the modeling of real-world processes, the decrease in the number of Web site pages required to complete a task, etc.), customer satisfaction (based on the

feedback from semi-structured user interviews), and aesthetic improvement (based on feedback from user surveys). These specific UxE measures were chosen as a result of the work published by Tullis and Albert in the book entitled *Measuring the user experience: collecting, analyzing, and presenting usability metrics* (2010), as previously described in Chapter 2. Activity 2 helped the capstone team compare various artifacts conceptually in order to determine which solution was the best option to pursue. This Activity produced a working theory that was further explored in the next Activity.

3.3 Activity 3: Design and Development

The third activity required the design and development of the identified solution from the information gathered in Activities 1 & 2 of the long-term DSRM process. AT's real-life use of technology perspective helped the capstone team to create a plausible user-centered solution. This is described in the following case study example:

The desired data points from Activity 2 were formally gathered during the design phase of Activity 3, before beginning the development of the updated Web site, and were subsequently gathered several times as the cycle progressed in order to incorporate evolving user-centered feedback on the progression of the Web site redesign throughout the entire cycle's lifespan. This type of Activity Theory-based planning ensured that the original project objective would be useful to both ParentLink and their customers.

With problems identified and objectives defined, the capstone team gathered user-centered data by interviewing real-world users to learn about them and their use of the ParentLink Web site (work processes, justifications, mental models, demographic information, etc.). After interviewing users, the capstone team created a user profile that combined the general themes/trends in user information. The capstone team then created user scenarios that outlined

how each process within the messaging system was performed by users. With this user data, the capstone team then used the Rapid Iterative Testing and Evaluation (RITE) Method to create low-fidelity, medium-fidelity, and high-fidelity prototypes of new Web site interfaces, which were all iteratively tested with users. RITE testing allows for fast and highly collaborative UxE testing, enabling researchers to make changes immediately after a consensus is reached (Bias & Mayhew, 2005; Medlock, Wixon, Terrano, Romero, & Fulton, 2002). This was valuable to the capstone team because only a few users were required to be tested in some cycles. In a highly-applied UxE testing environment, as is popular among small software organizations and at ParentLink, RITE testing can be very cost-effective (Bias & Mayhew, 2005). Data was gathered at all stages of this process and used to increase the ease-of-use, customer satisfaction, and aesthetic quality of the new Web site.

Activity 3 produced the functional knowledge required to demonstrate the resolution of the identified problem (a poorly designed Web site) and the artifacts used to solve the identified problem (a new design for the Web site itself).

3.4 Activity 4: Demonstration

Once a working solution to each cycle had been created, the long-term DSRM process required that the capstone team not only implement, but also demonstrate the proposed solution in order to gather data as to the effectiveness of the previous Activities. This demonstration Activity helped to show whether or not the real-life use of technology requirement of AT was valuable to the product development process. An example of this Activity was applied in this case study as follows:

In all cases, the final high-fidelity prototype was found to be a success. Task completion duration times and the number of Web site pages required to complete a task were both

decreased. The modeling of real-world processes was followed more closely, helping to decrease the level of cognition required by the user to complete a task. The feedback from semi-structured user interviews and surveys showed that all participants were more pleased with the new Web site's usability and preferred it over the existing system in its aesthetic quality as well (discussed in detail in Section 4.2.3). This Activity used the artifacts created in Activity 3 to solve ParentLink's identified problems and also produced the measurement and analysis knowledge required for use in Activity 5.

3.5 Activity 5: Evaluation

Data gathered from the previous Activities was then assessed against the stated problem and desired objective. AT's long-term ethnographic perspective helped to judge whether changes over time were effective in addressing Activity 1's problem(s). The evaluation of the first cycle of the long-term DSRM can be summarized below.

With qualitative and quantitative data now gathered, ParentLink immediately updated their Web site to reflect all of the prototype changes and released the updated interface to their customers. From the date of release, ParentLink saw an increase in the amount of positive feedback from their customers on the new enhancements, as shared with ParentLink through support desk contact and other business-related feedback (industry conferences, customer emails, customer phone calls, in-person customer meetings, email surveys, etc.). This Activity produced the disciplinary knowledge that described how effective the DSRM process was in solving the original problem.

3.6 Activity 6: Communication

Having finished the fifth Activity of the long-term DSRM process, the longitudinal DSRM requires that the results of the research project be communicated to the world at-large in order to progress the understanding of research in the domain. AT's belief in transparency and providing a meaningful context of the user and his actions are certainly in line with Activity 6. The first cycle of the long-term DSRM was communicated as described below.

The results of the initial study were shared with ParentLink via an in-person presentation to various personnel from many departments within the company, including ParentLink's President. In order to ensure a successful transition of knowledge to ParentLink staff, the capstone team chose to continue an ongoing relationship with ParentLink throughout the weeks it took to implement the interface improvements until the interface had been updated and released to all of their customers. The success of this cycle spurred the subsequent cycles that were explored with ParentLink for the next two years of research.

In final fulfillment of this Activity, this cycle's experience is now being published for the larger academic and practitioner community to benefit others who might find this research useful in application within other organizations. Activity 6 shares the results of this research cycle in order to further the knowledge and understanding of a longitudinal study of UxE for others to utilize within this research domain.

3.7 Iterations of Methodology

Having finished Activity 6 and having an appropriate resolution to the problem presented in the first cycle of this research project, ParentLink expressed a renewed willingness to integrate long-term UxE practices into their existing business processes. This seamlessly led into the next cycle of UxE problem solving using the DSRM by creating the next cycle of the longitudinal

DSRM process (mobile development) and more ethnographic practices informed by AT, as described in the next chapter of this report. Researchers continued to repeat the long-term DSRM process to resolve subsequent problems, incorporating the previous knowledge and understanding from other cycles and processes, in order to feed into later processes, and further integrated UxE practices within the existing organizational processes of ParentLink for the next two years of this research project, making the entire three-year study longitudinal in nature and unique in this research domain. Backed by the long-term ethnographic perspective of AT, the DSRM was adapted to incorporate the real-life use of technology and allow for considerations of the social/world context of the user and their tools.

This long-term methodology helped investigate the effect of the design of long-term UxE practices by incorporating continuing organizational changes in UxE knowledge and practice throughout the three-year span of the case study. Additionally, the organizational changes that were implemented throughout this long-term UxE case study were consistently tested with end-user customers to determine their effects. Finally, the problems/issues that arose in the implementation of UxE principles during the application of this long-term UxE case study were iteratively improved upon and reported to the organization and in this research report for the benefit of the academic community. (See Table 4-1)

3.8 Research Questions

As mentioned in Chapter 1, the research questions for this study focus on two primary concerns:

- What improvements in the design of the customer's experience can long-term UxE practices bring to a small corporate enterprise? What changes occur from the corporate

and customer's point of view as the customer's experience evolves throughout a long-term UxE study?

- What problems and issues arise in the implementation of UxE principles during the application of long-term UxE practices to a case study?

The successes and failures of the customer and corporate experiential improvements were measured by a set of data relating to the combination of corporate success and customer relationships. These metrics were tracked through the use of traditional testing methodologies, relying heavily on semi-structured interviews, user surveys, and user testing to help gauge whether long-term UxE changes within ParentLink were effective or not. In addition to these UxE testing data points, more passive data was also gathered from ParentLink servers and analytic systems to judge the level of long-term UxE throughout this research project. The following individual metrics were gathered and evaluated for this longitudinal study:

- Metric 1 – Increased commitment level to long-term UxE by ParentLink, as measured by the number of UxE-related process tasks performed by ParentLink employees, defined in the longitudinal DSRM process model.
- Metric 2 – Increased implementation level of mobile solutions, as measured by number of mobile applications available to download online. This metric was driven by customer requests for mobile solutions and helps to meet the current needs of modern users.
- Metric 3 – Decreased development costs, as measured in the hours required to create the product and the employee salary used to pay for the product creation and/or support.
- Metric 4 – Increased customer usage rates, as measured by the combination of Web site page views, total batches of messages sent, and customer reuse rate.

- Metric 5 – Increased product sales rates, as measured by the percent change in sales year over year.
- Metric 6 – Increased customer satisfaction rates, as measured from user feedback tools (user testing, surveys, and interviews).
- Metric 7 – Increased levels of modeling real-world user processes, as measured from user testing.
- Metric 8 – Decreased number of Web site pages required to complete a task, as measured from user testing.
- Metric 9 – Decreased time required for task completion, as measured from user testing.
- Metric 10 – Increased usage of mobile and desktop applications, as measured by the combination of the total number of Web site page views and user surveys on each platform (desktop and mobile).

These metrics help to form a more complete picture of the difference between traditional short-term testing methodologies and longitudinal testing. These measures also help to identify the obstacles that will be encountered within this domain and how the capstone team attempted to resolve them.

The above methodology describes a single phase of a long-term UxE process, which was repeated for six total cycles. The methodology, as was applied in the first cycle described in this chapter, was extended and applied to all later cycles of the research project, and at each stage, data was passed from the Activities of one cycle as input to the Activities of the next cycle(s) in order to create a long-term UxE research project. The longitudinal DSRM process, including the perspective of AT, and all related data that was collected from all six cycles during this research project are described in the next chapter.

4 RESULTS AND ANALYSIS

The implementation described in the previous chapter outlined the longitudinal User Experience Engineering (UxE) process followed throughout this study, inclusive of six total UxE cycles. Additionally, the methodology, as was applied in the first cycle described in this report, was extended and applied to all later cycles of the research project, and at each stage, data was passed from the Activities of one cycle as input to the Activities of the next cycle(s) in order to create a long-term UxE research project. The longitudinal Design Science Research Methodology (DSRM) process, combined with the perspective of Activity Theory (AT) (e.g., psychological, ethnographic, longitudinal, and behavioral considerations), and all related data that was collected from all six cycles during this research project are described in this chapter. Qualitative and quantitative data points (user surveys, time studies, semi-structured interviews, server usage logs, competitive analyses with other products, etc.) were collected as previously described in Chapter 2 of this report. The results of previous cycles informed the latter cycles of this study, thereby establishing the validity of the long-term UxE approach used by the research team.

4.1 Cycle Timeline

Each of the six cycles comprising this project are briefly outlined in Table 4-1, organized according to the order in which it is discussed in the later sections of this chapter:

Table 4-1: Research Project Timeline with Individual Cycle Details

Cycle Number	*Cycle Title*	*Cycle Time Period*
1	ParentLink User Interface (UI) Redesign	Oct. 2009 – Aug. 2010
2	Mobile Development	Nov. 2010 – Apr. 2012
3	UI Language Translation	Oct. 2011 – Nov. 2011
4	Stories in Ticketing System	Nov. 2011 – Dec. 2011
5	Google Analytics	Nov. 2011 – Apr. 2012
6	District Administrator Dashboard	Jan. 2012 – Apr. 2012

As many of these cycles overlap in regards to their chronological order, it is important to note that many of them were being performed in parallel due to the nature of the activity itself. For example, Cycle 2 was a direct result of Cycle 1, but took nearly two years to complete because it required a structural and procedural change within ParentLink itself, which required a tremendous effort from ParentLink and the research teams involved. The cycles of longer durations were inherently more difficult to complete.

In the following discussion, each of the six UxE cycles will be described using the format of the six activities of the DSRM. References to applications of AT will be included in each of the activity discussions. Additionally, due to the large volume of data that was created and analyzed throughout this longitudinal study, a short analysis from each cycle will be given inline in each relevant section with more detailed data collections located in the Appendices of this report. (See Appendix A-C)

4.2 Cycle 1 - ParentLink.net User Interface (UI) Redesign (Oct 2009-Aug 2010)

4.2.1 Problem Identification, Motivation, and Solution Objectives

Parlant Technology was concerned that the increasing number of complaints from their customers would decrease the appeal of their product and the market share of their services. This, in turn, would decrease the revenue of their company. In order to combat this problem, they asked a capstone team of Information Technology (IT) students from Brigham Young University (BYU) to redesign the user experience of their Web site. The capstone team at BYU consisted of four students and one faculty coach, who served in an advisory role to the capstone team. In 2009, their Web site was a desktop-only version with hundreds of features that most users found difficult to navigate. To begin the activity, the capstone team decided to explore the software individually and perform some initial research on who ParentLink's users really were. The goal statement of this activity became: "To redesign ParentLink's development cycle to include usability testing and interface optimization by March 31, 2010, on minimal budget, to increase customer retention" (Redfearn, Bauer, Bone, & Russell, 2010).

The capstone team proceeded to identify the specific tangible solution objectives that would help accomplish a UxE-focused implementation of ParentLink's development cycle. In order to shape the development cycle, the capstone team decided to focus specifically on the following Cycle 1-related tasks:

- Task 1 - Research Existing ParentLink System
- Task 2 - Perform User Interviews & Observations
- Task 3 - Create User Profiles
- Task 4 - Create and Test User Scenarios

- Task 5 - Create Site Map
- Task 6 - Create Storyboards
- Task 7 - Create and Test Interface Prototypes
- Task 8 - Create Testing Protocol
- Task 9 - Perform Technical Analysis of Existing Technology
- Task 10 - Create New Development Schedule
- Task 11 - Write Technical Report
- Task 12 - Give Final Presentation

Because of the amount of work required to complete Cycle 1 in a timely fashion and provide a high-quality outcome to ParentLink, an undergraduate group of 35 students was recruited to work on this cycle. Beginning with the first task, the undergraduate students, led by the capstone team, began to research and develop an updated interface for ParentLink's Web site and a plan on how to integrate UxE practices into their development cycle. The undergraduate students also assisted with the initial testing of prototype interfaces. The undergraduates helped contribute data to Tasks 2-4 and 7-8 of Cycle 1.

4.2.2 Design, Development, Demonstration, and Evaluation

A description of each of the individual 12 tasks of Cycle 1 follows with details on how each of the tasks contributed to the resolution of Cycle 1:

4.2.2.1 Task 1: Research Existing ParentLink System

In order to understand ParentLink as a company, a series of orientation meetings were held with ParentLink employees, including software development, customer support, marketing,

and sales department personnel. During these meetings, the employees were interviewed and the capstone team discussed the history of ParentLink, how their system worked, what kinds of software and hardware solutions were being used, and what the future vision and direction for ParentLink was. In addition to other related subjects, the capstone team's understanding of ParentLink was increased to the point where the capstone team felt confident about continuing with the activity and interacting with users to improve the software interface. At this stage in Cycle 1, ParentLink requested that the capstone team research and develop an entirely new UI for ParentLink.net, create a visual map of the entire ParentLink online system, provide recommendations for technical changes that could be made internally to their system, and test the new UI with their existing customer base (Redfearn et al., 2010).

The capstone team was then given access to the ParentLink software that was pre-loaded with real-world historical data; the same kind of environment they used for testing and quality assurance during their internal product development. Each student then spent some time exploring the Web site and performing various user tasks, like creating and managing user accounts, sending messages, and creating and viewing reports. With an introductory idea of what could be done on the Web site, the capstone team proceeded to perform user interviews.

4.2.2.2 Task 2: Perform User Interviews & Observations

The student undergraduate teams were divided into five groups of five students each, with one senior-level capstone student designated as the manager for the group. Each group visited a real-world user in the local region that was also a ParentLink customer. Whether or not the customer was also a ParentLink software user was not yet determined. The student testing teams interviewed district administrators, school administrators (including principals), secretaries, teachers, parents/guardians, and even community members, to understand what kinds

of attributes formed trends among their users. The capstone team utilized the following tools to gather user data at this stage:

- Semi-structured interviews
- User task observations
- Handwritten notes
- Video recordings
- Audio recordings

A group of 14 users was initially involved in the semi-structured interviews and user task observations designed to ascertain the reasons why the ParentLink software was of value to the end-user customer, what they envisioned the software doing in the future, and what problems existed with the software already. The design groups then reviewed and analyzed each set of user interview data to ensure that no important customer comments were missed. By compiling the notes from all user interviews together, the student groups discussed the issues and concerns brought to the capstone team by the end-users of ParentLink and validated with those real-world users that the messaging feature of the ParentLink software were the most frequently used and most frustrating part of the Web site. This immediately became the focus of this activity. Later meetings verified this user feedback with ParentLink as they had heard these same complaints and requests for an improved messaging system from many other customers as well. Agreeing on this focus allowed the capstone team to create a more customer-focused improvement plan.

4.2.2.3 Task 3: Create User Profiles

Each group then created a user profile that described, in general terms, the types of people that were using ParentLink software. Previously, ParentLink only had some initial

impressions about their real-world user groups, so the capstone team needed to gather user data in order to ensure the perceived customer was more clearly described in order to design more customer-centric products in the future. Compiling the various data sources together, the capstone team created user profiles for each of the identified user groups (district administrators, school administrators (including principals), secretaries, teachers, parents/guardians, and community members). An example of a user profile can be found in Appendix A of this report.

After reviewing the information contained in each of the user profiles, the capstone team began a discussion with Parlant employees as to whom they thought would be the most important users of their software. Combined with the interview results, the capstone team agreed that only administrators would be interested in the reporting functionality of the Web site, while secretaries and teachers would be the target audience for their school-to-home messaging system. Before this research was performed, it was assumed that the ParentLink messaging system was actually used by district and school administrators to notify those within their areas of any pertinent information, but the real-world interviews revealed that secretaries were interacting with the ParentLink Web site much more often than any administrator was. Of the six district-level users the capstone team first interviewed, they all stated that the ParentLink Web site was used exclusively by their secretaries to send messages to those in their area (Redfearn et al., 2010). This almost immediate informational advantage to Parlant showed the validity of UxE practices and helped propel the activity forward to the next task.

4.2.2.4 Task 4: Create and Test User Scenarios

Although ParentLink offered many different tools on their Web site, the identified focus of improving messaging functionality from the real-world user interviews led to the creation of user scenarios for these focus areas. The user scenarios were then verified and tested with

ParentLink employees and other student team members to verify the functionality of each process and ensure its accurate description. Ninety-one user scenarios were documented and tested. An example of these scenarios can be found in Appendix A of this report.

4.2.2.5 Task 5: Create Site Map

While exploring the Web site throughout this activity, ParentLink asked the capstone team to develop a series of maps that described how the hierarchy of the Web site was organized. ParentLink had never done this before and had no idea how many Web site pages and features actually existed in their system, so the capstone team began creating a map of their Web site. As the capstone team continued to map the remainder of their Web site, it was quickly realized that a map showing all the Web site pages/functions of the ParentLink system would take up the space of an entire conference room wall. Due to space restrictions, only a sample of the site map is included in Appendix A of this report. This seemingly overwhelming level of complexity and information served as a lesson to ParentLink and the capstone team that the ParentLink system had become far too complex for an average user to ever utilize in its entirety. Further discussions with users helped the capstone team to identify that users were not aware of most of the ParentLink features, which helped account for the focus on messaging functionality. (Redfearn et al., 2010)

4.2.2.6 Task 6: Create Storyboards

The capstone teams drew storyboards depicting the user completing several actions. This helped each team to better understand the process through which the user wanted to complete a messaging task and how their perception of the ParentLink software fit into that functional work process model. This task was illustrated to ParentLink as a method of improving the

understanding of user processes, but was never practiced by ParentLink employees during Cycle 1. An example of the storyboards can be found in Appendix A of this report.

4.2.2.7 Task 7: Create and Test Interface Prototypes

Twelve sets of prototypes, spanning low, medium, and high-fidelity versions, were created and tested with real people to iteratively improve on the existing ParentLink UI (Redfearn et al., 2010). Examples of the prototypes can be found in Appendix A of this report. Throughout this task, the order of user testing was randomized to assist with decreasing user bias and maturation effects. Additionally, Table 4-2 describes the quasi-experimental design that was followed and repeated throughout this process to iteratively incorporate user feedback into subsequent versions of the UI as it was being developed:

Table 4-2: Quasi-Experimental Design Overview

Prototype Number	*Fidelity Level*	*Pre-test Observation (O)*	*Treatment (T) Number*	*Post-test Observation (O)*
1	Low	O 1	T 1	O 2
2		O 3	T 2	O 4
3		O 5	T 3	O 6
4		O 7	T 4	O 8
5		O 9	T 5	O 10
6	Medium	O 11	T 6	O 12
7		O 13	T 7	O 14
8		O 15	T 8	O 16
9		O 17	T 9	O 18
10		O 19	T 10	O 20
11	High	O 21	T 11	O 22
12		O 23	T 12	O 24

At each stage of prototype iteration, the feedback from users was incorporated into the next stage of prototype development. In other words, the output from Observations 1 and 2 were incorporated as input sources to subsequent user testing processes. The first round of prototypes was tested with university students and their friends using the previously created user scenarios to determine which prototype interface features and versions appeared to provide a better experience for the users. A second round of prototype testing was performed with a medium-fidelity mockup version that was tested with users who were not existing customers of ParentLink, but matched the demographics of those real-world customers in age range, education, and technical expertise. Finally, a high-fidelity prototype of the user interface was created and tested with both university students (future users of the ParentLink software) and older users who matched the demographics of current users.

Over 70 usability tests were performed during this task, resulting in over 30 hours of UxE testing throughout a nine-month period (Redfearn et al., 2010, p. 4). During the final prototype testing, the capstone team found they were able to decrease message sending time by 99 seconds--a 70% decrease in the time required to complete the same message sending scenario (Redfearn et al., 2010, p. 4). Additionally, when compared side-by-side, with the order of the screens randomized, the users expressed an 80% preference of the final prototype interface (a combination of an aesthetic and functional choice made by users) over the existing ParentLink UI (Redfearn et al., 2010, p. 4). While many of the initial low-fidelity prototype interfaces received negative user feedback, the design suggestions were quickly integrated into medium- and high-fidelity prototypes in order to meet the needs of the users. As a result, all high-fidelity prototype versions received positive user feedback from the final testing sessions. The capstone team believes this positive feedback was due to the frustration of users with the previous

ParentLink UI and not necessarily a result of an exceptional prototype UI design. Some of the feedback received during the final prototype testing includes the following quotations from tested users:

- "You'd have to be brain dead not to figure it out" (Redfearn, 2010b).
- "Preferred prototype in all cases" (Redfearn, 2010b).
- "Screen 1 really seemed like it was a lot easier to read…" (Redfearn, 2010b).
- "The task objectives were easier to understand as displayed on Screen 1" (Redfearn, 2010b).

4.2.2.8 Task 8: Create Testing Protocol

A testing protocol was developed by the capstone team from the 70+ user tests that was performed during the development of the new ParentLink messaging UI. This protocol was designed to utilize in-person and remote Rapid Iterative Testing and Evaluation (RITE) user testing methodologies. Although this was requested by ParentLink as an essential part of ParentLink being able to perform UxE practices in the future, this protocol was never referenced nor used by ParentLink until later Cycles.

4.2.2.9 Task 9: Perform Technical Analysis of Existing Technology

As requested by ParentLink, the capstone team performed research in regards to the software being used in the ParentLink system and offered recommendations on improvements that could be made. Some of the suggested improvements included:

- Updating server software versions
- Further separating the front-end user interface from the back-end server system
- Implementing more Web standards

- Removing the custom programming support for the Internet Explorer 6 Web browser, and supporting the newer, more standards-compliant Web browser versions (e.g., Internet Explorer 7+ and Firefox) (Redfearn et al., 2010, p. 136)

The details of the technical analysis can be found in Appendix A of this report. ParentLink decided not to implement any of the recommendations in this task; citing different priorities for the company as the reason. This was justified by ParentLink because, at the time, there were no architectural/software problems with their systems, although many of these recommendations were later forced upon ParentLink as architectural/software problems arose. One example of the forced adoption of a technical recommendation from the capstone team occurred during Cycle 2. In order to accommodate the development of mobile applications on multiple platforms (e.g., iOS, Android, and Windows Phone) and with multiple screen sizes (e.g., cell phones and tablets), ParentLink had to further implement popular Web standards to avoid fully customizing their software for each and every device that customers could own.

4.2.2.10 Task 10: Create New Development Schedule

An integral part of helping ParentLink to adopt UxE practices into their business process was to give them a detailed timetable of how UxE testing could be done in parallel with their two-week long Agile development cycle. Before the capstone team's interaction with ParentLink, ParentLink assumed that their short two-week Agile development cycle would make it impossible to gather any user feedback to be used in their products. Upon further researching the RITE testing methodology, as discussed in Chapter 3, the capstone team created a schedule that outlines what UxE and development tasks should be done on which business days to integrate UxE practices into an existing two-week development cycle.

Table 4-3: UxE & Agile Integration Schedule

Business Day	*User Experience Engineering Team*	*Development Team*
1	Define tasks and scenarios and find users to test	Define system requirements and functionality
2	Create first low-fidelity prototype mockup	Implement some functionality with very minimal focus on interface development
3	Test low-fidelity prototype with users	
4		Implement confirmed low-fidelity prototype user feedback
5	Test medium-fidelity prototype with users	
6		Implement confirmed medium-fidelity prototype user feedback
7	Test high-fidelity prototype with users	
8		Implement high-fidelity prototype user feedback
9	Weigh customer feedback against organizational goals to determine the next feature to be developed	
10		Release the project to the customer

As shown in Table 4-3, a UxE team needs to work in parallel with a development team in order to perform UxE tasks that feed out of the development team's work process (as is the case with system requirements feeding into low-fidelity prototype creation), which can then include user-centered information and be fed back into the work process of the development team (as is the case with low-fidelity prototype user feedback being immediately implemented by the development team). In parallel with software developers, User Experience Engineers can work closely with their software developer colleagues (and vice versa) to continually improve products by using RITE testing methods to gather quick feedback from real-world users. This feedback can be integrated quickly into products as they are developed without requiring large-scale usability testing cycles.

ParentLink was very excited about the delivery of this task, but failed to integrate any of the aspects of our schedule into their development cycle. Due to resource constraints, ParentLink

was not interested in hiring additional staff to act as UxE subject-matter experts or to create a UxE team to advance better user experiences for their customers.

4.2.2.11 Task 10: Write Technical Report

The purpose of a final technical report was to gather all of the information collected throughout Cycle 1 by the capstone team into one repository that could be given to ParentLink employees. This would allow ParentLink to follow through on the improvement of their Web site, increase the integration of UxE practices into their development cycle, and would give them the knowledge of how to perform all of the tasks done by the capstone team for themselves in the future. The technical report from Cycle 1 was never actually read by any ParentLink employee. Instead of referencing the data in this report, ParentLink employees relied on the Final Presentation (Task 11) to inform their future plans and UxE methods. Relevant sections of Cycle 1's technical report, as cited throughout the entirety of this research paper, can be found in Appendices A-C of this report.

4.2.2.12 Task 11: Give Final Presentation

The last task in Cycle 1 was to provide a formal interactive presentation to junior and senior members of the ParentLink staff to explain the updated UI, RITE method testing, UxE practices, the suggested development cycle, and the technical recommendations of the capstone team. This allowed ParentLink employees to ask questions and have a discussion with the capstone team about the process followed by the designers and the future of ParentLink with relation to the findings of Cycle 1.

Each of the tasks in Cycle 1 led to a substantial body of work that provided the guidance that ParentLink needed to meet the goal of the student capstone team, which was to redesign

ParentLink's "development cycle to include usability testing and interface optimization by March 31, 2010, on minimal budget, to increase customer retention" (Redfearn et al., 2010, p. 1). This final presentation turned out to be critical to the success of this activity because many of the tasks created during this activity were never referenced or used by ParentLink. This presentation was the only means that was actually referenced by ParentLink employees for communicating most of the findings and recommendations from Cycle 1 to ParentLink staff.

4.2.3 Evaluation

One of the largest problems with ParentLink's software approach was that their company was driven almost entirely by software engineers (i.e., software programmers), as many software companies are. ParentLink's engineers had become detached from their actual end-user customers. They were feature-focused, always striving to increase the number of tasks their system could perform without asking first whether that feature would really benefit the majority of their users. The capstone team provided all of the research and analysis information, along with the redesigned Messaging interfaces, to ParentLink and the new UI was implemented in a matter of weeks. In preparation for future user testing, ParentLink established a user testing station in their office that could be used when customers visited their location. Although Task 8 gave ParentLink a written instructional manual on how to perform remote and in-person user testing using the RITE methodology, only a few in-person tests were performed after Cycle 1 and no remote testing was ever performed by ParentLink employees.

ParentLink experienced a 32% and 64% increase in sales in 2011 and 2012, respectively. Internal reports cite interface improvements achieved in Cycle 1 and subsequent cycles as the impetus for these increased sales figures (Redfearn, Hassler, Jibson, & Dellenbach, 2013).

Initially, ParentLink allowed their customers to opt-in to the new UI. Approximately half of the districts were excited to make this switch as soon as the update was available. Because of the positive feedback and adoption rate of the new UI, the remaining ParentLink customers were switched to the new messaging system UI in August 2010. In order to give a more realistic picture of customer engagement, the total number of batches of messages sent each month on the ParentLink system will be discussed throughout this study. A "batch" refers to a single message being sent from a school employee (e.g., secretary, principal, district administrator) who is using the ParentLink Web site to the people in their area. Because the size of a school and/or district can vary dramatically around the world, a batch gives the exact number of successful task completions in the message sending process of the ParentLink Web site.

The total number of batches of messages sent from January 2010 – February 2013 is shown in Figure 4–1:

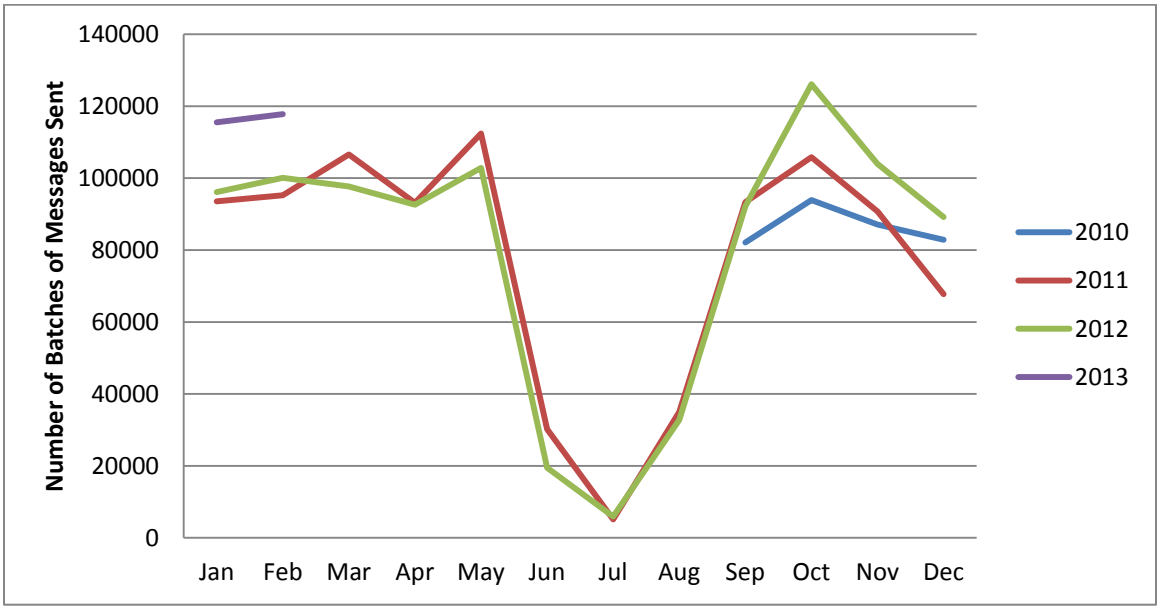

Figure 4–1: Total ParentLink Batches of Messages Sent, Aggregated by Month, 2010-2013

The mid-year decrease in the number of batches of messages being sent, as shown in Figure 4–1, can be attributed to the summer break schedule that most schools in the US follow. Figure 4–1 also indicates that although an investment was made in improving the ParentLink messaging interface in 2010, as verified through user testing and ongoing user feedback, there was no dramatic correlation between the UI improvement and the total number of batches of messages being sent by ParentLink customers. When viewed from the lens of the total number of batches of messages sent year over year, it appears that the ParentLink UI was of little consequence to the total number of batches of messages being sent. Figure 4–2 shows the annual totals of batches of messages sent from 2010-2012:

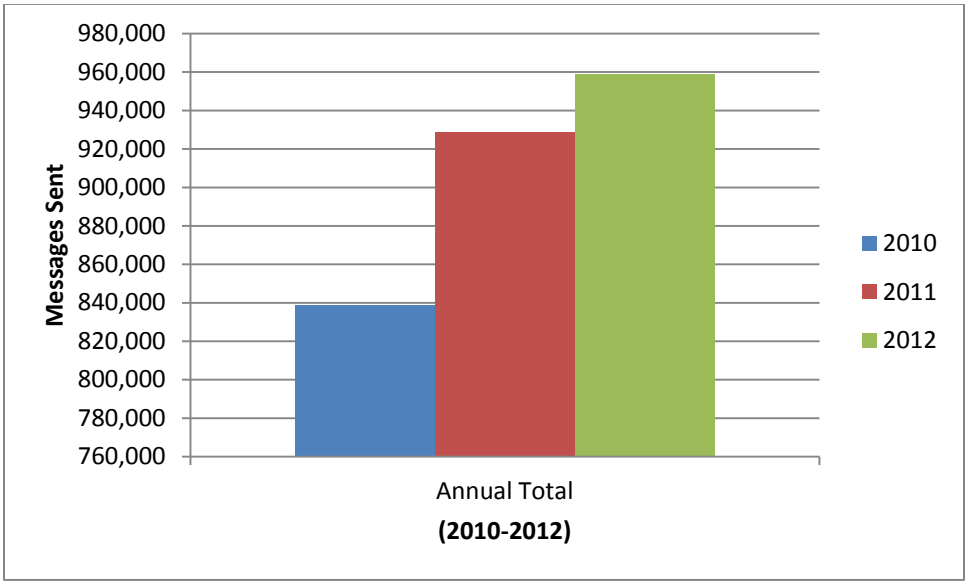

Figure 4–2: Total ParentLink Batches of Messages Sent, Aggregated by Year, 2010-2012

Figure 4–2 shows there was an increase in the total number of batches of messages sent in 2011 (up 11% year over year) and in 2012 (up 3% year over year), indicating that the changes to the ParentLink UI did have a positive effect, although the research team expected the total

number of batches of messages sent in 2012 to be much higher than was observed, since the increase in customers in 2012 was 64%.. It is important to also note that the number of customers using the ParentLink software system did not change during the summer of 2010, indicating that the number of batches of messages sent during this period was among the same group of existing customers.

With the success of the Web site redesign, it was then disappointing to see that ParentLink had stopped its UxE integration after this Web UI update. No User Experience Engineer subject-matter expert was hired to lead the UxE process cycle within the company, no change in the development cycle was made, and no change among the development staff was made to make UxE practices a larger part of the ParentLink organizational culture.

4.2.4 Communication

Many software companies struggle with incorporating UxE principles into their development plans (Hussain, Slany, & Holzinger, 2009; Joshi, Sarda, & Tripathi, 2010; Schwartz & Gunn, 2009; Sohaib & Khan, 2010). This often results in products with poorly designed usability that feels outdated to users. As a result, many companies begin to find progressively frustrated customers who lose interest in using their products because it becomes too difficult to incorporate the software efficiently into the user's real-world work process. Many software companies then perform dramatic redesigns of their interfaces in order to stem the tide of customer dissatisfaction, which require large budgets and significant resources to fix.

At the beginning of Cycle 1, ParentLink stated the goal of wanting to evolve from their traditional software cycle of infrequent, single-intervention, and dramatic UI redesigns to incorporate UxE principles into their work processes. This activity showed it was more difficult to execute on that desire than ParentLink and the capstone team had expected. ParentLink

quickly reverted back to their historical two-week Agile development-centered practices without considering the effects of such an action. Because of the research and delivery of the UI in Cycle 1 by the capstone team, ParentLink had not had much interaction with the actual UxE process; they simply implemented a design update that was outsourced to a group of designers (i.e., the student capstone team). This allowed ParentLink to successfully implement a better interface and have the time to receive the positive customer reaction to it, but there was little UxE process involvement from ParentLink during this cycle and there was no long-term dedication to UxE testing from ParentLink employees. Without any UxE subject-matter expertise, it should have been no surprise that ParentLink could see the potential benefit of UxE practices to their business, but was unable to successfully implement UxE methodologies on its first attempt with the capstone team. The updated messaging UI did result in more satisfied customers and saved ParentLink the time and resources required to do all of this research and development on their own. ParentLink started to understand why they actually needed to perform UxE research during the development of their products, but not to the extent required to act on their own and commit to long-term practical UxE process changes within the organization.

In order to overcome this traditional UxE-challenged software development practice problem, there was a stronger commitment from ParentLink in late Nov. 2010, led by their senior staff members, to change their development process culture formally and permanently. By seeing the benefits (increased customer satisfaction, decreased UI complaints, etc.) of a single UxE process, ParentLink desired to implement a long-term UxE process solution, but did not know how to implement a long-term UxE methodology.

In Nov. 2010, the final research team (i.e., the authors of this report) started working with ParentLink again and began meeting formally with ParentLink employees bi-monthly for the

next two years to progress a fundamental cultural change within ParentLink itself, to make ParentLink a case study in long-term UxE process adoption. It was at this moment that this traditional single-intervention user testing project (as described in Cycle 1) became a truly long-term UxE process adoption research project, incorporating many iterative evaluations and improvements over an extended period of time and evaluating the transitions within ParentLink from the more ethnographic approach of AT. The remaining cycles in this report outline the steps undertaken throughout this longitudinal period to make ParentLink a user-focused company and the successes and failures that were experienced throughout this three-year research study. By relying on the longitudinal DSRM process developed for applied UxE settings in this domain, which was described in the previous chapter, the output from Activity 6 of Cycle 1 of the DSRM process was able to serve as an active input source to Activity 1 of Cycles 2–6 of this project. The gradual building of experience and knowledge in UxE helped to drive greater alignment between the needs of ParentLink customers and the goals of ParentLink as a product.

4.3 Cycle 2 - Mobile Development (Nov. 2010 - April 2012)

4.3.1 Problem Identification, Motivation, and Solution Objectives

After the completion of Cycle 1, the research team did not see any long-term UxE process changes implemented within ParentLink. ParentLink implemented the updated UI from Cycle 1 rapidly, but did not follow through on any of the other suggestions for improvement from Cycle 1, including the updated development cycle. ParentLink was impressed by the positive feedback from their users when they implemented the new messaging UI, but requested help again from the research team to continue progressing toward a user-centered software company. With a new long-term commitment to create a culture of UxE process adoption within

their organization, ParentLink senior leadership began to make changes in personnel to allow this change to take hold internally.

Because there were no UxE subject-matter expert employees hired to lead the recommended development cycle changes as presented in Task 10 of Cycle 1, the capstone team recommended that ParentLink convert one of their existing employees into a UxE process advocate. Because ParentLink as a company was primarily focused on software development, current employees would require extensive training to partially fill any UxE role within the organization. An ongoing dialogue with ParentLink led the research team to realize that much more first-hand work would need to be done between the research team and ParentLink employees in order to manage the level of training and advocacy required to change the corporate culture of ParentLink employees. ParentLink promoted one of their existing employees to a product management position, replacing their existing Product Manager, and the research team began to meet bi-monthly with the Product Manager, Director of Research and Development, Vice President of Operations, and other ParentLink staff at regular intervals.

Internally, ParentLink had begun to receive feedback from customers identifying the need for a mobile interface to their system. Instead of using the responsive design approach to adapt current UIs to meet the requirements of smaller interface systems, ParentLink chose to develop mobile applications for iOS and Android. In 2010, ParentLink had no mobile software products of any kind and their competitors had begun to create mobile applications of their own. Competing solutions along with increased customer feedback identified the lack of a mobile presence as a top problem for ParentLink to address. ParentLink's motivation for addressing this problem was to increase their presence in their market through increased sales and to provide a

greater benefit to their existing customers by incorporating customer feedback much more quickly than in previous software development cycles.

The solutions sought during this Cycle included the creation of an iPhone, iPad, and Android application, respectively. Although mobile Web sites had been considered as a solution for this activity, the experience of the existing ParentLink staff and the internal interest in application development languages (iOS and Android) made responsive design Web sites a more costly choice to pursue.

In November 2010, ParentLink had begun to dabble in the creation of prototype interfaces for their mobile applications. They had various ideas of what they wanted to see in a new mobile application system, but had never tested it on any real-world users. ParentLink knew they were out of touch with specific things that their users wanted in the mobile application suite, but they felt intimidated and did not think they could actually follow-through on performing UxE research as had been performed by the capstone team in Cycle 1. A few of the reasons that had been given as to why ParentLink could not follow through on a UxE process on their own include the following:

- It takes too long to test users
- It takes a UxE subject-matter professional to test users
- Customers would not be interested in performing user tests
- ParentLink did not want to do testing/did not feel qualified to test on their own (Redfearn, 2011)

In order to overcome these reservations in integrating UxE principles into the development of a software product, the research team proceeded to review many of the process details and recommendations detailed in Cycle 1 again with ParentLink employees. The results

of Cycle 1 had proven their value before and this lent more credibility to the recommendations of the research team during the mobile application development. The research team repeated the UxE prototype process in Cycle 1 (user research, prototype creation, prototype testing) with ParentLink employees leading many of the tests instead of university student teams. ParentLink trusted in the proven abilities of the research team, but they needed in-depth training and real-world practice before feeling their knowledge and experience were of a caliber to make appropriate practical UxE judgements on the mobile interfaces.

One important experience for ParentLink employees, including the Product Manager, Director of Research and Development, Vice President of Operations, and other ParentLink staff, was to have the research team take them to a local university to gather user feedback on their mobile application progress so far. The research team began this user feedback session by giving several real-time user tests with university students. After gathering some initial demographic information, each user was asked to perform a specific task applicable to a user storyboard scenario. The testers and observers took notes about the process and asked for feedback on what would make each scenario easier to complete. After participating in a few example test sessions, the ParentLink employees continued to test users on their own in a similar manner to gather user feedback on the prototype ParentLink mobile application UIs. In one hour, successful RITE method testing allowed ParentLink to gather feedback from 36 users that helped guide the future development of the mobile application interface. (Dellenbach, Hassler, Jibson, & Redfearn, 2012)

4.3.2 Design, Development, Demonstration, and Evaluation

After a successful real world testing session with students and staff on a university campus, ParentLink employees once again saw the importance of testing and gathering feedback

from real users, with an important change in ParentLink's behavior: now ParentLink employees had participated and developed UxE design skills for themselves. Along with the prototype phases that had been explored before the university campus testing, ParentLink found the user testing not only useful to the guidance of their product development, but also enjoyable for employees to perform. One employee who initially came for five minutes, decided to stay for the entire hour because of the positive experience. The user feedback was immediately implemented in the next version of the mobile application and the design guidance was extended to the iPad and Android applications as well. ParentLink continued to gather user feedback on their own to iteratively improve their mobile applications as further updates were provided to their customers. The iOS applications (iPhone/iPod & iPad) were first released on May 11, 2011, with the Android application being released on Oct. 18, 2011. These initial application releases were very limited and only provided basic functionality with the ParentLink system. Since then, ParentLink has released additional applications, including custom school district branded versions, which totaled 84 applications among all platforms by Feb. 2013. Since 2011, ParentLink has continued to release small, iterative changes to their mobile applications with additional features and support, as requested by customers. ParentLink has utilized the UxE processes that were taught to them throughout these iterative mobile improvements. (Redfearn, 2013)

Cycle 2 marked the stage at which ParentLink performed some of the process steps required to integrate UxE principles into their Agile development cycle without the guidance of the research team, but was still learning how to perform UxE research on their own. They developed parts of their products further than they should have, costing some development resources, but gathered much more feedback in the medium-fidelity stage of prototyping (much

earlier than they had ever done before) so that a poorly designed product was never released to their customers.

The increase in mobile traffic has continually grown for ParentLink. Prior to May 2011, there was no mobile application offered and although ParentLink had been told by customers that some people were accessing the ParentLink Web site using tablets, like the iPad (which helped drive the development of a mobile application in the first place), ParentLink had never offered a mobile Web site version of any kind. Unfortunately, ParentLink also lacked the ability to track mobile engagement on their Web site. In order to overcome this, the research team began to encourage ParentLink to implement a free Web site analytics solution to gather quantitative feedback on how their system was being used by real-world customers. The tools offered by Google Analytics give an insight into the usage characteristics of ParentLink customers. More details on this problem are described in Cycle 5. For the purposes of information, however, data gathered since Nov. 2011 will serve to illustrate mobile trends from ParentLink customers since Google Analytics was first implemented. Figure 4–3 shows the total number of Web site visits from devices (mobile and desktop) accessing the ParentLink Web site, aggregated by week, during the same 26-week school-year time period, year over year, for two years.

The data from Figure 4–3 shows that there is just over a 4% decrease year over year in overall usage of the ParentLink Web site during this 26-week school period, and as described earlier, the customer base has increased continually over the last several years. The two dramatic decreases in site visits throughout this graph can be attributed to US Holiday observance (e.g., Thanksgiving, Christmas, New Year's Eve, etc.). This leads one to believe that new customers are not using the Web site to a significant degree, existing customers are using the Web site less, or a combination of these two hypotheses. However, when mobile devices are separated from the

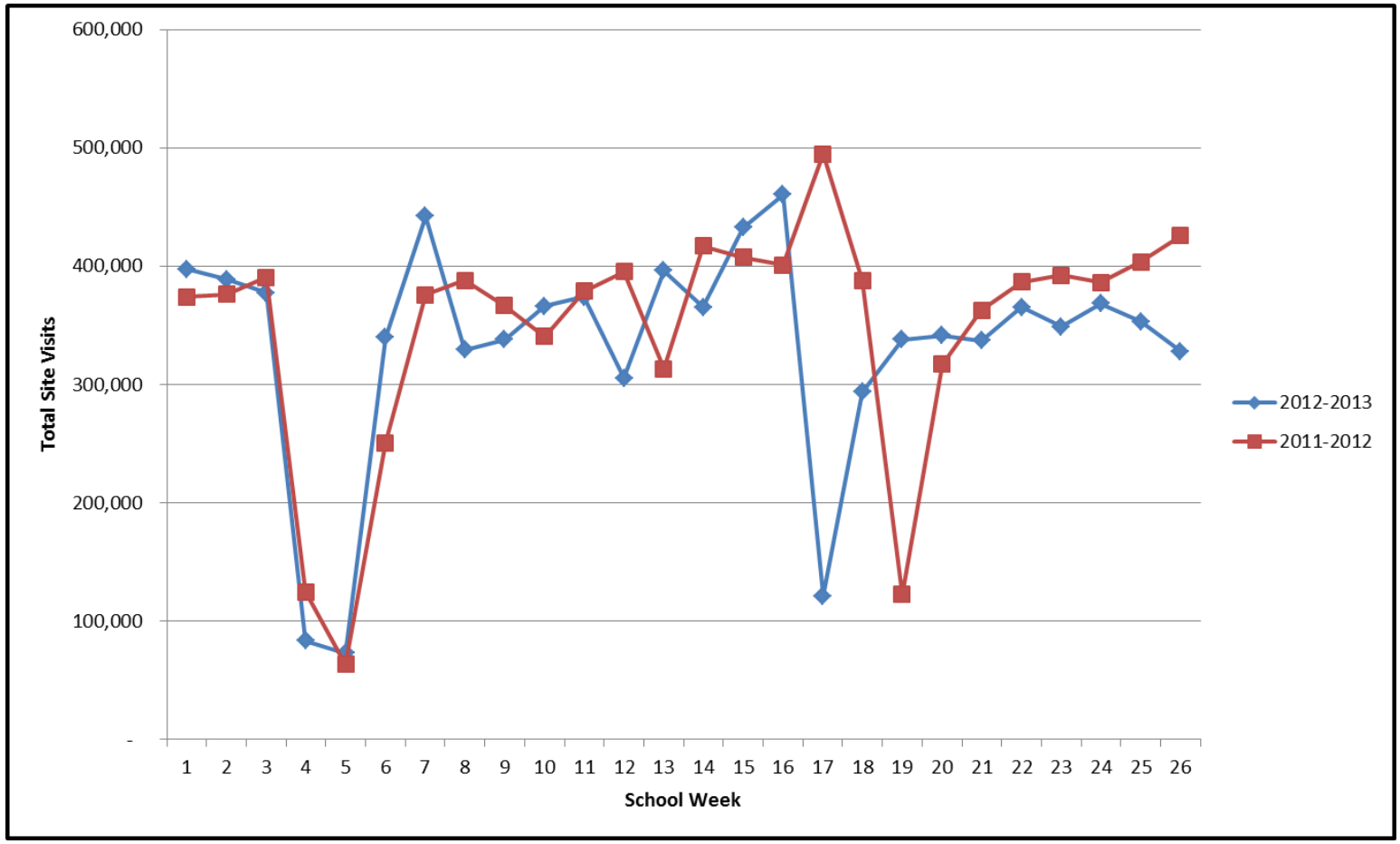

Figure 4–3: Total Web Site Visits, Aggregated by Week, Compared Year over Year 2011-2013

total number of Web site visits, Figure 4–4 shows usage trends over the same 26-week time period.

The result of mobile device usage is quite interesting; it has increased by over 14% year over year during the 26-week time period. Customers continue to request and pay for more mobile access and features, and it appears that ParentLink's customers are using these mobile features more each month and year.

Due to the timing of when usage rate data became available to ParentLink through the Google Analytics tool (seven months after the mobile applications were first released), we cannot draw any direct conclusions about the first release of iOS and Android applications and their effects on mobile device usage in the ParentLink system from Google's measurement tools. However, since the release of their applications, one ParentLink employee stated, "We also have better app ratings than our competitors. I attest this to our usability testing and our developers being very meticulous in their design" (Redfearn et al., 2013).

4.3.3 Communication

Cycle 2 marked the second point at which a full-scale DSRM-based UxE improvement process was followed by the research team to create an improved product for ParentLink customers. It also served as the first point at which ParentLink had direct participation in involving real-world users, first-hand, in the development of a product. ParentLink's engagement in the UxE process had increased dramatically from Cycle 1, but still was lacking in Cycle 2. This shows the difficulty of adopting UxE-based processes within the existing structure of a development-centered organization, but that progress had been made and further progress was within the ability of ParentLink's employees.

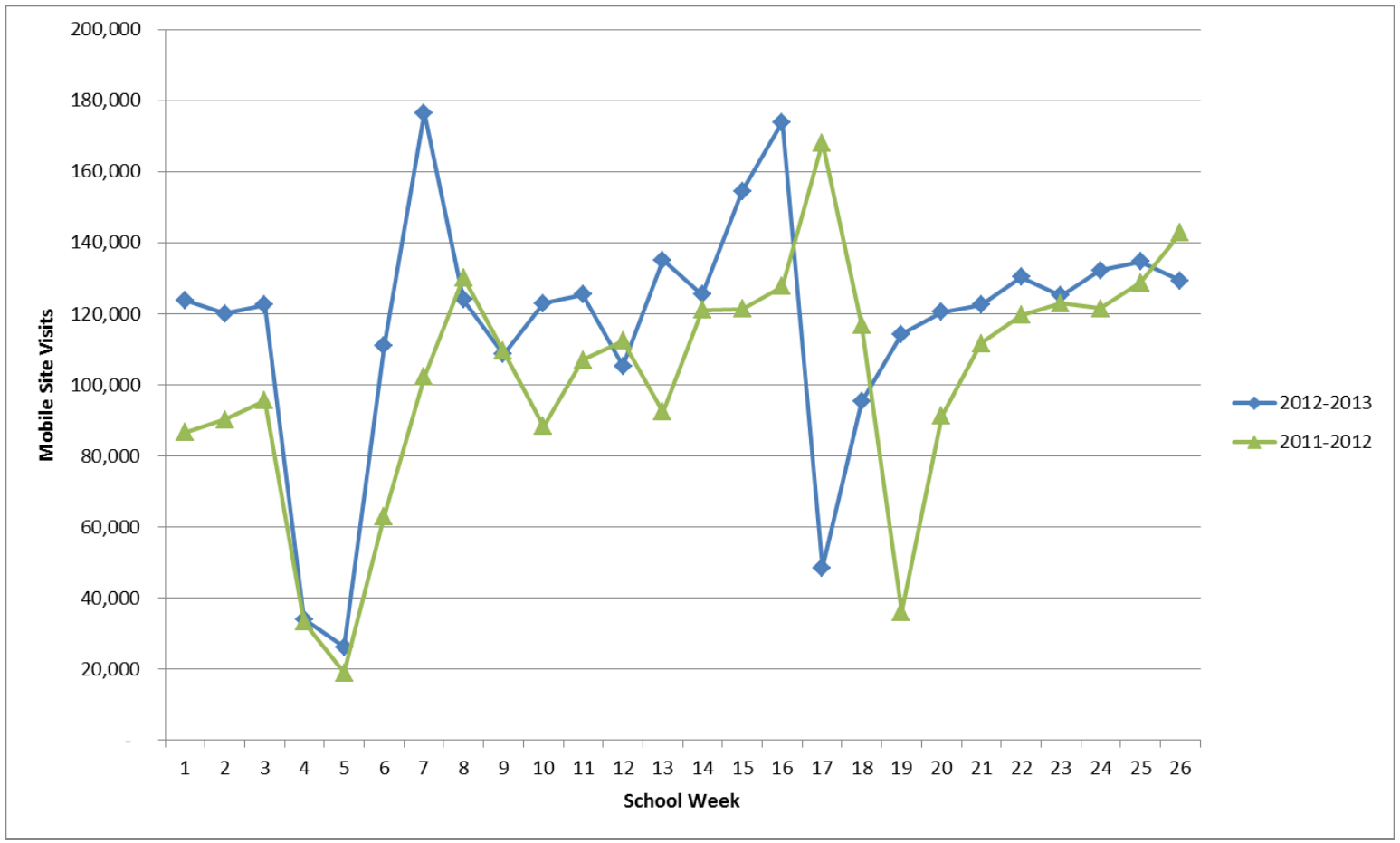

Figure 4–4: Total Mobile Web Site Visits, Aggregated by Week, Compared Year over Year 2011-2013

4.4 Cycle 3 - UI Language Translation (Oct. 2011 - Nov. 2011)

4.4.1 Problem Identification, Motivation, and Solution Objectives

Having gathered additional feedback from their customers on their own, ParentLink presented the research team with a problem: school district administrators from their customer base in Clark County, NV, had requested that the ParentLink interface be provided in multiple languages. ParentLink had discussed this possibility internally as the company had plans to expand their customer base internationally (beginning with the UK and Thailand). Although ParentLink's system was already capable of handling the delivery of messages in specific languages (already translated and recorded/transcribed by district members themselves), the UI of their system had always been available in English only. ParentLink had begun to make plans to translate their entire system into Spanish first, following with other languages, but the research team raised concerns that no research had been done into whether parents, guardians, students, and community members would actually prefer to use an interface translated into their native non-English language. ParentLink wanted to provide their customers with this seemingly trivial-to-develop upgrade to their software system to increase existing customer satisfaction and to increase their feature list for future sales opportunities. (Redfearn, 2011)

The research team decided to first answer the question as to whether a translated UI was desired by parents, guardians, students, and community members. The solution objectives were to:

- Identify language trends on the Internet, generally; especially among US users
- Identify language trends with existing ParentLink customers
- Identify methods to translate the system

- Identify the costs to ParentLink to implement a translated UI
- Identify the steps needed to implement a translated UI

4.4.2 Design, Development, Demonstration, and Evaluation

To begin the design phase of this activity, the research team began by researching language trends. One Internet analytics company, comScore, regularly researches and publishes Internet demographic information that gives a profile of trends online, including Internet language usage in the US. comScore reporting data, combined with analyses from other sources, showed that most users did not want a translated UI, especially if done through an automatic translation service (Redfearn, 2011). ParentLink employees planned to only implement their translated UI with the assistance of the automatic translation engine provided by Google Translate at this time. With this comScore research highlight, it appeared that providing such a feature would not be beneficial to the short-term strategy of ParentLink. Since Google Analytics had been implemented at this stage of research, the research team was also able to utilize the server-based qualitative metrics available on that service to determine whether ParentLink's customers were attempting to access the Web site in any specifically defined device/browser languages. Table 4-4 shows the relationship amongst the top six languages of total Web site visits to the ParentLink system from December 2011 – February 2013:

Table 4-4: Top User Agent Language Settings, Dec. 2011 - Feb. 2013

Language	*Total Visits*	*Percent of Total Visits*
English	19,014,850	99.39%
Spanish	39,231	0.21%
Chinese	16,767	0.09%
Thai	11,332	0.06%
Korean	10,249	0.05%
German	8,509	0.04%
All Languages	19,132,255	100.00%

Table 4-4 shows that over 99% of the over 19 million visits to the ParentLink Web site during this time period used a device that was set to display English-language Web site pages. Though not as dramatic, other researchers have found similar trends in non-English Web site page language requests (Redfearn, 2011). With less than 1% of devices visiting (117,405 total visits) actively seeking non-English Web site pages, the research team felt justified in recommending ParentLink forgo all internationalization at this point.

After gathering these collaborative report findings, the research team presented the results to ParentLink. Surprised, ParentLink now felt justified in explaining why users did not really want a translated UI and would prefer to use an English interface anyway.

4.4.3 Evaluation & Communication

Since the language data indicated that language translation would only benefit a very small number of users (approximately 117,000), the costs to actually implement the system upgrade and the identification of the steps required to follow through on the UI translation were never explored. This reorganization of priorities saved ParentLink development time and

resources. This did show progress toward becoming more UxE-centered within ParentLink. Before the research team's work with ParentLink, ParentLink's development team would have implemented this feature without ever performing any research about its real-world application to end-user customers. Although ParentLink still did not perform any research on their own to test the feasibility of this customer request, they did show initiative in asking the research team to perform an analysis before moving forward to implement the translation feature.

4.5 Cycle 4 - Stories in Ticketing System (Nov. 2011 - Dec. 2011)

4.5.1 Problem Identification, Motivation, and Solution Objectives

Within the framework of an Agile development cycle, many software companies utilize "stories" to help explain the work that is being performed at any given time. At ParentLink, the format of these stories is inconsistent and completely developer-centric. The quality and format are completely dependent on the person who is creating/modifying the story. During one of the regular bi-monthly meetings with ParentLink senior staff members, the research team began asking about what types of UxE information were being included within ParentLink's internal story management software. Interestingly, there was very little usable UxE data contained within a story. In order to further the internal focus on real-world users and UxE-related concerns, the research team worked with ParentLink employees from across the organization to redesign the internal story system.

The motivation for this activity came from ParentLink's agreement with the research team that employees were not thinking about the needs of the user as frequently as they needed to in order to become a more user-centered software company.

The research team worked through two prototyping sessions with the Product Manager, senior developers and support personnel (the main users of the story system) to create a design that included essential user-related data (user profiles, prototype interface screen shots, user scenarios, etc.), along with redesigning the layout and creating collapsible panels within the UI to more efficiently display the extensive amount of data that can be included in a story. An example story prototype can be found in Appendix B.

4.5.2 Design, Development, Demonstration, and Evaluation

Due to the demanding development schedule of existing ParentLink priorities to implement customer requests (mainly mobile application development), the implementation of the updated user-based story system was not implemented at the time of the completion of the prototype interfaces. ParentLink planned to implement the updated UI for Cycle 4 during the summer of 2012, after the research team concluded their bi-monthly meeting schedule with ParentLink.

4.5.3 Evaluation & Communication

All of the ParentLink employees who were shown the prototype interface for the story system were impressed with the suggested updates and were looking forward to implementing the new UI. The stakeholders who were involved in the process of creating the updated UI could also see the difference between a user-centered story system and the story system they had been using previously. This activity shows a further dedication of ParentLink toward long-term UxE process adoption by incorporating user-centered data into their existing story system itself. The completion of this activity was designed to improve the support of UxE processes and to help all ParentLink employees remember the importance of the user.

4.6 Cycle 5 - Google Analytics (Nov. 2011 - April 2012)

4.6.1 Problem Identification, Motivation, and Solution Objectives

During Cycle 1, the capstone team discovered that ParentLink only had a limited number of metrics about their products. ParentLink knew how many districts had purchased their products, how many total messages were sent, the total batches of messages being sent, and how many schools were actually using their products, but there was no major investment into looking at the detailed analytical data within the ParentLink system. In Nov. 2011, the research team recommended that the functionality provided free by Google Analytics was an important next step in better understanding how real-world users were utilizing the ParentLink system. In general, ParentLink simply did not have many data points about their actual traffic and real-world users that could help inform future development plans for the company.

Additionally, ParentLink realized that without hiring personnel to create and maintain their own internal analytics system, Google Analytics would provide much more data than they were able to gather themselves. In addition, because the programming required to implement Google Analytics was minimal and the service was maintained by a third party (Google), there was little effort required to obtain this service.

Google Analytics functionality was deployed to the ParentLink servers in a single week with a few hours' work by one senior developer. Once the usage information began to accumulate online, ParentLink quickly realized that the amount of data provided by this analytics tool was quickly becoming difficult to use; ParentLink was experiencing information overload. In order to help ParentLink understand a few important points about Google Analytics, the research team began to discuss specific metrics in detail with ParentLink employees during the bi-monthly meetings with senior staff members. By analyzing mobile usage, desktop usage,

language preferences, device usage, and other important metrics, ParentLink could see how their software changes were affecting their business model and what their real-world users were doing with the ParentLink software. This provided numerous rich and valuable user data sets that helped ParentLink to better focus on the needs of users and become a better practicing UxE process-based software company.

ParentLink's motivation for this activity had several characteristics:

- They thought any analytics solution would take significant resources to implement.
- They wanted to know more data about their users to have a more complete understanding of how their services were being used, especially to see:
    - The workflow of users through their Web site,
    - The types of users using their Web site and proportions of them,
    - Problems that users were having on the Web site that were unreported to support personnel.
- They wanted to be able to explain usage trends and strategic direction with quantifiable data.
- They wanted a solution that provided deeper analytics that did not require annual licensing fees was also easy to implement within their existing infrastructure.

Before ParentLink was ready to invest the resources required to make use of this new analytical data, they first needed to know that Google Analytics could be useful to them and would not take a significant investment to implement, maintain, and explore later on. ParentLink had invested significant resources into creating a few custom analytics for their own use when their company was first started, so they were aware of the time and energy it takes to create something like Google Analytics. Not having known that Google Analytics was free, much of

their concern was addressed immediately by the research team with this statement. The research team then explained the process of including a small section of programming information on each page of their Web site that was automatically generated by Google that would then allow all of the analytical information that could be gathered by Google's system to function across their entire online system. After implementation, the amount of information available to ParentLink was overwhelming to the degree that it was seen as not useful to the company. The research team then helped show ParentLink employees how to use Google Analytics to access some of its core features in order to answer the types of questions they had about users, usage, and workflows. By creating a few shortcuts to essential reports, ParentLink employees could quickly check on key metrics without having to explore the entire analytical suite.

As explained by the senior developer who implemented the Google Analytics code snippet, it only took him about an hour to update their code base for the entire system. ParentLink employees quickly realized how useful this information was to their long-term UxE strategy because the quantitative server-side data could be combined with qualitative user feedback to identify trends within ParentLink's products.

4.6.2 Design, Development, Demonstration, Evaluation, and Communication of Artifacts

ParentLink now uses the Google Analytics suite during the development of their products and as a part of making strategic decisions within their corporation. The data provided by Google helps them understand their users, their usage, and the workflow of their end-user customers. This helps ParentLink better design their software systems and better meet the needs of their users. Google Analytics also helps their long-term UxE strategy by allowing them to track trends over time and determine whether user feature requests might be useful to a large audience or not.

Perhaps more importantly than the ability to gather user data, is the increased level of UxE process engagement by ParentLink that this activity shows.

4.7 Cycle 6 - District Administrator Dashboard (Nov. 2011 - April 2012)

4.7.1 Problem Identification, Motivation, and Solution Objectives

Cycle 6 marked the most significant milestone in the long-term UxE process changes at ParentLink. In Cycle 1, many district administrators had identified that the reporting system on ParentLink's Web site was difficult to use and lacked the visual refinement that users were expecting (Redfearn et al., 2010). Additionally, the reporting function also took a long time to run, so many users never accessed this portion of the Web site, although they wanted to know the data that was available there. Unbeknownst to the research team, ParentLink had begun work on a district administrator dashboard in 2011 to solve this problem. Since district administrators represented the most senior level of their customer base, they were motivated to resolve these reporting system user problems with a well-designed interface that was most visually appealing and fast to respond.

After several low and medium fidelity prototypes and some user testing had already been completed without any assistance from the research team, ParentLink finally showed the work that they had done on the dashboard to the research team to gather some expert feedback on their user research and UI development before a high-fidelity prototype was created. This was the first time that ParentLink had followed through on a complete long-term UxE-based Agile development cycle completely autonomously through low and medium fidelity prototyping phases. At this stage, ParentLink was a little unsure of how to present specific types of information to their users, so the research team trained ParentLink employees on various

information visualization methods and how best to display the information efficiently on their dashboard. They also provided ParentLink with online resources to determine the best methods to display various information types on their systems in the future.

4.7.2 Design, Development, Demonstration, Evaluation, and Communication of Artifacts

During the high fidelity prototype development of Cycle 6, the research team helped assist ParentLink employees with the final visual touches to their system and helped verify that an appropriate UxE process had been followed to address the real-world needs of their users for this activity. As a result, ParentLink had done almost all of the necessary work on their own without any external help from the research team, having followed the necessary UxE process steps for a successful integration of user feedback into their product development process. ParentLink presented a well-designed medium fidelity prototype to the research team for final review before a programming release was undertaken.

This final activity showed that ParentLink had finally committed itself to participating in UxE processes. This proactive UxE integration strongly suggested that ParentLink would continue to perform user-centered research and design in future projects on their own.

4.8 Evaluation of Cycles

As was described in great detail in the previous sections of this chapter, ParentLink made significant improvements in the design of the customer's experience. When Cycle 1 and 6 are compared, for example, the increased level of UxE engagement by ParentLink is a stark contrast. ParentLink also showed that, given enough time and support from upper-level leadership, long-term UxE practices can help benefit a small corporate enterprise. As changes occurred within and amongst the six described cycles, the corporate and customer's points of view became more

and more aligned with each other. From the perspective of ParentLink's customers, the customer's experience evolved throughout this long-term UxE study as well and became of more value to ParentLink's corporate goals. One ParentLink employee explains: "Our mobile apps have a 30% higher reuse rate over our desktop application for parents….We have seen an increase of about 20% in usage of our messaging system since [2010]". (Redfearn et al., 2013) Since "reuse rate" means that the same user (parent) is visiting the ParentLink Web site through a mobile interface. This means that 30% more parents return to use the mobile ParentLink system more than once. This statistic is good news for parental engagement.

Although it is not possible to prove a causal relationship between the improvements noted by ParentLink and the use of UxE processes within their existing development cycle, ParentLink credits their success with the close integration of long-term UxE processes and their development cycle. A higher level of customer engagement on mobile applications also indicates that throughout the six cycles, ParentLink has successfully increased the levels that their mobile systems are used by their customers. Furthermore, the following quotes indicate that ParentLink is now committed to the integration of long-term UxE processes within their existing development process:

- "We do this [long-term UxE] more and more now. And we know how to do it which is also very important."
- "I attest [our success] to our usability…."(Redfearn et al., 2013)

Many problems and issues arose in the implementation of UxE principles during the application of long-term UxE processes to this case study. From a complete lack of UxE-related practice within ParentLink in Cycle 1, the first-hand training over a three-year period from the research team helped ParentLink learn an appreciation for UxE-based principles to the point

where they performed an entire UxE-related product development cycle on their own, without any major assistance from the research team, as described in Cycle 6. Throughout this research project, ParentLink relied on a long-term UxE process in order to increase their corporate involvement in UxE-based practices and better align their strategic goals with the needs of their real-world customers. By eliciting customer feedback early and often, ParentLink learned that by delivering a product that was more customer-focused, their end-users were more pleased with ParentLink products and more loyal to the ParentLink brand. In the long-term, relying on UxE-based practices and processes will save ParentLink both time and money in their product development cycle because they are not investing resources where they are not needed. Customer needs will be met and unnecessary services and features will remain undeveloped. Additionally, relying on long-term UxE practices and processes will mean that big mistakes are made less frequently by ParentLink developers because end-user customers are involved throughout the entire product development cycle.

Incorporating long-term UxE practices did not come easy for ParentLink. As a developer-centric software company, their culture was based on feature sets and advanced capabilities. It took three years between Cycles 1 and 6 for ParentLink to acquire the knowledge and experience necessary to perform UxE practices on their own. ParentLink also needed to fail many times (at different severity levels) before they learned the value of a long-term UxE process.

The successes and failures of these long-term UxE cycles were measured by a set of data relating to the combination of corporate success and customer relationships. These metrics were tracked using traditional testing methodologies, relying heavily on semi-structured interviews, user surveys, and user testing.

Corporate long-term UxE process success was measured by the increased commitment to long-term UxE-based tasks by ParentLink from Cycles 1-6. This also was demonstrated by the increased implementation of mobile solutions (releasing more mobile device applications) as described in Cycle 2. Another benefit to ParentLink was seen in the decreased development costs associated with Cycle 3, where an entire internationalization effort was shown to be of little value to ParentLink before they invested any real time to create such a feature for a very small fraction of users.

Customer relationships were measured in detail to help ParentLink gauge whether the long-term UxE changes effected on their customers (the end users) were effective or not. By the end of Cycle 6, ParentLink had seen an increase in customer usage rates, product sales rates, and customer satisfaction (from first-hand user feedback and surveys). ParentLink increased their modeling of real-world user processes to aid in customer-to-product engagement levels and then saw a decrease in the numbers of Web site pages required to complete tasks in their products and the time required to complete top-priority user tasks. By decreasing the time necessary to perform tasks in their products and the number of steps required of user-centered tasks, ParentLink was able to create more useful mobile and desktop applications and increase market share in their domain.

4.9 Summary of Results

Although the results and analysis of each of the 6 Cycles of the long-term UxE process have been described throughout this chapter, the following list summarizes the observed results of each of the measures of improvement stated throughout this report.

4.9.1 Metric 1 – Increased Commitment Level to Long-Term UxE by ParentLink

ParentLink gradually increased their involvement in UxE design practices and decreased their dependence on external UxE consultants (the research team). They performed none of the UxE-related process tasks in Cycle 1. They performed a few tasks in Cycles 3 and 4. They performed several tasks in Cycle 2 and 5. ParentLink performed all UxE-related process tasks in Cycle 6; they became 100% committed to long-term UxE practices. At the final research meeting in April 2012, ParentLink management expressed that, "we are now a UX company" (Redfearn et al., 2013). Without the support of upper-level management, the adoption of UxE-related processes and practices would certainly have been much more difficult for ParentLink employees to adopt. When analyzed chronologically, ParentLink gradually increased their involvement in integrating UxE-related processes within their existing development environment until they successfully complete all the tasks expected of a UxE process. They have shown a willingness and dedication as UxE practitioners to continue toward long-term UxE testing with their own products and end-user customers.

4.9.2 Metric 2 – Increased Implementation Level of Mobile Solutions

In May 2011, ParentLink released their first two mobile applications, both iOS-based, after various requests from customers for this functionality. By February 2013, ParentLink had released 84 total applications between iOS and Android platforms (Redfearn, 2013). The initial application releases were very limited and only provided basic functionality with the ParentLink system. Since 2011, ParentLink has continued to release small, iterative changes to their mobile applications with additional features and support, as requested by customers. With plans to continue releasing mobile applications on both of these major platforms, ParentLink has clearly increased their implementation level of mobile solutions.

4.9.3 Metric 3 – Decreased Development Costs

The more closely integrated ParentLink became with UxE processes, the more overall employee time and salary was saved by the organization. In Cycle 3, this measure was most obvious. Although only hypothetical, ParentLink had planned to create another product feature without any prior research as to the demand for it by their real world users. Once the research was performed, the development of the internationalization of their products was completely stopped, saving at least a week of employee development hours and at least a week of employee salary to initially create the feature (Redfearn, 2011). Additional support/maintenance costs resulting from not having to care for an additional feature also were saved.

4.9.4 Metric 4 – Increased Customer Usage Rates

This metric is complex and intriguing. Total Web site page views for ParentLink have decreased by about 4% while mobile Web site usage has increased over 14% (see Figure 4–3 and Figure 4–4) after Cycle 5 was implemented. ParentLink attributes this increase in mobile Web site visits as a direct response to better meeting the needs of their users, who have repeatedly requested mobile versions of their software products (Dellenbach et al., 2012). Additionally, user surveys indicate that ParentLink customers are more frequently using mobile applications (indicative in the Web site usage trends already stated) and are sending more batches of messages through the ParentLink system each year (a 30,257 message increase year over year in 2012, totaling almost 959,000 batches of messages). Although some customers are using ParentLink's systems less (desktop Web site users), other customers (mobile application users) are becoming much more engaged and using their systems more frequently.

4.9.5 Metric 5 – Increased Product Sales Rates

ParentLink's sales have continued to rise year over year for many years now. The last two years (2011 & 2012) have resulted in an increase of 32 and 64%, respectively. ParentLink attributes their sales rates to the UxE processes they have implemented. (Redfearn et al., 2013)

4.9.6 Metric 6 – Increased Customer Satisfaction Rates

Before Cycle 1, customers consistently complained about the messaging and reporting functions of the ParentLink Web site. Additionally this customer feedback was never formally tracked or analyzed. Customers now consistently provide feedback that since Cycle 1, ParentLink has continued to improve their products and services. User testing, surveys, and interviews show that since the Web site redesign of Cycle 1, customers have been satisfied with their purchases and report no major complaints. ParentLink's customer surveys indicate a satisfaction level of 93% from 2011-2013 with a sample size of over 3,350 responses among 215 unique end-user customers, indicating an aggregated average of 15.6 survey responses from each end-user respondent (ParentLink, 2013). See Appendix A for the example survey form used to gather this data. It should be noted that these survey responses by customers were optional and self-selecting. This reflects a powerful level of satisfaction and engagement to the ParentLink system. ParentLink, beginning in late 2011, now actively gathers and analyzes customer feedback in a continuous manner in an attempt to address user concerns more quickly than before. (ParentLink, 2013)

4.9.7 Metric 7 – Increased Levels of Modeling Real-world User Processes

This proved to be a more difficult metric to track. Cycle 1's Web site redesign made the most dramatic move toward modeling real-world user processes and resulted in lower levels of

user frustration, a decrease in the time required to write a message, and a decrease in the number of Web site pages required to complete a messaging task. By eliminating two unnecessary Web site pages and decreasing the time required to send a message by 99 seconds (from 142 seconds to 43 seconds) users have been much more satisfied with the messaging feature of ParentLink.net (Redfearn et al., 2010; Redfearn, 2010a). A 99 second decrease of time equates to a 70% decrease in the total time required to complete the messaging process. From September 2010-February 2013, this savings of time totaled over 7.7 years of additional productivity for ParentLink customers.

4.9.8 Metric 8 – Decreased Number of Web Site Pages Required to Complete a Task

Along with the previously listed metric, Cycle 1 eliminated two Web site pages from the messaging process to decrease the time required to complete a messaging task and to increase customer satisfaction with the messaging system (Redfearn et al., 2010).

4.9.9 Metric 9 – Decreased Time Required for Task Completion

As previously described, the time required to complete a messaging task was decreased by 99 seconds in Cycle 1 (Redfearn et al., 2010), which led to dramatic productivity improvements as noted above. This helped to show ParentLink the value of reducing the time required to complete tasks and this was considered an essential design point for future applications/services.

4.9.10 Metric 10 – Increased Usage of Mobile and Desktop Applications

ParentLink has seen an increase in mobile Web site usage of 14% overall, but they tout a "…30% higher reuse rate over [the] desktop application for parents." 30% more parents have

accessed the ParentLink Web site during more than one login session now, which is good news for parental engagement. Overall, total Web site usage has decreased by 4% after Cycle 5 was implemented, but core user groups are more active on the ParentLink system than ever before. Customer feedback also suggests customers are happier with the product since Cycle 1 completed, at a level of 93%. with a sample size of over 3,350 responses among 215 unique end-user customers, indicating an aggregated average of 15.6 survey responses from each end-user respondent (ParentLink, 2013; Redfearn et al., 2013; Redfearn, 2013). See Appendix A for the example survey form used to gather this data.

Overall, incorporating long-term UxE practices in a small organization proved very challenging to the research team and to ParentLink itself. The three-year process of becoming a more user-centered software company did not come easily, nor without some costs (mostly research- and education-related), however, the level of customer satisfaction (as well as the other metrics already described) and the increased level of practicing UxE processes have both grown in a linear fashion during this time period. A final analysis of this project follows in the next chapter, including suggestions for future research.

5 CONCLUSIONS AND RECOMMENDATIONS

The data gathered during the six cycles outlined in the previous chapter have shown the progression of a three-year case study centered on the implementation of a long-term UxE process within an existing software company. This study attempted to ask the following research questions:

- What improvements in the design of the customer's experience can long-term UxE practices bring to a small corporate enterprise? What changes occur from the corporate and customer's point of view as the customer's experience evolves throughout a long-term UxE study?
- What problems and issues arise in the implementation of UxE principles during the application of long-term UxE practices to a case study?

The initial implementation of UxE succeeded as a single intervention of improvement, but was unsuccessful in changing company behavior; UxE processes were not yet adopted as part of ParentLink's internal development processes. This further illustrated one of the failures with single intervention UxE design practices. Subsequent Cycles 2-6 showed a gradual progression toward a functional UxE system within the organizational structure of our industrial partner. Cycles 1-5 included many struggles in UxE leadership and commitment, including a general unfamiliarity with how to perform UxE-centered research and incorporate end-users into the development of a system. The longitudinal relationship among the research team and ParentLink

employees was the key factor that facilitated the changes required by ParentLink in order to incorporate long-term UxE practices into their existing Agile development cycle. Additionally, the support of ParentLink management served as a critical component to driving all ParentLink employees to adopt UxE-related processes and practices. In the final research team meeting in April 2012, ParentLink management expressed that, "we are now a UX company" (Redfearn et al., 2013).

5.1 Cycle Review

Table 5-1 gives a brief overview of the six cycles that comprised this research study, organized according to the order in which they were discussed in the previous chapter:

Table 5-1: Research Project Timeline with Individual Cycle Details

Cycle Number	*Cycle Title*	*Cycle Time Period*
1	ParentLink User Interface (UI) Redesign	Oct. 2009 – Aug. 2010
2	Mobile Development	Nov. 2010 – Apr. 2012
3	UI Language Translation	Oct. 2011 – Nov. 2011
4	Stories in Ticketing System	Nov. 2011 – Dec. 2011
5	Google Analytics	Nov. 2011 – Apr. 2012
6	District Administrator Dashboard	Jan. 2012 – Apr. 2012

The research team relied on a modified version of Peffers et al.'s Design Science Research Methodology (DSRM) that included an iterative and longitudinal perspective to allow the research team to address problems over the lifespan of the three-year research project. This also allowed the research team to learn from previous cycles and apply that body of knowledge to future cycles. The longitudinal perspective of Leontiev's Activity Theory (AT) also proved essential to this research project, enabling the research team to focus on the ever-changing nature

of human development to adjust more quickly to users' evolving needs at any given time during the project. Not every detail of the DSRM and AT were fully explored (as was the case with Cycle 3 never being implemented), but overall, these theories served as the framework to identifying problems and resolving them within ParentLink's existing software development process.

The research team found some success with the application of DSRM and AT to this three-year long-term UxE case study. It provided a well-developed structure and perspective in order to encompass many of the issues that might arise with a longitudinal study. This method helped identify the improvements in the design of the customer's experience that long-term UxE practices could bring to a small corporate enterprise and helped identify the changes that occur from the corporate and customer's points of view. Also, as the customer's experience evolved throughout the long-term UxE study, DSRM and AT helped consistently adjust the identified problems and objectives that helped deliver more user-centered solutions.

Until 2009, ParentLink had never seriously included any UxE methodologies or analysis in the development of their products. Since 2009, several UxE studies have been performed with various types of users, resulting in more user-centered products that more closely match the needs of ParentLink customers. From the six cycles described in this report, ParentLink now understands that a long-term UxE strategy will require them to increase their commitment to long-term UxE processes and increase their implementation of mobile solutions, because these requests fulfill the needs of their users. In the long-term, relying on UxE-based practices and processes will save ParentLink both time and money in their product development cycle because they are not investing resources where they are not needed. Customer needs will be met and unnecessary services and features will remain undeveloped. Additionally, relying on long-term

UxE practices and processes will mean that big mistakes are made less frequently by ParentLink developers because end-user customers are involved throughout the entire product development cycle.

5.2 Measures Review

Throughout the six cycles described in this report, the research team gathered and analyzed the following 10 metrics, as shown in Table 5-2. A description of each of the 10 metrics follows in the next section of this report for additional information regarding each measure:

5.2.1 Metric 1 - UxE Commitment Level

Commitment level to long-term UxE by ParentLink, as measured by the number of UxE-related process tasks performed by ParentLink employees, defined in the longitudinal DSRM process model. There was a 100% commitment to long-term UxE processes after Cycle 6. This measure was a direct result of ParentLink management's involvement in the adoption of UxE-related processes and practices, without which such commitment would have been unlikely over the long-term period of this study.

5.2.2 Metric 2 - Mobile Implementation Level

Implementation level of mobile solutions, as measured by number of mobile applications available to download online. This metric was driven by customer requests for mobile solutions and helps to meet the future technology needs of real-world users. ParentLink released 84 more mobile applications after Cycle 2. The initial application releases were very limited and only provided basic functionality with the ParentLink system. Since 2011, ParentLink has continued

Table 5-2: Review of Metrics from Research Project

Metric	*Metric Keywords*	*Before Relevant Cycle(s)*	*After Relevant Cycle(s)*	*Total Change During Project*
1	UxE Commitment Level	0 tasks	All tasks	100% more commitment
2	Mobile Implementation Level	0 apps	84 apps	84 more apps
3	Development Costs	1 wk time & salary planned (to start)	No investment	1 week time & salary saved (to start)
4	Customer Usage Rates	Page views: unknown; Batches sent: 838.6K; Customer reuse rate: unknown	Page views: 4% desktop decrease & 14% mobile increase; Batches sent: 958.9K; Customer reuse rate: 30% increase	Page views: 4% desktop decrease & 14% mobile increase; Batches sent: 120.3K increase; Customer reuse rate: 30% increase
5	Product Sales Rates	32% increase in 2011	64% increase in 2012	64% increase, year over year
6	Customer Satisfaction Rates	Low but unmeasured	93% satisfied; 3,350+ responses; 215 unique customers	93% satisfied; 3,350+ responses; 215 unique customers
7	Real-world Process Modeling	Pages required: 5; Time required: 142 sec	Pages required: 3; Time required: 43 sec	Page decrease: 2; Time decrease: 99 sec = 70% decrease = 7.7+ yrs. saved
8	Pages to Task Completion	Pages required: 7	Pages required: 5	Page decrease: 2
9	Time to Task Completion	Time required: 142 sec	Time required: 43 sec	Time decrease: 99 sec = 70% decrease = 7.7 yrs saved
10	Desktop & Mobile Application Comparison	Page views: unknown; Customer reuse rate: unknown; Customer satisfaction: low & unmeasured	Page views: 4% desktop decrease & 14% mobile increase; Customer reuse rate: 30% increase; Customer satisfaction: 93% satisfied; 3,350+ responses; 215 unique customers	Page views: 4% desktop decrease & 14% mobile increase; Customer reuse rate: 30% increase; Customer satisfaction: 93% satisfied; 3,350+ responses; 215 unique customers

to release small, iterative changes to their mobile applications with additional features and support, as requested by customers.

5.2.3 Metric 3 - Development Costs

Development costs, as measured in the hours required to create the product and the employee salary used to pay for the product creation and/or support. ParentLink saved at least 1 week of employee time and employee salary after Cycle 3.

5.2.4 Metric 4 - Customer Usage Rates

Customer usage rates, as measured by the combination of Web site page views, total batches of messages sent, and customer reuse rate. ParentLink page views decreased by 4% for the desktop Web site and increased by 14% for mobile applications after Cycle 5 was implemented. There was an increase of 120,319 more batches of messages sent from 2010-2012 and a customer reuse rate increase of 30% after Cycle 6. Now that 30% more parents have logged into the ParentLink Web site more than once, there is an increased level of parental engagement.

5.2.5 Metric 5 - Product Sales Rates

Product sales rates, as measured by the percent change in sales year over year. ParentLink increased their product sales by 64% in 2012 after Cycle 6.

5.2.6 Metric 6 - Customer Satisfaction Rates

Customer satisfaction rates, as measured from user feedback tools (user testing, surveys, and interviews) that were gathered beginning in late 2011. ParentLink customers were found to

be 93% satisfied with the software offerings after Cycle 6 with a sample size of over 3,350 responses among 215 unique end-user customers, indicating an aggregated average of 15.6 survey responses from each end-user respondent. See Appendix A for the example survey form used to gather this data.

5.2.7 Metric 7 - Real-world Process Modeling

Levels of modeling real-world user processes, as measured from user testing. Two Web site pages were removed from the messaging interface and by reorganizing the process flow, saved 99 seconds in messaging tasks after Cycle 1. A 99 second decrease of time equates to a 70% decrease in the total time required to complete the messaging process. From September 2010-February 2013, this savings of time totaled over 7.7 years of additional productivity for ParentLink customers.

5.2.8 Metric 8 - Web Site Pages to Task Completion

Number of Web site pages required to complete a task, as measured from user testing. Two Web site pages were removed from the messaging interface after Cycle 1.

5.2.9 Metric 9 - Time to Task Completion

Time required for task completion, as measured from user testing. Users were saved 99 seconds in the average time required to send a message after Cycle 1, resulting in a significant improvement in productivity as noted above.

5.2.10 Metric 10 - Desktop & Mobile Application Comparison

Comparison of usage of mobile and desktop applications, as measured by the combination of the total number of Web site page views, and user surveys on each platform (desktop and mobile). After Cycle 6, ParentLink saw a decrease of 4% in their desktop Web site usage and an increase of 14% in their mobile application usage after Cycle 5 was implemented. Customers returned to use ParentLink 30% more often and customers were 93% satisfied with ParentLink's software offerings as well with a sample size of over 3,350 responses among 215 unique end-user customers, indicating an aggregated average of 15.6 survey responses from each end-user respondent. See Appendix A for the example survey form used to gather this data.

Each of these metrics helped show the impact of long-term UxE process changes within ParentLink individually and in a larger perspective, especially as the knowledge learned from one cycle was exercised again in subsequent cycles.

5.3 Concluding Summary

First-hand training between the research team and ParentLink employees proved essential to the success of this project. Without long-term training and assistance from the research team, ParentLink did not have the resources to perform user-centered research on their own and incorporate user feedback into their Agile development cycle. A longitudinal study of UxE allows each single Activity of each Cycle to culminate into a greater body of knowledge and practice that continue to evolve over time and align more closely with the needs of end users. Continuous improvement philosophies similar to our long-term UxE approach have been practiced in other domains for decades (especially in manufacturing) and will serve well in the context of long-term UxE processes. Although it has become popular to outsource the design and development of many products, lacking this type of long-term UxE knowledge about an

organization's own product offerings removes any long-term experiential benefit that arises from long-term UxE practice.

The longitudinal data from this research project (e.g., ParentLink's commitment to long-term UxE practices), as described in the 6 cycles of Chapter 4, has shown that a long-term UxE process approach was difficult to implement at first, but provided a dramatic increase in customer satisfaction and customer engagement with the software system (Redfearn et al., 2010). It has also shown that ParentLink has been innovative in their product category and continues to grow the size of their business (Redfearn et al., 2013). From a cultural standpoint, the ParentLink leadership has helped the corporation to believe in the benefits of and be dedicated to the implementation of a practical long-term UxE process approach to software development. Before this cross-departmental focus was stressed, the implementation of long-term UxE methods failed, as seen in Cycle 1.

Along with AT, the implications of tracking long-term UxE data could be dramatic. A focus on the entire environment of a user, as stressed through AT, will be most beneficial in determining the real-world effects of changes in software programs. More importantly, tracking such user-centered data over an extended period of time will allow interfaces to be designed as changes are happening, in a more "real-time" situation (as shown by the method of this long-term UxE process adoption study) as opposed to always being "behind the curve" (as seen in traditional single-intervention testing).

A combination of user input and background (server-side) recorded data will provide the best picture of the current status of UxE for any software program. Once recorded for an extended period of time, including a large sample of "touches" with the interface itself, a company can form a baseline of the user-perceived efficiency of their software. This analysis has

yet to be performed and published in the academic literature, but future studies could take existing testing scenarios, as described by Tullis and Albert (Tullis & Albert, 2010), and track their corresponding metrics in order to determine how their efficacy changes over an extended period of time.

Once baselines are established, it is hypothesized that small changes in the user's experience can be detected almost instantly, and can be corrected just as quickly, as needed. This will prevent user-centric software testing from becoming stagnant and resulting in lower user involvement and the eventual loss of customers due to lagging behind users' expectations of software performance and functionality.

Eventually, the need for a paradigm shift in how software tools are designed for users could become necessary. AT will help to make this shift a reality by focusing not solely on the tool, but on the objective that is sought by the user. The process of accomplishing the objective should use whatever tool is most effective in the completion of the goal, but tools should offer a means to accomplish a good user experience, not simply one or more tasks.

The research team discovered that long-term cross-sectional UxE methods can be successfully implemented within an organization in place of traditional single-intervention testing methods. Long-term UxE-based methods require a slightly higher level of development cost initially, but provide a continual and overall higher return on investment throughout the product lifecycle by utilizing customer feedback and making smaller iterative changes to the product over time. Long-term UxE-based processes help to avoid late-stage development problems by continually improving the product with the parallel guidance of real-world users. This consistent matching of user's needs over all periods of time with changing product offerings makes customers more satisfied with their purchases. The research team also discovered that

long-term UxE methods were more effective in providing tangible user feedback at the right stages of system development in order to decrease development costs and increase customer usage rates, sales rates, and satisfaction rates.

The research team hypothesizes that, due to the popularity of Agile development practices among small software development organizations, a long-term UxE approach using the DSRM and rooted in AT will yield similar results in other domains among similarly small developer-centric organizations. Future longitudinal studies of UxE research in this domain will help us to discover whether integrating long-term UxE processes within an existing Agile development cycle are useful in other organizations as well. The research team suggests that future research explore the benefits of DSRM in a long-term UxE application to determine whether the success is indicative of the benefit of DSRM to long-term UxE process adoption or of other factors not described as the causal mechanism for beneficial results. The research team hopes to see other methodologies extended into the long-term UxE domain as well to see what processes might be the most beneficial to UxE researchers and practitioners. Perhaps even more beneficial to develop are methods to more quickly implement long-term UxE practices into existing organizations so more longitudinal research data can be published in the UxE domain.

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APPENDICES

APPENDIX A. Cycle 1 Supporting Documentation from Student Capstone Team

This appendix contains all of the cited documentation referenced as part of Cycle 1 throughout this study. This documentation was generated by the student Capstone Team.

A.1 Final Project Overview Report

Abstract

Throughout the life of this project, our Project Objective Statement (POS) led the focus of our activities. Our POS was to redesign ParentLink's development cycle to include usability testing and interface optimization by March 31, 2010, on minimal budget, to increase customer retention. In order to accomplish this objective, our team had to perform in-depth research, plan various projects, and present our findings in a meaningful way to ParentLink. In the end, we have not only developed a legitimate prototype that has already proven itself more useful to ParentLink's customers (reducing message sending time by 1.5 mins), but we have made a plan for ParentLink to incorporate usability testing into their two-week development cycle.

Introduction

ParentLink is a local Provo company that specializes in a school-to-home messaging system. In recent months, the competition in their business sphere has increased dramatically. In order to innovate and remain competitive, ParentLink realizes that having an easy-to-use interface to their product is essential to their product. However, ParentLink does not know how to properly implement the testing and development required to create an improved interface for

their product. Our capstone team was contracted in order to perform research on the existing interface, provide prototype interfaces for ParentLink to implement, and also to give technical and developmental recommendations that could be used to help ParentLink compete in the marketplace.

With the term 'usability' in mind, our main goal was to design an improvement on the existing ParentLink web interface system which not only decreased confusion among existing customers, but decreased the amount of time it would take any single user to send a message on the interface. This goal was sought with the help of ParentLink as this is singly the most-used function of their software system. With this prototype and experience documented, we could then teach ParentLink how to incorporate testing into their existing development processes and improve their interface in the future on their own time. The adage of "teaching a man to fish" was the main aspiration of our project.

Project Objectives

The statement which guided our project can be summarized in the following manner. Our objective was to redesign ParentLink's development cycle to include usability testing and interface optimization by March 31, 2010, on minimal budget, to increase customer retention. There were many aspects to our project that helped to accomplish our goals, which we did finish successfully. Some of the deliverables that we identified in order to meet our objectives are listed below:

- Usability Testing Protocols
- Remote Version
- In-person Version
- Usability Testing

- Group Leadership & Management
- RITE Testing
- Traditional Testing
- Online Database and Reporting Tools
- Final Prototype Interface Development
- Technical Recommendations
- Development Cycle Instructions
- ParentLink Company Training

Project Accomplishments

The following is a brief description of the portions of our project that led to the final outcome. There is also a link to the full documentation of each section for referential purposes.

Usability Testing Protocols

A testing protocol was developed during the first semester of our project. Including both in-person and remote testing procedures, this protocol not only gives detailed instructions on how to perform usability testing, but also documents how all of our user testing was performed. The last section of this report includes a lengthy description on the steps required to perform specific messaging and reporting functions of the existing ParentLink interface, which helps to aid the guidance of novice computer users in using the ParentLink web page. This protocol can be found here in the Appendix of this document.

Usability Testing

After our procedures were prepared, tested, and standardized, our team led groups of fellow Information Technology (IT) students to test existing ParentLink users. We also performed tests with non-ParentLink users and did so in both remote and in-person manners in

order to gather a wide breadth of testing data. After individual tests, our groups all made improved prototypes from the feedback received during the testing and repeated this process several times. The data from these tests can be found here in the Appendix of this document.

Online Database and Reporting Tools

In order to organize and record all of our user information, we created a web site and database to house these essential testing records. The website is no longer live but we have included all the database and code source for the website on the drive accompanying this report. However, the data from this site has also been included in the Appendix section of this report. The user information and testing data can be found here.

Prototype Interface Development

After the initial testing was gathered and 10 prototypes had been made, we compiled all of the data from the group testing and created a final prototype interface. This interface was tested over 40 times alone with various college students (a request from ParentLink to measure it's usability to future ParentLink users as well) to make sure that the final prototype was an improvement on previous prototypes. This final prototype proved incredibly useful and intuitive, saving both time and mental frustration to every single user that was tested. The final prototype can be found here in the Appendix of this document. The testing results from the final prototype can also be found here.

Technical Recommendations

While testing and using the ParentLink site, we found that nearly every user complained about the slow loading of Web site pages at ParentLink. In order to combat this and other complaints, we offer several strictly technical recommendations that will help ParentLink to implement useful technologies that will aid in system performance and management. Simply

upgrading the version of Zope that is being used will dramatically decrease page-loading times to their customers. The recommendations we offer can be found here in the Appendix of this document.

Development Cycle Instructions

Though short and succinct, the integration of usability testing into the current two-week agile development cycle of ParentLink will help the company to be competitive with other school-to-home messaging systems and to stay ahead of its rivals in the long-run. Being the only company presently concerned with usability, ParentLink stands to dramatically increase its market share if they properly implement user-friendly changes to their web software. Our usability development cycle schedule can be found here in the Appendix of this report.

ParentLink Company Training

The final portion of our project is to present all of our testing materials, videos, and data to ParentLink, along with their technical recommendations and improved development cycle that integrates user testing. This will include a pre-presentation information packet comprised of this report, a formal presentation in which we talk about the development cycle and how to perform user testing, and several follow-up visits, as needed, to ensure ParentLink's success. This has not yet been performed, but will take place during the month of May 2010.

Project Results

While no single part of this project was easy to accomplish, we have created a project that is not only impressive in its results, but will prove infinitely useful to ParentLink and their business strategy. In short, by integrating usability testing and improving the usefulness of their product, ParentLink is nearly guaranteed to make more money and find more customers for their web-based interface. Our work resulted in the following metrics:

- 70+ Usability Tests
- Management of 30+ Students
- 12 Prototypes Designed
- 220+ Pages of Documentation
- Final Prototype
- Decreased Message Sending Time by 1.5 mins
- 80% Preference of Prototype Interface
- One User Comment:
- "You'd have to be brain dead not to figure it out."

Conclusion

With the hundreds of pages of documentation, this report strives to summarize the objectives, accomplishments, and numerical improvements that have been made by our team during the 2009 - 2010 school year at Brigham Young University (BYU). The entire collection of documentation from our group is available in the Appendix of this document. See the Table of Contents for reference on where to locate a specific document. All of the details in the Appendix provide the specific information gathered and recommended to ParentLink and will need to be reviewed by ParentLink's employees in order for usability testing to be successfully implemented into ParentLink's business process.

A.2 Testing Protocol Example

Introduction

The purpose of this testing protocol is to inform you, as a Human-Computer Interaction (HCI) researcher, on how to do your job. This will include the instructions on what specific aspects of the ParentLink.net website you will be testing, and what kinds of things you need to do throughout the testing process in order to gather the information necessary to improve the ParentLink web page. This specific document is divided into two sections, one devoted to the remote testing procedure while the other is meant for in-person testing. In order to be effective in your responsibilities, we suggest that you read the document, in its entirety, before ever making assignments in your group. Once every group member understands all of the roles, then make decisions on which roles you will perform, and help each other to complete the tasks of the group. Remember above all, *that you are not the user.*

Testing Roles

User

Each test will include one user. The user's job is to complete each given scenario and provide constant feedback (by talking out loud) regarding each step they take. This includes what they click on, what led them to take that specific step, any confusion experienced, or any problems they encounter, along with any other useful feedback.

Before starting any tests, each user must add himself to a database that will track all the users involved in our testing. This includes providing some personal demographic information and answering some preliminary questions about their use of the ParentLink system.

Each user will be given a username and password that they will use to access the ParentLink test website at byucapstone.parentlink.net. Create a specific account if needed for the user. The username they are given should have the same user Role as the one they use on their own ParentLink site. All usernames with their associated roles are listed below. At the end of each scenario, the user may suggest any other things that they think would be useful to note.

Role	Username	Password
District Administrator	byudistadmin	cougar
Parent	byuparent	cougar
School Administrator	byuschooladmin	cougar
Staff	byustaff	cougar

Note: Our site doesn't have the ability to create Attendance Secretary, Parent, Parlant Support, and Teacher roles. These tests need to be performed on each user's site rather than on our test site.

Facilitator

Each test will include one facilitator. The facilitator's job is to give the user the scenarios they should complete, one-by-one. They will then watch what the user does to complete each scenario. If the user needs help completing a scenario, the facilitator will give them more information to guide them in completing the given task.

The facilitator is also in charge of making sure screen and audio capture software is ready at the start of each session and is responsible for starting and stopping the software at the beginning and end of each session, making sure that the captured files are saved in a way that they can be identified in a unique manner, noting the location, time, and date of the test. The facilitator will create a unique "Test ID" which will be used in the filenames of the captured files and also recorded on the test's online form. A Test ID will comprise of the group number performing the test, the first and last initials of the user, and the date of the test. For example, if Group 1 is administering the test to John Doe on 1/15/2010, the Test ID will be 1JD1152010. They will also make sure to log out of any previous ParentLink sessions when starting a new session. At the end of each scenario, the facilitator and observer will review the notes from that scenario together and the facilitator may add any other notes as needed.

Observer

Each test will include at least one observer. The observer's job is to take notes on what is happening. The notes will include the name of the user, facilitator, and observer, as well as the role, feature, and task being tested. The notes for each session should be identified in a unique manner, noting the location, time, and date of the test. Forms will be provided to record all necessary information. The observer must be sure to put the correct Test ID on each test's form. As the user completes each task while talking aloud, the observer will record notes about what the user says and does. Important things for the observer to record are the steps they take to complete a task, why the user took that step, and any difficulties encountered by the customer. They should pay special attention to anything that the user did that does not coincide with our list of steps for a given task, and note whether this further helped or hindered the user in completing the task. At the end of each scenario, the facilitator and observer will review the notes from that scenario together and the facilitator may add any other notes as needed.

The Users

We would like to remind you again that *you are not the user*. We would also remind you that the purpose of this protocol is to measure and improve the usability of the ParentLink web site. When testing users, in depth information about each person is not needed. Only basic information is necessary for the purposes of our testing. However, this basic information is essential. You must record the following information about each user, without fault:

- Name
- Role

- Age
- Technical-experience Level

To conduct a good test, hundreds of people are not needed. Because our testing will be done several times over as we gather data, improve the site, and retest our prototypes, smaller sets of data are more useful for our HCI purposes. Ten people from each testing role, for example, would be a good start for our basic initial testing purposes, with additional tests run in the future. Once a prototype is made, we will test more users.

Throughout your time with the user, the facilitator should ask questions verbally to the user so that the observer can write down the answers. Questions should be brief and easy to answer.

Success Measurements

There are several ways by which we can measure the effectiveness of the existing ParentLink web site. The number of mouse clicks and errors are a good start for measuring quantitatively how easy the site is to work with. Time elapsed to complete a task can be taken and then averaged among users. To measure frustrations, we could have a scale from 1 to 10.

We chose to use the time it took to complete given tasks as the metric to determine whether the prototypes developed are an improvement over the existing ParentLink interface.

Instructions

Now that you know the purpose of your group, here is an outline of the most essential steps that should be taken during each testing session, separated according to each testing type: remote and in-person testing. Basically, you need to use the appropriate technology to record as much data as possible, and then use the testing roles (user, facilitator, and observer) to operate through a testing scenario.

Remote Testing Procedures

- Contact user and arrange a time to test.
    - Be sure the user has a webcam and a computer with high-speed Internet.
- Use GoToMeeting.com to connect to the user's computer.
- Have the user navigate to http://sites.google.com/site/parentlinkhci/ and add themself to the user database by clicking "Add a new user".
- Have the user open a new Remote User Test Form to see what they should keep in mind during the test.
- Begin screen capture.

- Perform your testing scenario.
- Stop screen capture.
- Save all recorded data.
- Have the user complete the Remote User Test Form.

In-Person Testing Procedures

- Contact user and arrange a time to test.
    - Be sure the user has a computer with high-speed Internet.
- Use a camera, microphone, or screen capture software in order record the user, computer, and whatever audio necessary to our testing.
- Have the user navigate to http://sites.google.com/site/parentlinkhci/ and add himself to the user database by clicking “Add a new user”.
- Have the observer open a new In-Person User Test Form which they will then complete as the test continues.
- Perform your testing scenario.
- Stop your recording devices.
- Save all recorded data.

A.3 Testing Scenario Examples

Reports

Scenario 1: I need to send a Contact Report showing weekly contact for BYU Capstone byudistadmin@parentlink.net every Saturday at 10:00 AM.

1. Click on the “Reports Tab”.
2. In the “Messages” section, click “Contact Report”.
3. In the “School” section, select “BYU Capstone”.
4. In the “Date Range” section, select “This Week”.
5. All other fields can stay at their defaults.
6. Click “Generate Report”.
7. Click “Schedule”.
8. Change the “Send Time” to 10:00 AM.
9. Change the “Days” to Saturday.
10. In the “Email Addresses” type byudistadmin@parentlink.net.
11. Click “Save”.

Scenario 2: I need to generate a Message Tracking report for all messages in the BYU Capstone district this month.

1. Click on the “Reports Tab”.
2. In the “Messages” section, click “Message Tracking”.
3. In the “School” section, select “BYU Capstone”.
4. In the “Date Range” section, select “This Month”.
5. All other fields can stay at their defaults.
6. Click “Generate Report”.

Scenario 3: I need to generate a Recipient Tracking report for all messages that have not been delivered in the BYU Capstone district this week.

1. Click on the “Reports Tab”.
2. In the “Messages” section, click “Message Tracking”.
3. In the “School” section, select “BYU Capstone”.
4. In the “Date Range” section, select “This Week”.
5. In the “Status” section, make sure only “Not Delivered” is checked.
6. All other fields can stay at their defaults.
7. Click “Generate Report”.

Managing Accounts

Scenario 1: I need to change my password.

1. Click the “My Account” tab.
2. Click the “Change login ID or password” link.
3. Change your password.
4. Click “Save”.

Scenario 2: I need to update my street address.

1. Click the “My Account” tab.
2. Click the address listed under “Mailing Address”.
3. Change the address.
4. Click “Save”.

A.4 User Profile Example

Persona: Julie Johnson

Vital Statistics

Age: 40-something
Gender: Female
Ethnic Background: Caucasian
Birthplace: Utah

Educational and Professional Background

Julie has had one year of trade school education. That is the extent of her professional education, but she has an aptitude for technology and isn't afraid to become acquainted with new technology.

Dreams for the future

Julie has a 15-year-old boy and she is excited to see him get a driver's license.

Hobbies and Interests

Julie enjoys sitting back in front of the TV. However, she also enjoys dogs, the outdoors, and fishing. She really loves gardening and is an active member of a local horticulture club

Eating and Dressing Preferences

Scrubs are one of Julie's favorites. She loves being able to move comfortably, and likes being ready to change activities at the drop of a hat.

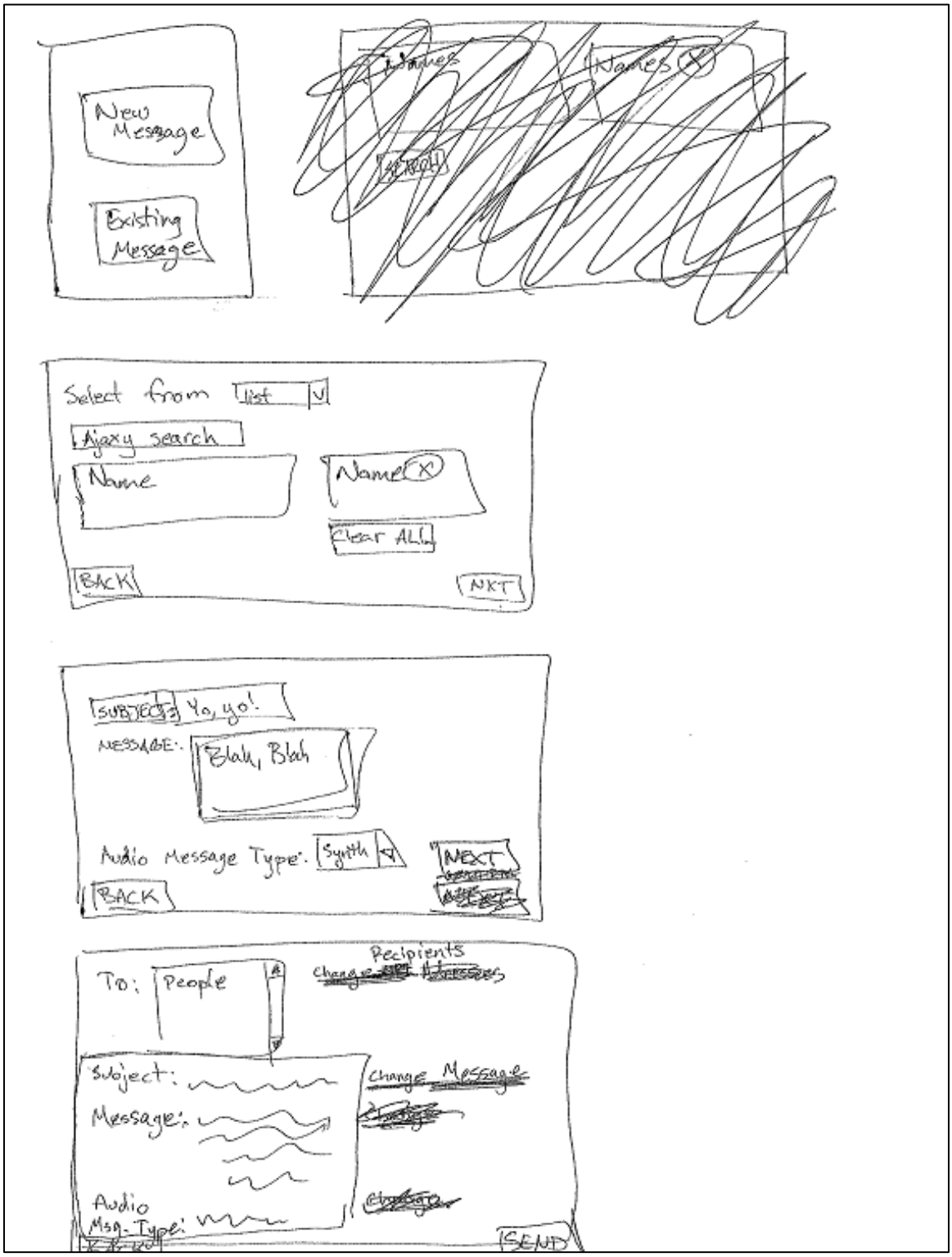
Lifestyle

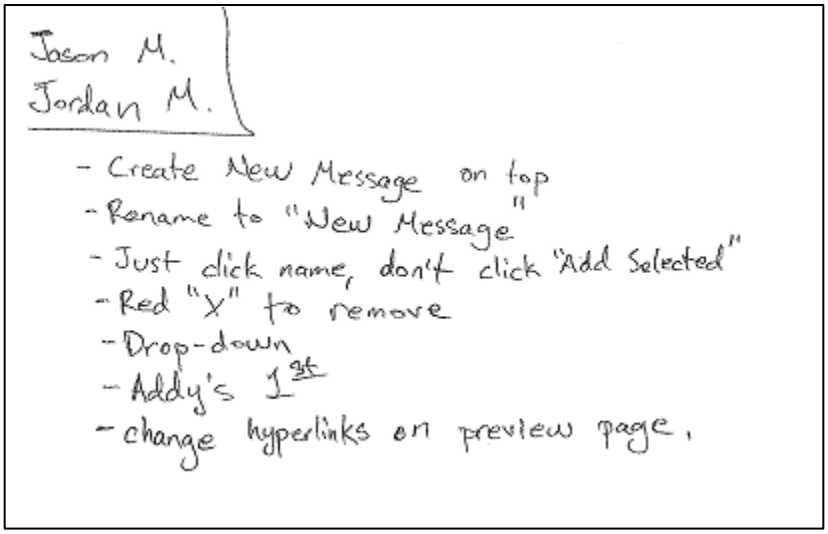
Julie is a working mom trying to assist her family in putting some money aside. However, she works at an elementary school because she enjoys assisting in the molding of young minds. She has a sincere concern for children and their safety.

Views on Communication

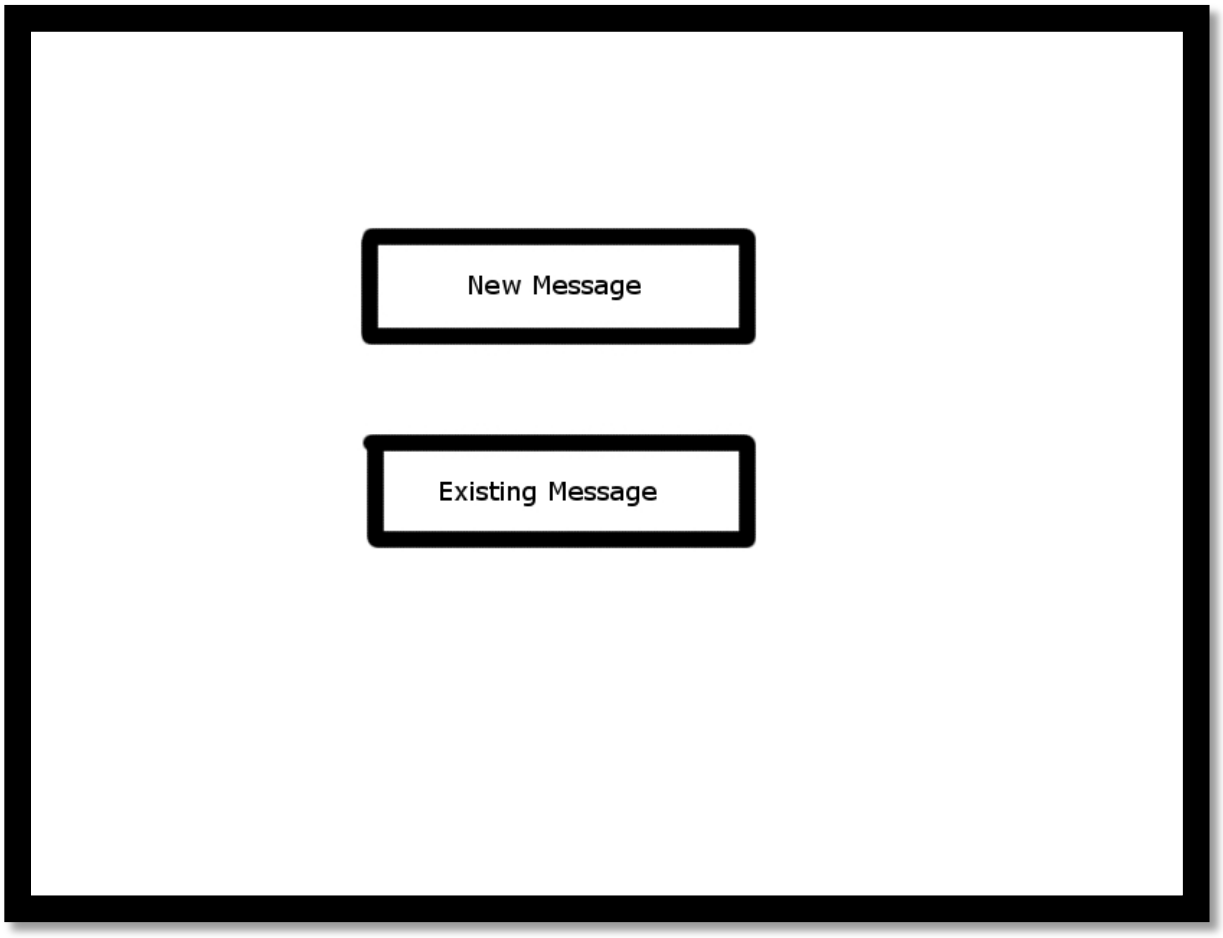
Julie communicates frequently with her family. If she needs to call her children and find out where they are, she will do it. As a secretary, she is constantly communicating with student's parents, faculty, and other school staff. Her job is a communication job. To Julie, communication is vital to her understanding of people, and situations. Julie wants to be able to communicate whenever she wants. That's why she uses the tools she uses. When Julie is communicating, that's all she does. She may have to put someone on hold, but she's usually communicating. For Julie, communication is how she conveys and understands people. However, as a secretary sometimes she has to communicate to too many people and has to do it in too short of a time frame. This is one reason why she has difficulties with current communication methods. Because communication is such a central part of Julie's life, it provides a lot of satisfaction when it works well and a lot of frustration when it doesn't.

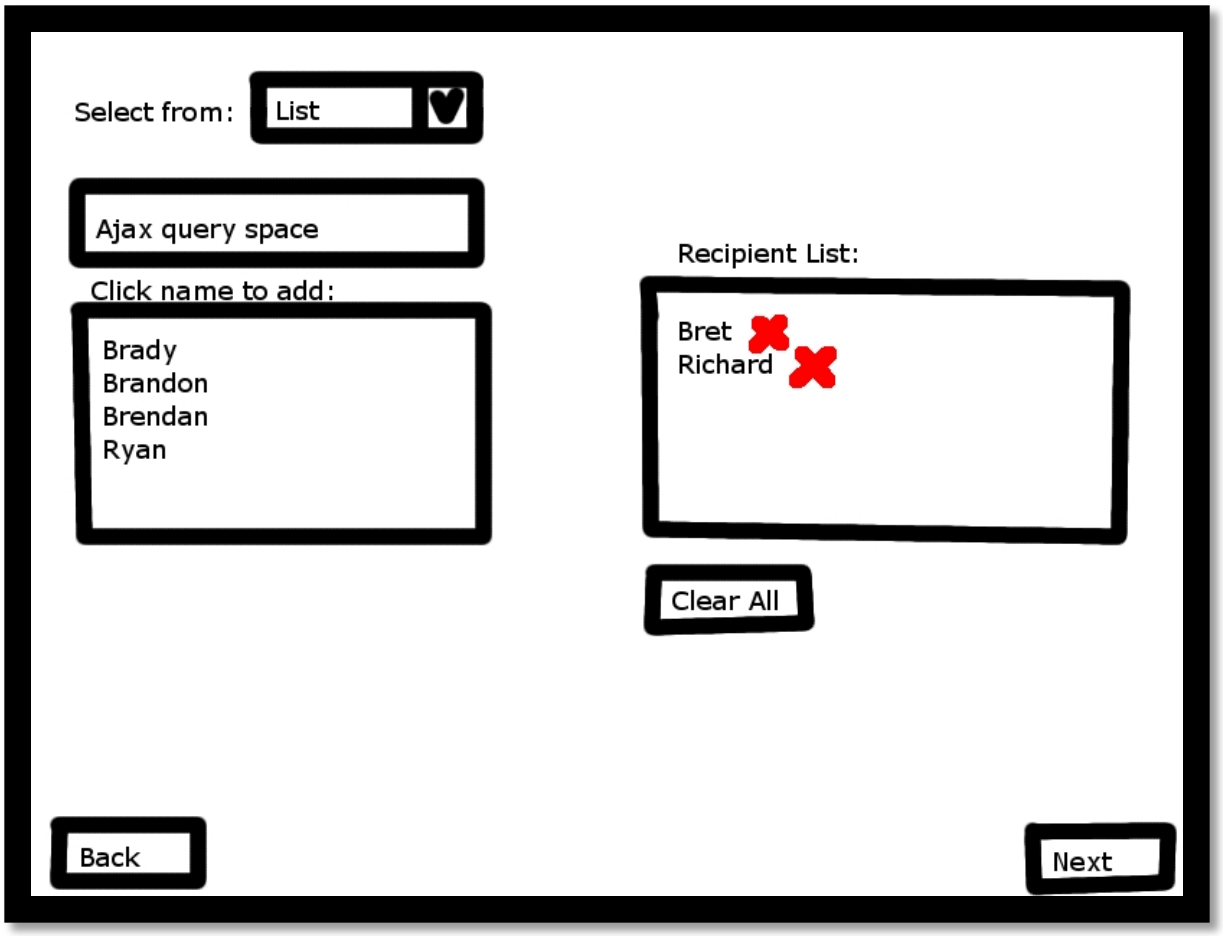
A.5 Low-fidelity Prototype Example

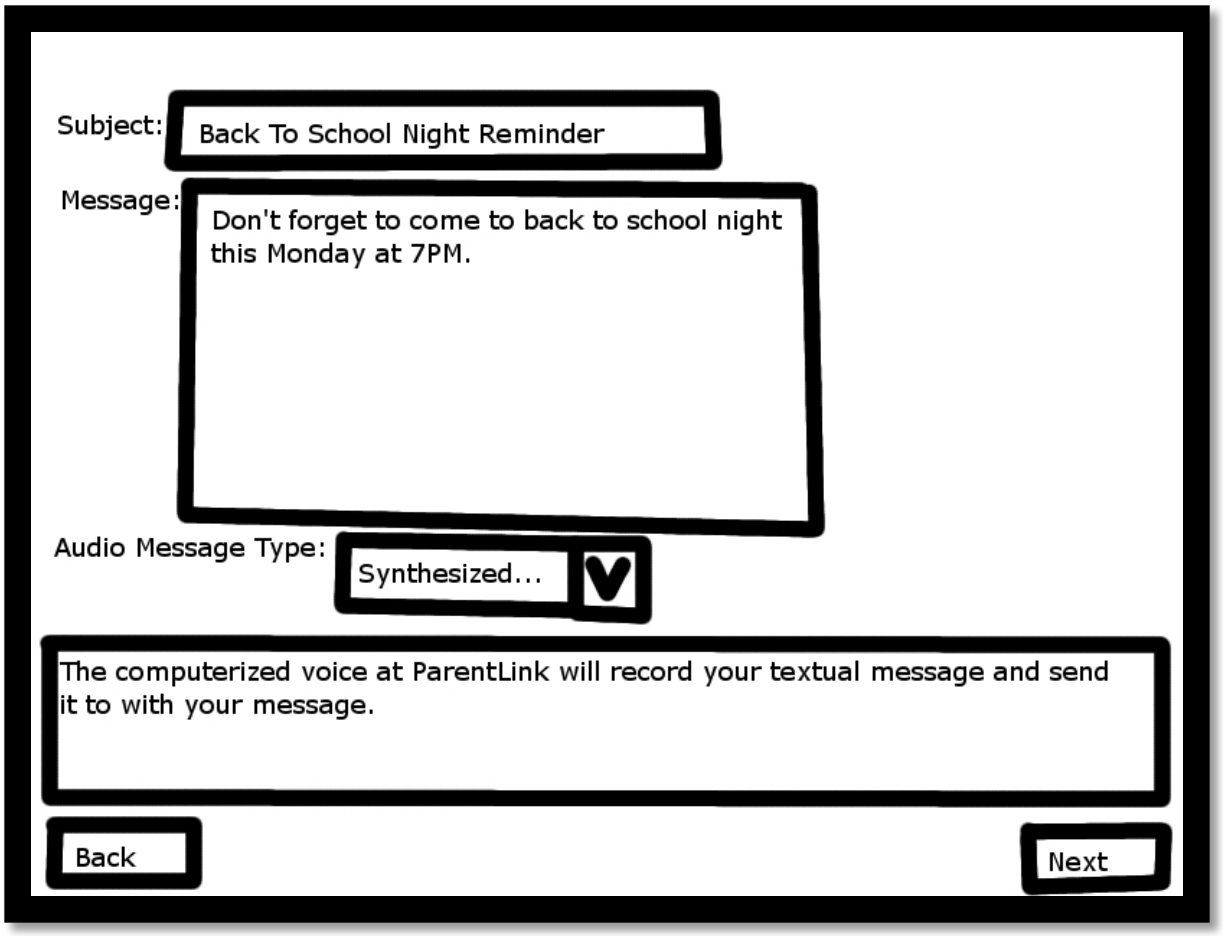


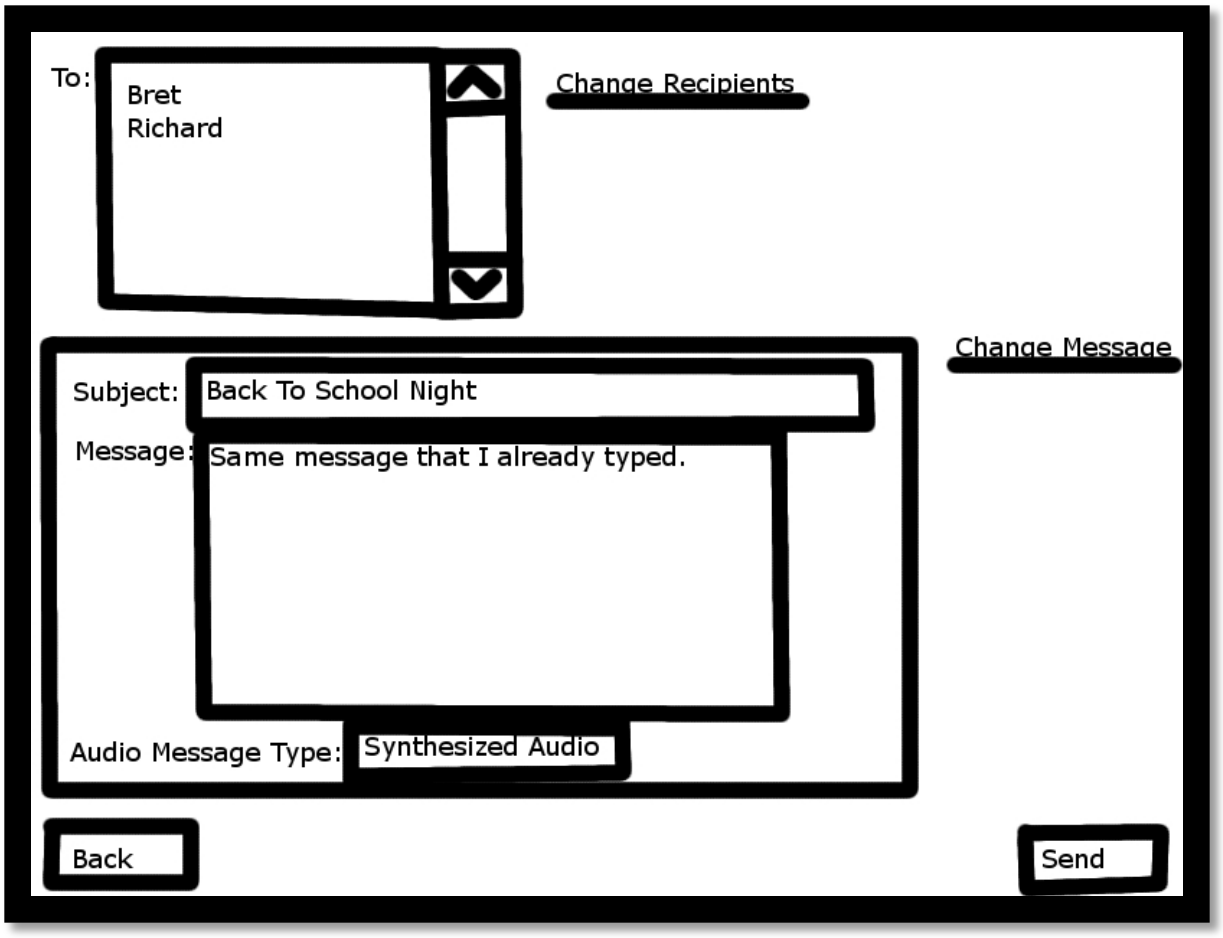


A.6 Medium-fidelity Prototype Example

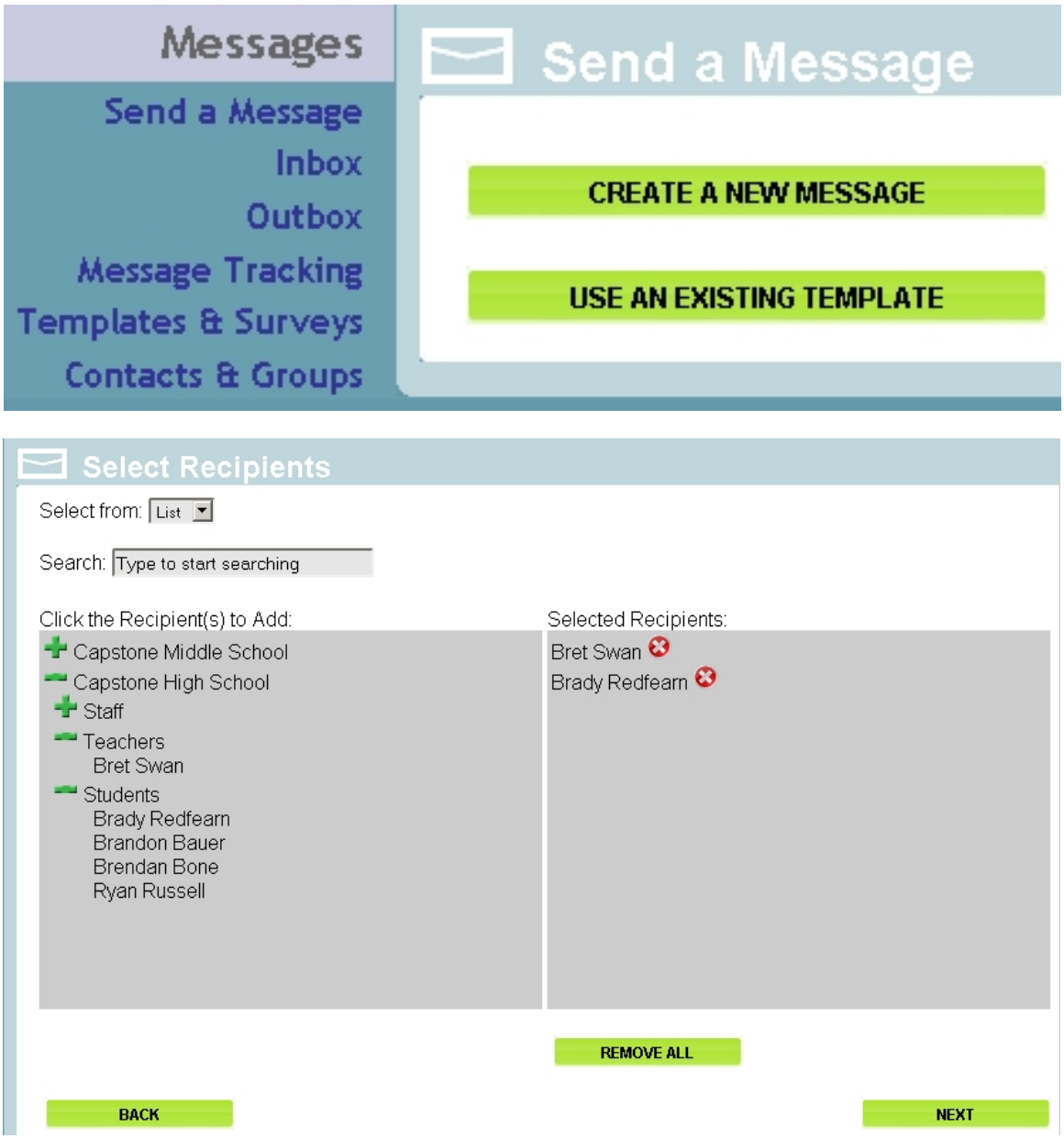


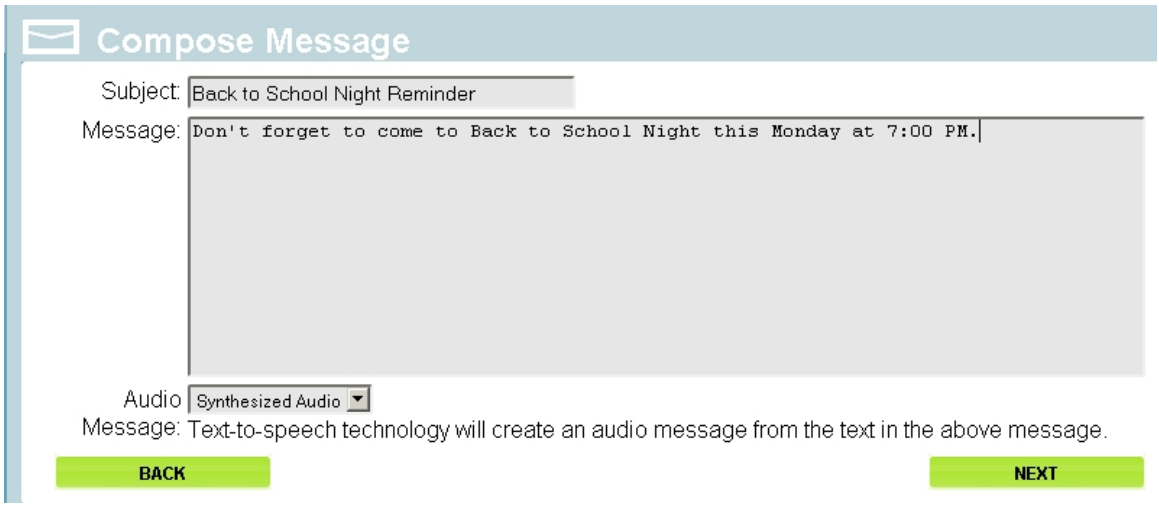


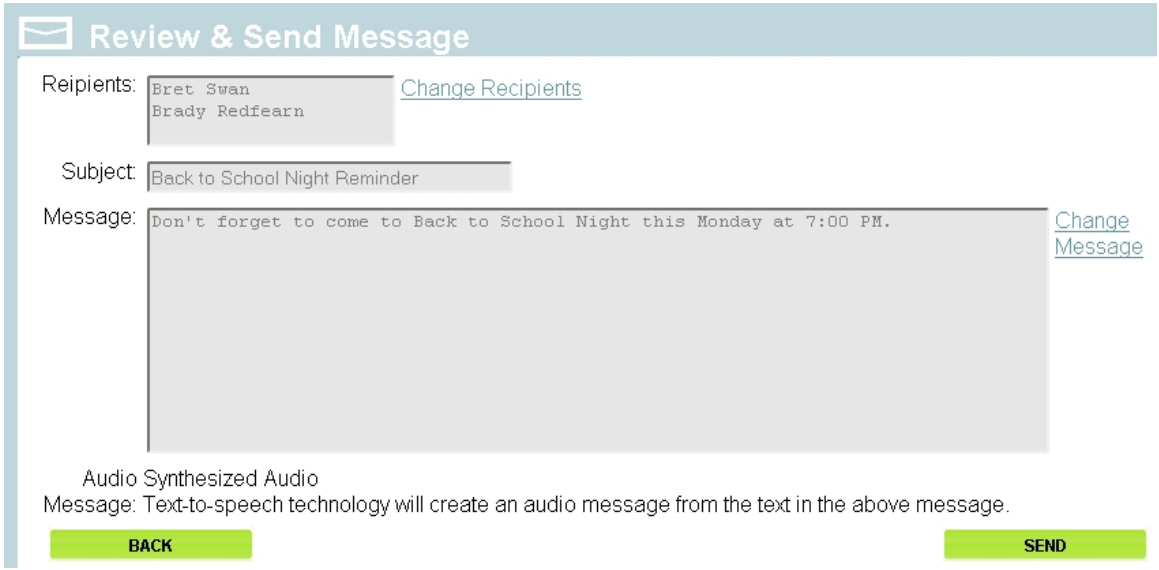




A.7 High-fidelity Prototype Example







A.8 Detailed Final Project Report Example

The ParentLink Interface

ParentLink's application frontend is currently served through Zope 2.8 (Z Object Publishing Environment), an object-oriented web server. Zope, which is programmed in Python, depends on various objects in its database, which can be written in Python, HTML, JavaScript, CSS, and other web languages, to dynamically generate and serve web pages. ParentLink also uses Microsoft SQL Server to store the data pertaining to every user and every school that uses ParentLink. When a user logs in to ParentLink's site, their credentials are first checking against data in the SQL database. This data is then fed back to Zope which generates several CSS files containing color and formatting data specific to the user's school, and uses the user's permissions to generate and serve out the web front-end to the customers.

The development team for ParentLink doubles as their design team, and currently is assigned to fit in some user testing as well. Because of the very small size of the development team, implementing new designs and testing the interface take a back seat to developing and implementing backend functionality. ParentLink's current design (referred to as version 7.0) was created about 4 years ago by an out-of-house designer. Since then, ParentLink's design has hardly changed, but they are currently brainstorming ideas in passing for their 8.0 design. Changing the interface too drastically means that new documentation and support material would need to be created, which would be a large and difficult undertaking for ParentLink's current staffing.

Technical Recommendations

While ParentLink's use of Zope and Python are giant steps in serving out a great web-based product, there are a few suggestions that we would offer to improve their system even more:

Update Zope

ParentLink is currently using Zope 2.8 (released in 2006), while the current version is 2.12.2. The older version is no longer maintained and the newest version contains some fixes to help in speed and compatibility, as well as some other new features.

Zope 3 has even more advantages:

- is a ground-up rewrite embodying the lessons learned from Zope 2
- is solid
- is clean and robust, with much better separation of concerns for developers

Update Python

ParentLink hasn't updated Python in over 3 years. The current release is 2.6.5.

Have fewer full-page refreshes

The ParentLink developers have recently been using AJAX more to allow for only needed parts of web pages to be refreshed at a time and using embedded popups. We applaud them in this and encourage them to continue by using AJAX in any section of the site and only loading sections of pages as needed.

Page loading times took up to a minute in our user testing. This is simply not acceptable to your users and they all commented that ParentLink was simply too slow to load anything.

Overall, ParentLink's developers are already doing a great job, so we encourage them to continue.

Development Cycle Instructions

Agile Development

The Agile development process is a new take on product development that promotes collaboration and adaptability by breaking a development process into small, iterative chunks. Defined by a group of developers in 2001 at Utah's own Snowbird resort, the Agile Manifesto reads as follows:

"We are uncovering better ways of developing software by doing it and helping others do it. Through this work we have come to value:

- **Individuals and interactions** over processes and tools
- **Working software** over comprehensive documentation
- **Customer collaboration** over contract negotiation
- **Responding to change** over following a plan

That is, while there is value in the items on the right, we value the items on the left more."

The manifesto goes on to state the underlying principles driving Agile development which are summarized below:

Seek customer satisfaction through early and continuous product delivery

Welcome and adapt to changing requirements to gain a competitive advantage

Deliver software frequently

Get business people and developers to work together throughout projects

Utilize motivated individuals

Communicate effectively through face-to-face conversation

Measure progress by how well a product works

Promote and maintain a constant development pace

Strive for technical excellence and simplicity

Seek ways to be more effective

RITE Testing

Rapid Iterative Testing and Evaluation (RITE) is a form of user testing that focuses on making small changes throughout the course of testing. The following steps will help to achieve meaningful results in RITE testing:

1. Choose a feature within your product that will be tested
2. Create scenarios and tasks that will target all parts of the feature chosen in the step above
3. Define questions and metrics that will yield meaningful results in your tests
4. Determine what type of user will use your feature the most in the final product
5. Select people to test that will best represent your group of users
6. Administer short, iterative tests:
    a. Test a user, ensuring that they follow the "think aloud" protocol
    b. Record all data that demonstrates the strengths and weaknesses of the feature
    c. Make possible small changes to the interface as defined by the test results

Integrating RITE Testing into Agile Development

In combining these schemes, a "user experience" (UX) team will be the tasked with performing RITE testing and ensuring a good user experience. To fit RITE testing into the short turn-around time defined in an Agile development schedule, the developers will need to take constant queues from the UX team. The UX team will need to have an active say in what is built first and what product features have highest priority. Some companies may even choose to have the developers work under the direction of the UX team.

The UX team should work with low-fidelity prototypes until just before reporting to the development team so they can spend as much time testing as possible. It is also best for the two teams to be on slightly staggered schedules so that progress can always be made by both teams.

A New Development Schedule

User testing is something at the forefront of the developer's minds as they know how important it is. However, due to limited personnel, time, and resources, the developers currently rely on what one of them referred to as "hallway usability testing". Currently, ParentLink only has four developers. To properly incorporate user testing into their development cycle, ParentLink would likely need to hire 2-4 new employees to create a UX team. For each 2-week Agile development period, ParentLink must focus on only one feature of their web site. Below is a proposed 2-week Agile/RITE cycle for ParentLink:

<table>
<tr><th>Business Day</th><th>UX Team</th><th>Development Team</th></tr>
<tr><td>1</td><td>Define tasks and scenarios. Find testers.</td><td>Define backend requirements and functionality.</td></tr>
<tr><td>2</td><td>Create first design mockup.</td><td rowspan="2">Implement functionality with very minimal focus on UI.</td></tr>
<tr><td>3</td><td rowspan="2">Test iteration 1.</td></tr>
<tr><td>4</td><td rowspan="2">Continue developing and design from test 1 results.</td></tr>
<tr><td>5</td><td rowspan="2">Test iteration 2.</td></tr>
<tr><td>6</td><td rowspan="2">Continue developing and design from test 2 results.</td></tr>
<tr><td>7</td><td rowspan="2">Test iteration 3.</td></tr>
<tr><td>8</td><td rowspan="2">Finish developing and design from test 3 results.</td></tr>
<tr><td>9</td><td rowspan="2">Gather customer feedback to determine the next feature to be developed.</td></tr>
<tr><td>10</td><td>Roll out feature.</td></tr>
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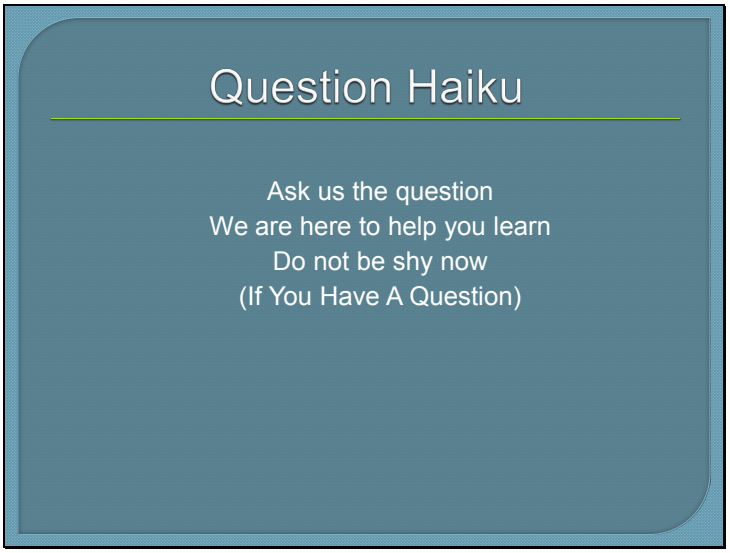
A.9 Final Project Presentation

Slide 1

Slide 2



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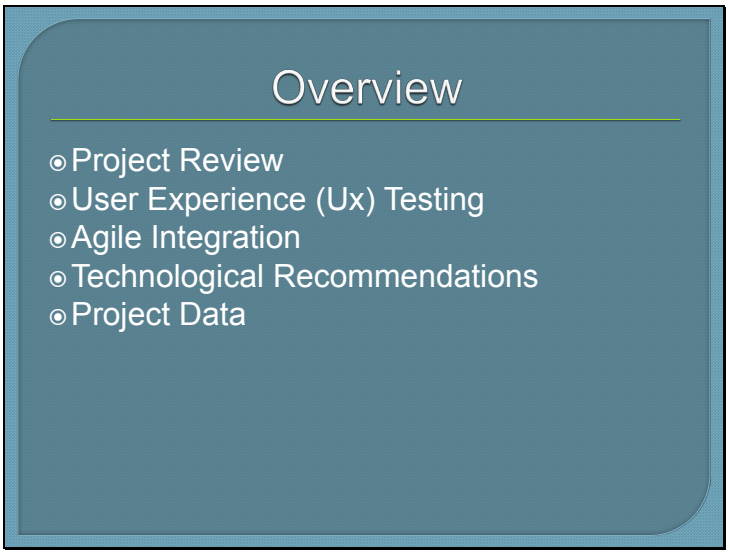

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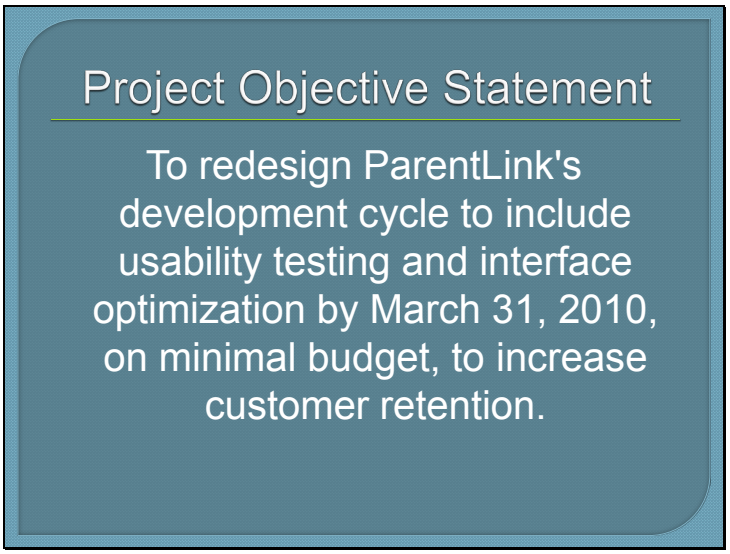

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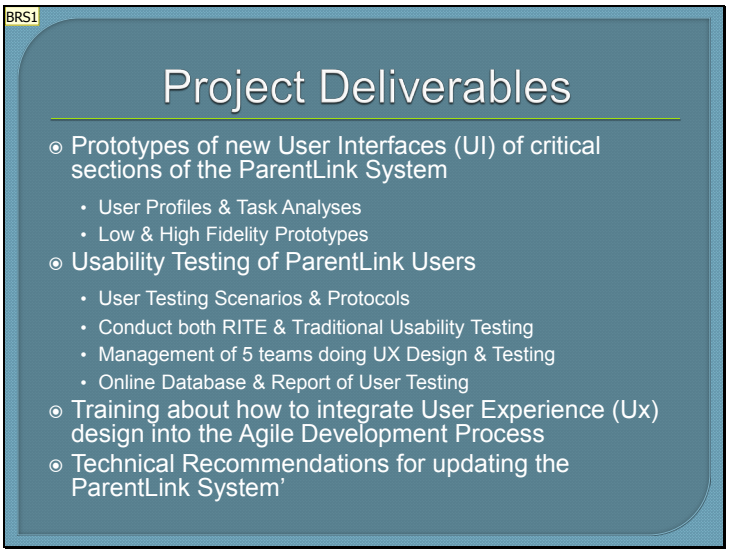

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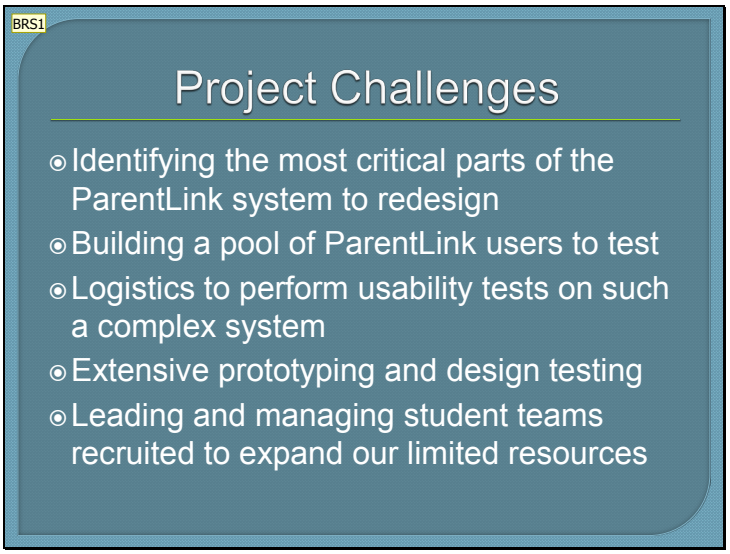

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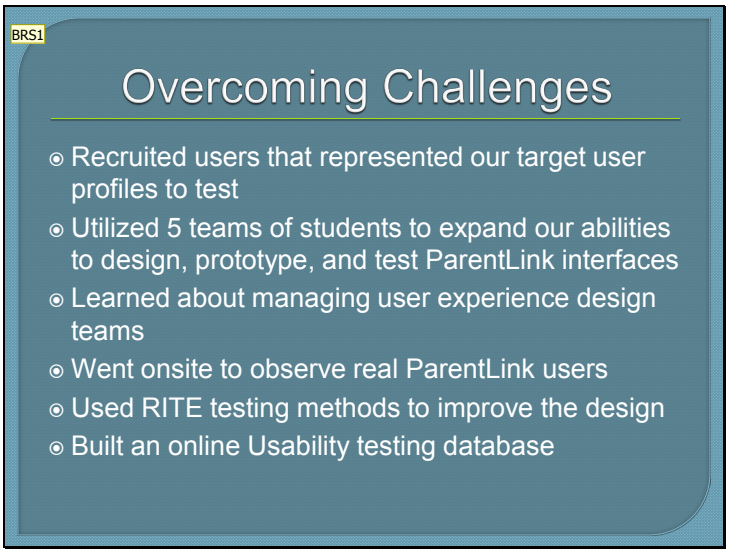

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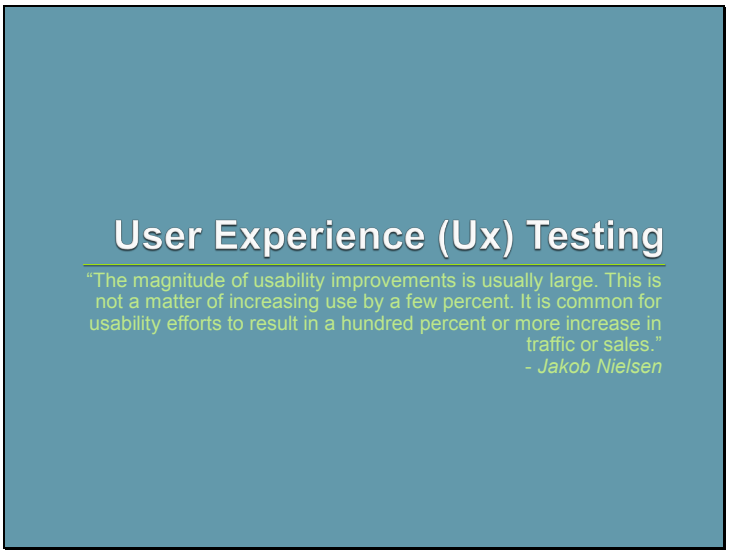

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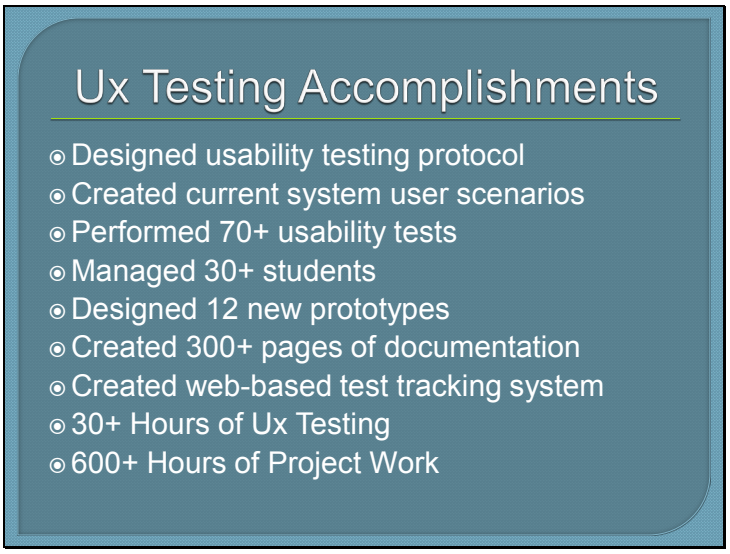

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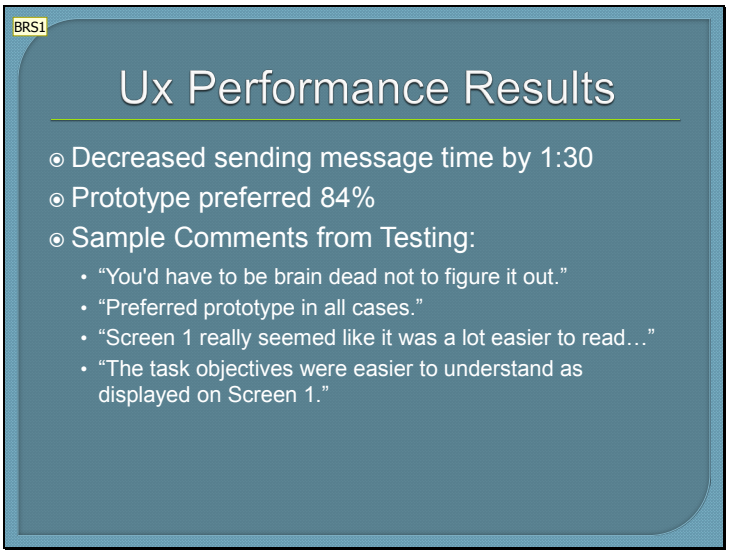

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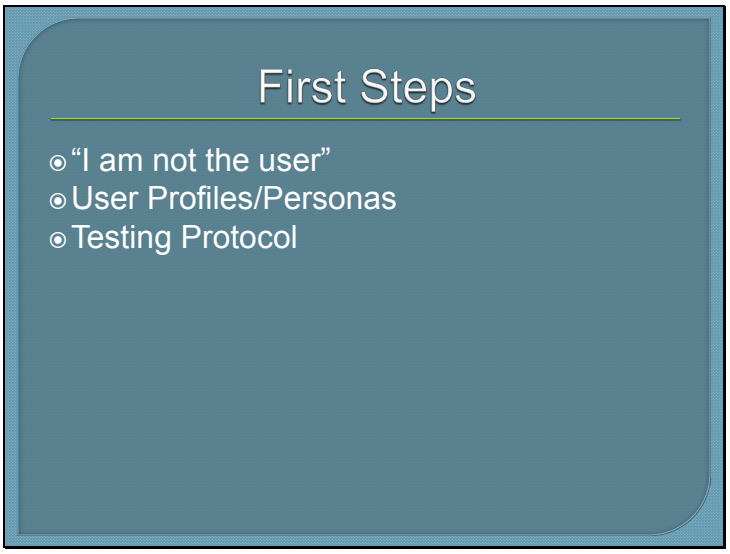

Slide 13

Ux Testing Types

USER-Centered Design	USAGE-Centered Design
Focus is on USERS: Ux, usability, and user satisfaction supporting task accomplishment	Focus is on DESIGN: feature identification and error correction supporting task accomplishment
Substantial user involvement in • User studies • Participatory design • User feedback • User testing	Selective user involvement (e.g., < 5) in • Exploratory UI modeling • Design variation • Usability inspection • Error identification & correction
Design driven by engineering & iterative testing of often high-fidelity prototypes	Design by rapid iteration, trial-and-error, evolution using low-fidelity prototyping
Systematic, fully specified processes	Highly varied, often informal or unspecified processes
Example: A typical Usability Study on high-fidelity prototypes of enough users to produce statistically significant results	Example: The Rapid Iterative Testing and Evaluation (RITE) method using 1-3 people to correct errors & identify features

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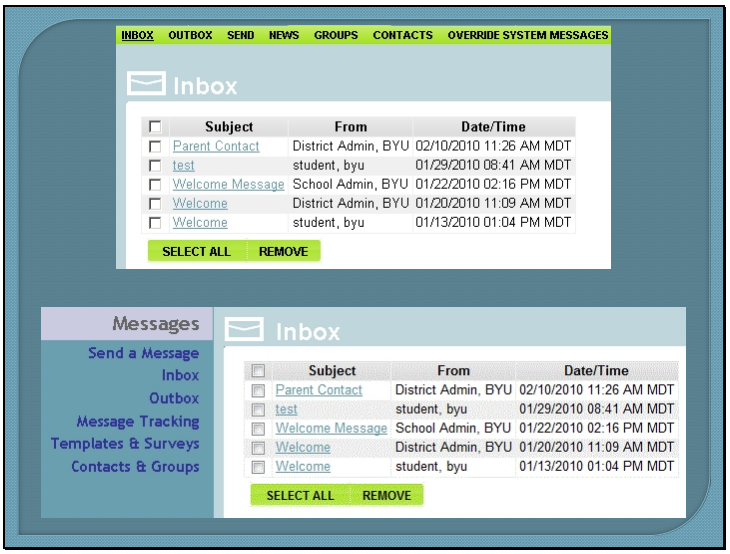
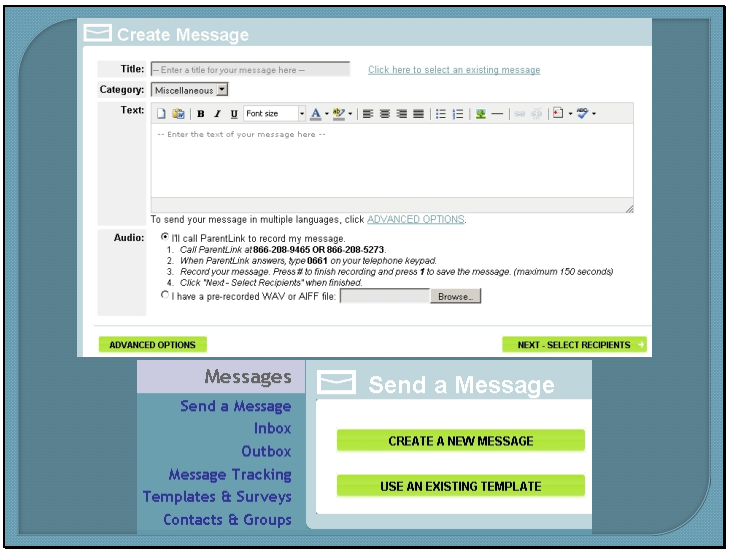
Existing Interface & Final Prototype Comparison

Slide 15



Slide 16



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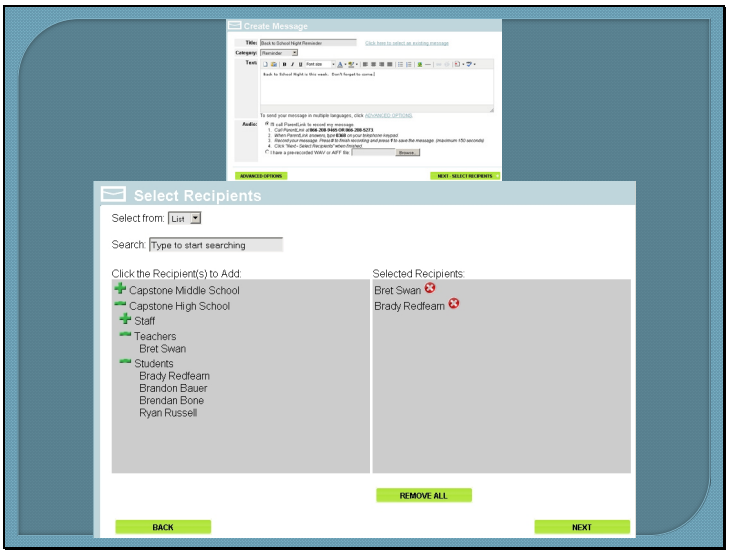

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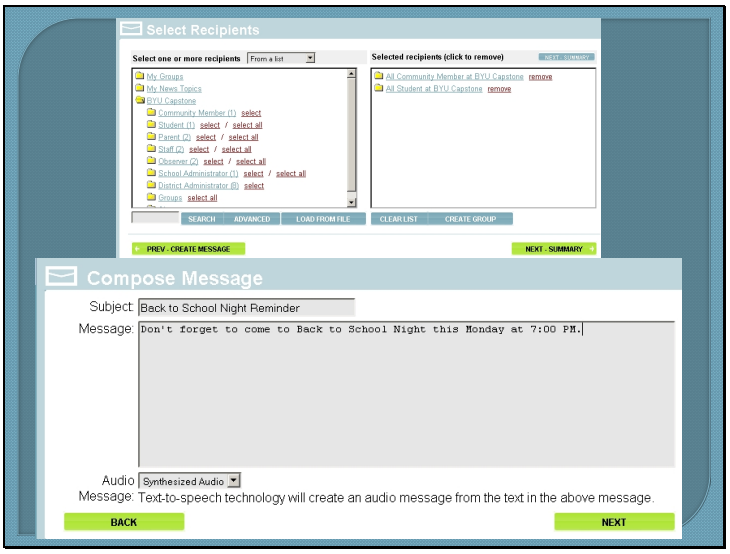

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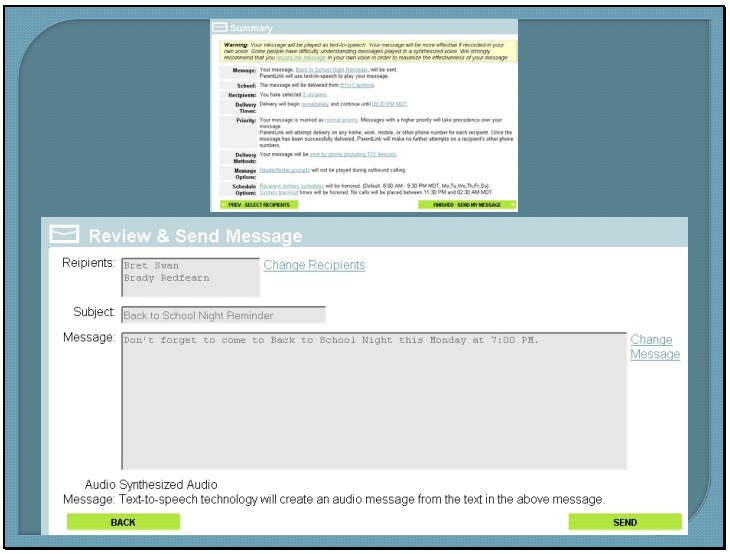

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Slide 21

Schedule in English

Business Day	Development Team	Ux Team
1	Define backend requirements and functionality.	Define tasks and scenarios. Find testers.
2	Implement functionality with very minimal focus on UI.	Create first design mockup.
3		RITE Test iteration 1.
4	Continue developing and design from test 1 results.	
5		RITE Test iteration 2.
6	Continue developing and design from test 2 results.	
7		RITE Test iteration 3.
8	Finish developing and design from test 3 results.	
9		Gather customer feedback to determine the next feature to be developed.
10	Roll out feature.	

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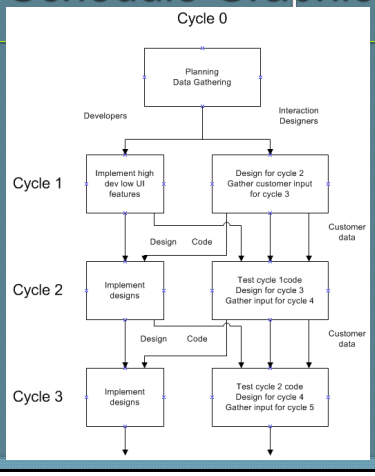
Schedule Graphic



BRS1

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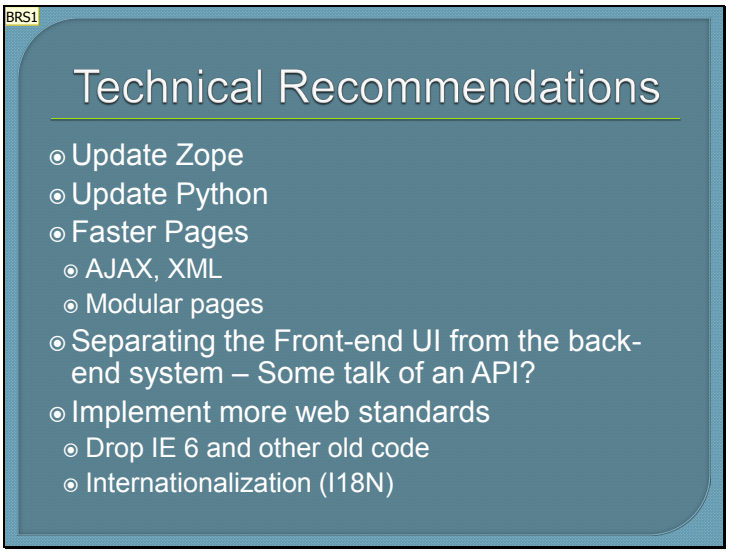
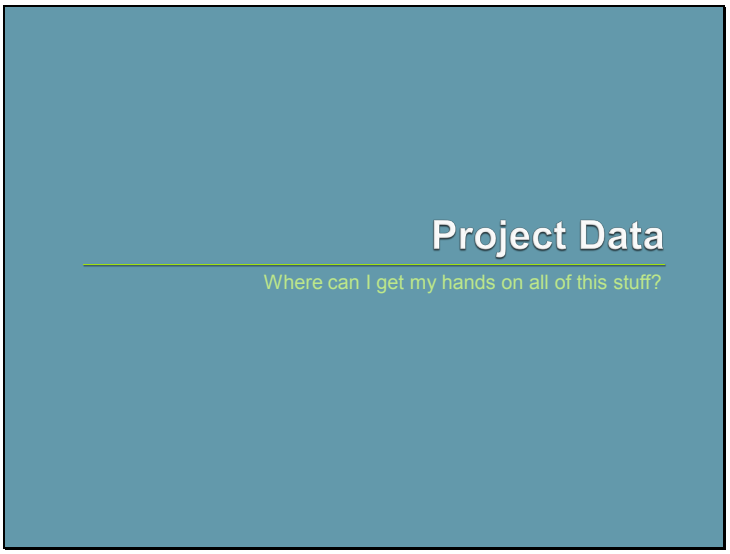
Slide 24



Slide 25



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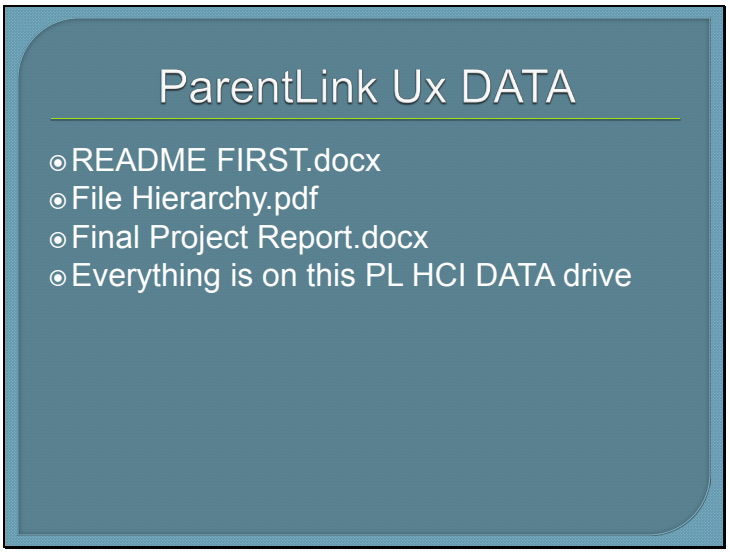

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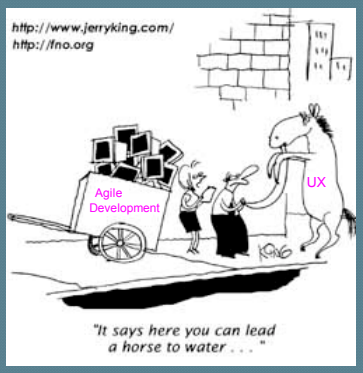
BRS1

Last Call for Questions or Comments?



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BRS1

Appendix

- Testing Scenario
- User Test Forms
- User Profiles

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Testing Scenario

- **Scenario 1: I need to send a welcome message (with audio recorded via phone) to all District and School Administrators in the BYU Capstone district.**
  - Click “Send a Message” on the home page, or click the “Messages” tab and then the “Send” menu item.
  - In the “Title” area, type “Welcome”.
  - From the “Category” dropdown, select “Miscellaneous”.
  - In the “Text” area, type a short welcome message.
  - In the “Audio” section, make sure “I'll call ParentLink to record my message” is selected.
  - Call ParentLink at 866-208-9465 OR 866-208-5273.
  - When ParentLink answers, type **1*117035 on your telephone keypad.
  - Record your message. Press # to finish recording and press 1 to save the message. (maximum 150 seconds)
  - Click "Next - Select Recipients".
  - Where it says “Select one or more recipients” make sure “From a list” is selected.
  - Select the “BYU Capstone” group.
  - Select all District and School Administrators.
  - Click “Next – Summary”.
  - Click “Finished – Send My Message”.

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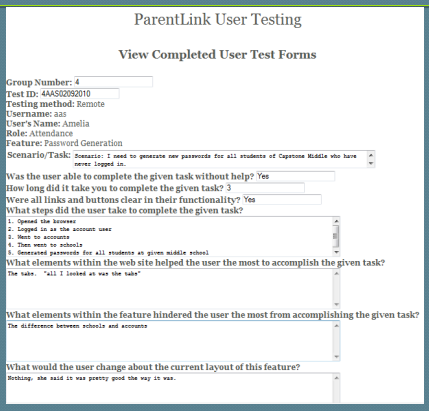
User Test Forms


ParentLink User Testing

View Completed User Test Forms

Group Number: 4
Test ID: 4AAS2092010
Testing method: Remote
Username: aas
User's Name: Amelia
Role: Attendance
Feature: Password Generation
Scenario/Task: Scenario: I need to generate new passwords for all students of Capstone Middle who have never logged in.
Was the user able to complete the given task without help? Yes
How long did it take you to complete the given task? 3
Were all links and buttons clear in their functionality? Yes
What steps did the user take to complete the given task?
1. Opened the browser
2. Logged in as the account user
3. Went to accounts
4. Then went to schools
5. Generated passwords for all students at given middle school
What elements within the web site helped the user the most to accomplish the given task?
The tabs. "all I looked at was the tabs"
What elements within the feature hindered the user the most from accomplishing the given task?
The difference between schools and accounts
What would the user change about the current layout of this feature?
Nothing, she said it was pretty good the way it was.

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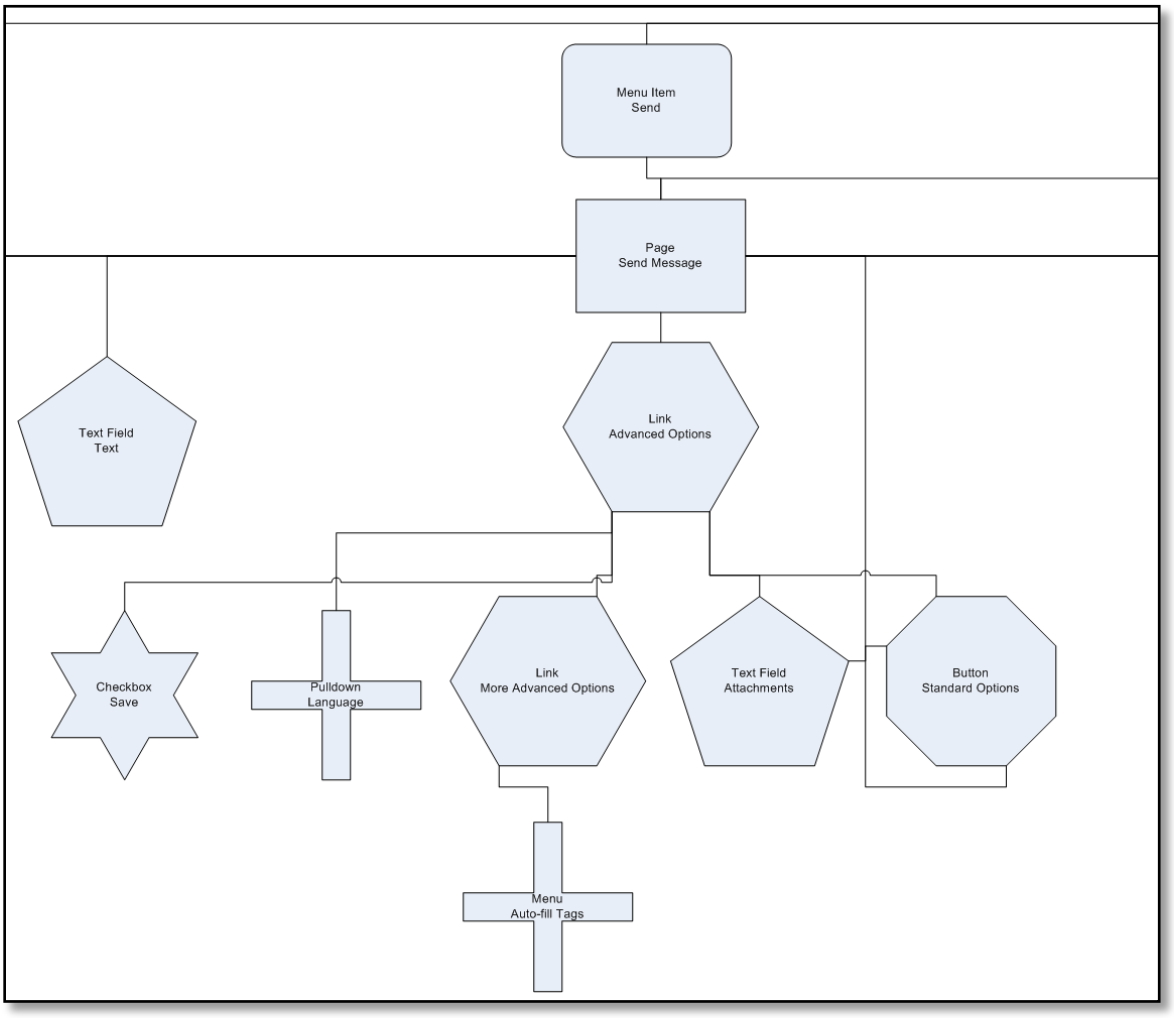
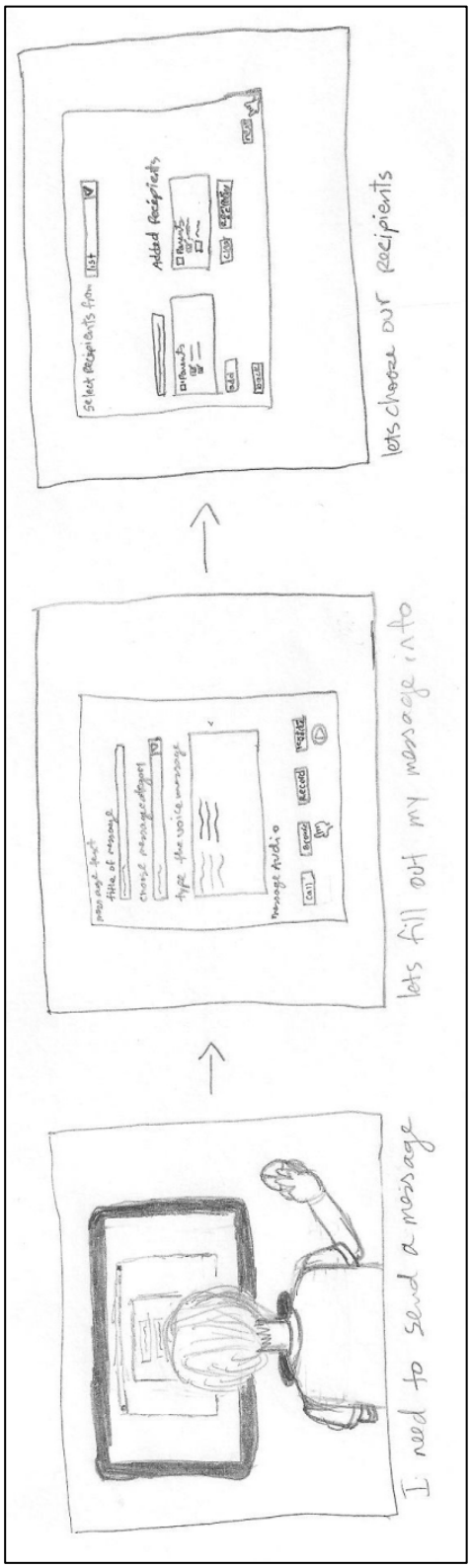
A.10 Site Map Example



A.11 Storyboard Example



A.12 ParentLink Survey Form

ParentLink Survey

Please take a minute to give us feedback on how we are doing. We appreciate knowing how our customers view us and where we need to improve.

I was able to create and send my message without difficulties.

	1	2	3	4	5	
Disagree	○	○	○	○	○	Agree

ParentLink delivered my message in a timely manner.

	1	2	3	4	5	
Disagree	○	○	○	○	○	Agree

ParentLink has been a reliable way for me to contact parents, student and staff.

	1	2	3	4	5	
Disagree	○	○	○	○	○	Agree

Message Name

Organization Name

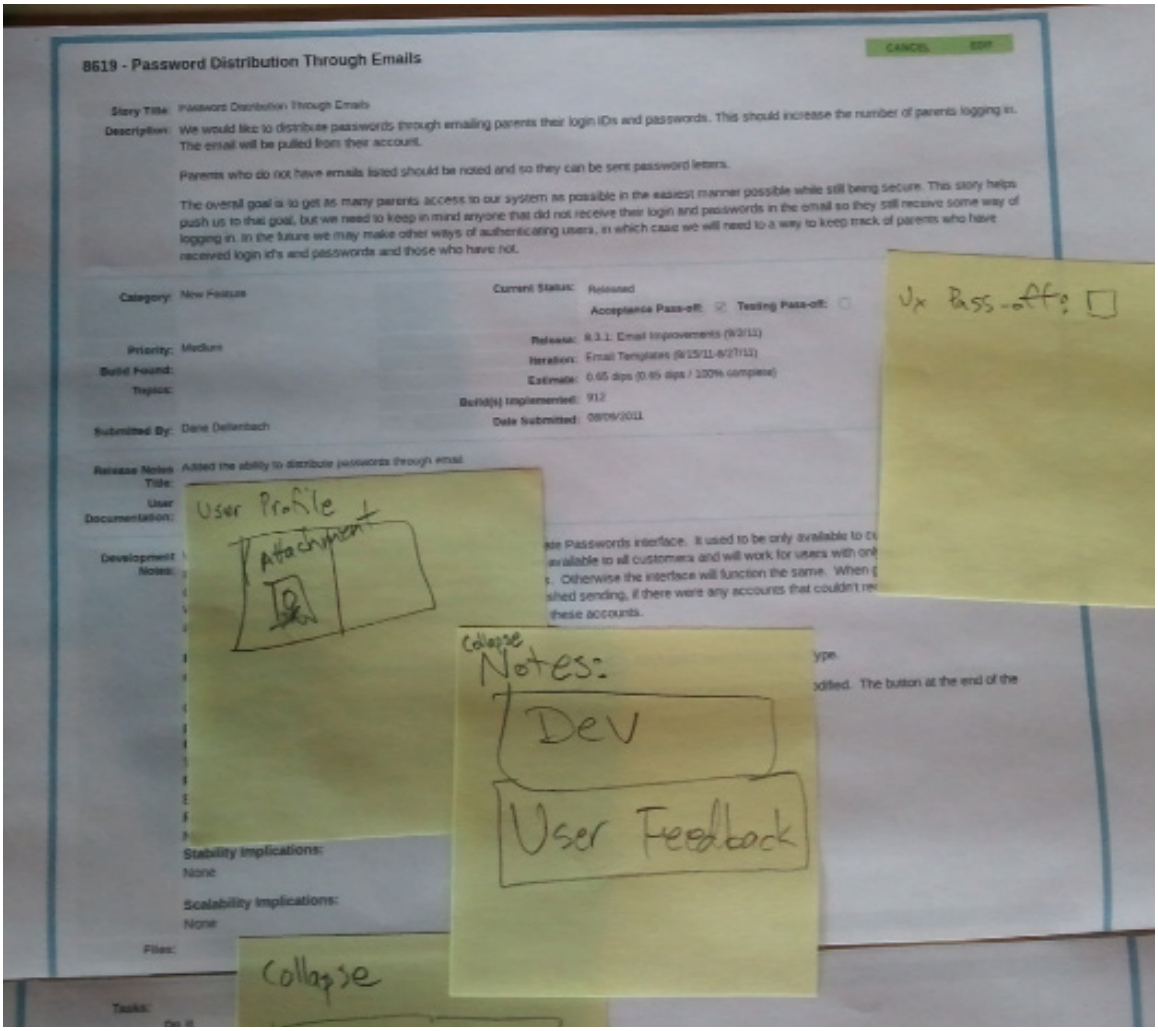
Anything else you would like to let us know? (optional)

To contact support please call 1-800-829-8107

APPENDIX B. Cycle 4 Supporting Documentation

This appendix contains all of the cited documentation referenced as part of Cycle 4 throughout this study. This documentation was generated by the Research Team

B.1 Stories in Ticket System Example



APPENDIX C. Concluding Supporting Documentation from Research Team

This appendix contains all of the cited documentation referenced as part of Cycle 6 throughout this study. This documentation was generated by the Research Team

C.1 Email from 14 March 2013.

"This study evaluates the improvements that can be achieved by using long-term UxE practices to increase various measures of success in a small corporate enterprise. The success of such improvements were measured by:

- Increased customer usage rates
- Increased product sales rates

2011 increase of 32% in sales, and in 2012 we had an increase of 64% in sales.

- Increased customer satisfaction rates

- Increased customer referral rates
- Increased commitment to long-term UxE by the studied organization (ParentLink)

We do this more and more now. And we know how to do it which is also very important.

- Increased implementation of mobile solutions

We now have over 80 mobile apps in the app store. This is the where we have seen the biggest growth in our company. We also have better app ratings than our competitors. I attest this to our usability testing and our developers being very meticulous in their design.

- Increased usage of mobile and desktop applications

Our mobile apps have a 30% higher reuse rate over our desktop application for parents (which we have not re-done since you came around). We have seen an increase of about 20% in usage of our messaging system since you did you capstone project with us a few years ago.

- Decreased time required for task completion

I don't think we have any more data on this.

- Decreased development costs

We have not had to redo our interface for usability purposes. But this is really hard for us to say anything on that is beneficial. Just really hard to measure

C.2 Research Question Graphics

Overall Results in Phase 1

1 Designed usability testing protocol
2 Created current system user scenarios
3 Performed 70+ usability tests
4 Managed 30+ students
5 Designed 12 new prototypes
6 Created 300+ pages of documentation
7 Created web-based test tracking system
8 30+ Hours of UX Testing
9 600+ Hours of Project Work
10 Final Prototype
    - Decreased Message Sending Time by 1.5 mins; a 73% decrease in task completion time with the new interface.
    - 84% user preference of Prototype Interface
    - User Comments:
        - "The more I do it, the faster it will be".
        - "You'd have to be brain dead not to figure it out."
        - "Preferred prototype in all cases."
        - "Screen 1 really seemed like it was a lot easier to read…"
        - "The task objectives were easier to understand as displayed on Screen 1."

Research Question

This study evaluates the improvements that can be achieved by using long-term UxE practices to increase various measures of success in a small corporate enterprise. The success of such improvements was measured by:

- Increased customer usage rates

Date	Number Batches
2010	838,640
2011	928,702
2012	958,959
9/2010 - 3/2013	2,466,922

Figure X.X - Total batches of messages sent on PL web site

- Increased product sales rates
    - Waiting on more recent data from PL
- Increased customer satisfaction rates
    - "The more I do it, the faster it will be".
    - "You'd have to be brain dead not to figure it out."
    - "Preferred prototype in all cases."

    - "Screen 1 really seemed like it was a lot easier to read…"
    - "The task objectives were easier to understand as displayed on Screen 1."
- Increased customer referral rates
    - Waiting on more recent data from PL
- Increased usage of mobile and desktop applications

Mobile Usage

iOS

- App first released May 24. 2011
- 44 custom apps by Feb 2013
- First iPhone/iPod apps:
    - May 24, 2011 - ParentLink for Administrators
    - Aug 25, 2011 - ParentLink
- iPad apps (only 2 - no custom apps)
    - May 24, 2011 - ParentLink for Administrators
    - Sept. 1 2011 - Parlant Mass Communication Service

Android

- Oct 18, 2011 - ParentLink for Admins
    - 1,000 - 5,000 downloads according to Play Store
- April 4, 2012 - MobileParent
- ParentLink - rebranded MobileParent?
    - 10-50K downloads according to Play Store
- 40 custom apps by Feb 2013

Data to show

- Mobile usage for iOS pre and post apps
    - Data shows people aren't rushing to replace Desktop with Apps
- Mobile usage for Android pre and post apps
    - Data shows people aren't rushing to replace Desktop with Apps
- Decreased time required for task completion
    - Decreased Message Sending Time by 1.5 mins; a 73% decrease in task completion time with the new interface.
- Decreased development costs
    - Waiting on more recent data from PL

These metrics were verified through the use of traditional testing methodologies, relying heavily on semi-structured interviews and user testing.