A Design Model for the Internet-Based Electronic Performance Support Systems

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Abstract

This presentation describes the design and development of an Internet-Based Electronic Performance Support System called the Systemic Change EPSS. The Systemic Change EPSS provides systemic change facilitators with the information, tools, and resources they need, and accessibility to other facilitators who are dealing with systemic change effort. This presentation outlines design issues for Internet-based EPSSs and strategies for developing such systems. Based on the formative research experience, we propose a design model for Internet-based EPSSs.

Introduction

What is EPSS?

There are different definitions of Electronic Performance Support Systems (EPSS). Gery (1995), who coined the term, defines an EPSS as a tool for just-in time performance support in the work place. In another term, an EPSS is a complete system or integration of performance support tools to achieve certain tasks in the work setting. The goal of an EPSS is "to provide whatever is necessary to generate performance at the moment of the need".

Similar to the case of different definitions of EPSSs, there are also different ideas about the components of an EPSS (Cagiltay, 2002). In its basic form an EPSS has the content, the support system, and the user interface that acts as an umbrella for the first two components (Gery, 1995). Cagiltay (2002) summarized different component views from Schwen et al. (1993), Hannafin et al. (2000), and Barker and Banerji (1995). All these component views contained the basic view Gery (1995) put forward.

EPSS Design Models

A small-scale EPSS system might be designed with little or no planning (for example, see the case in Hoyt, Stockman & Thalmann, 1997). However, the use of this approach for the larger systems may not be appropriate since it might cost more time and money. Therefore, we need a systematic planning approach to design such systems, which is called a model. Gustafson and Maribe (1997) explain the role of model as "a model is a simple representation of more complex forms, processes and functions of physical phenomena or ideas. Models are constructed to conceptualize representations of reality."

The purpose of an Instructional Design (ID) model is "to convey key concepts and processes to be included in a particular approach" (Molenda et al., 1996). Models tell us the critical success factors to instructional design. To be more specific, an ID model tells us what to do and when to do it, and it barely tells how to do it. Molenda et al. (1996) point to the importance of an ID model by this example: "…experience leads the expert away from the cookbook and toward improvisation. But for the apprentice chef, the cookbook is the vital link to maintaining quality and consistency from day to day." The ID model is the cookbook that will address these concerns for instructional design.

In its early times there was not any specific research-based models available for developing an EPSS (Scales & Yang, 1993). The researchers indicated that it was essential to have an experienced project manager observe the EPSS development process. Since then several EPSS design models have emerged. Four of these models are explained below briefly. As Love and March (1975) expresses, the same thing might have several different models.

Law (1995) organized EPSS design issues into 3 main categories. These categories are front-end analysis, development, and evaluation and research. He presents an EPSS case study, which was designed based on his model. His model includes principals from instructional systems, software engineering, performance technology, and formative evaluation. He concluded that a variety of design strategies should be examined to find out the best solution for the EPSS situation.

The Des Jardins-Davis EPSS design model is a linear model, which has 3 phases (Des Jardins & Davis, 1995). Phase 1, marketing, consists of 1 step: marketing the EPSS. Phase 2, investigating, consists of 3 steps: planning

the EPSS, conducting specification analysis of the EPSS, and presenting findings. Phase 3, doing, consists of 6 steps: developing a maintenance strategy, preparing EPSS development plan, building the EPSS, doing the implementation, doing the evaluation, and maintaining the EPSS. Their EPSS design model lacks methodology. In addition, there was no application of the model to any specific EPSS case.

Lohr (1998) indicated that the design and development skills required to produce an EPSS fall into many domains. She offered ADDIE model as an easy to implement design strategy, until easier EPSS development tools for the instructional designers are developed. She describes how the model was utilized to create a graphical user interface, in the form of an EPSS, for a university computer course.

Sheu (2000) followed a socio-technical design framework, user-centered perspective, and a rapid prototyping approach when she designed an EPSS for doctoral students taking their qualifying exams. She developed the model by looking at the previous work practices of the time and psychological behaviors of users preparing to take the qualifying exams.

In common with all these 4 design models mentioned above is the use of ADDIE model, which is a generic, systematic, and classical approach to instructional design. The word ADDIE represents Analysis, Design, Development, Implementation, and Evaluation. In some of these cases, designers utilized a modified version of the ADDIE model. Actually Kruse (2002) states that "there are more than 100 different ID models, but almost all are based on the ADDIE model".

Internet-based EPSSs

The literature shows that EPSS is still an immature field lacking a generally accepted design model, let alone models for Internet-based EPSSs.

Using the Internet for different purposes has entered a revolution during last two decades. Especially, after the development of the hyperlink on the World Wide Web (WWW), the Internet has offered more user-friendly environments (Starr, 1997). While organizations and educational institutions have been using the Internet to distribute information for a long time, the implications for the instructional design and delivery of EPSSs over the Internet have not been sufficiently explored. Laffey and Musser (1996) envisioned Internet-based tools as a new form of EPSS, creating new performance spaces. They indicated the properties of a dynamic support system as the ability to change with experience, to be updated, and adjusted by the performer, and augment other resources found in the user's community. However, they did not explain how they merged the Internet and their EPSS, which was built to support pre-service teachers, field-based mentors, and college faculty as they collaborate, engage in practice, document their efforts, share their experiences, and assess outcomes.

Research Questions

The purpose of this study is to propose a design and development model for Internet-based EPSSs. For this purpose the following research question was investigated:

- What should an effective, efficient, and appealing design model incorporate for the design and development of an Internet-based EPSS?

Systemic Change EPSS

The idea of creating an EPSS for systemic change was born after a discussion between an Indiana University graduate student and a professor at the same university. After deciding on designing an Internet-based EPSS for systemic change facilitators, the designers started to search for a model that they could follow throughout the design process. However, the literature had very limited number of design models for the EPSS design. Due to lack of Internet-based EPSS design models, designers decided to create their own model by using the Internet-based EPSS design case. This way they also added new information to the body of knowledge in our field and they provided a reflection of their design process. The model explained here is based on a design process of the Internet-based EPSS case.

Two graduate students and one professor worked on designing the Internet-based EPSS. The designers followed a formative research methodology to create the model. The activities to design the Internet-based EPSS have provided the data for creating the design model.

Methodology

The model developed in this study is a design theory. Theories in applied fields like instructional design can be categorized as design theories and descriptive theories (Reigeluth, 1999). Design theories are different from descriptive theories. While descriptive theories explain existing situations or phenomenon like learning theories, design theories provide models and guidelines for designing and/or improving instructional practices (Reigeluth, 1999).

Formative research is an action research to develop or to improve design theories for designing instructional practices and processes (Reigeluth, 1999). Formative research is driven by "what worked well", "what did not work well" and "what improvements can be made" questions. A practice developed by following a theory may show the weaknesses of the process, which develops the theory. By examining the case, the theory may be improved for further applications. Research theories are based on some values (Reigeluth, 1999). Descriptive theories emphasize the validity of the research since the answer to "what is" question matters, whereas design theories value the preferability, thus the answer to "what is better" question has more importance. Formative research values the process. Reigeluth and Frick (1999) categorized the values of design theories in three categories: effectiveness, efficiency and appeal. Effectiveness implies to get to the target or to get the job done correctly. Efficiency is to reach to the results by using optimum resources. Appeal is the degree the process is enjoyable for the designers and the users.

Reigeluth and Frick (1999) developed three methodological procedures for formative research: designed case, in vivo naturalistic case, and post facto naturalistic case. Each procedure can be used for an existent theory or for a new theory. In our case, a model for designing Internet-based EPSS, we took the approach of designed case for a new theory. The steps involved in this methodology are, with time base sequence:

- Creating a case to generate design theory
- Collecting and analyzing formative data on the instance
- Revising the instance
- Repeating the data collection and revision cycle
- Fully developing the tentative theory

We applied these steps to develop the model for designing an Internet-based EPSS. Since the created case is a work in progress, so is the model. Constant revis ion cycle takes place in the development of the product and in the process to produce it.

Proposed Design Model

The model presented here is a tentative model for designing an Internet-based EPSS (Figure 1.). The evaluation and modification of the model take place throughout the design process. The model consists of 10 steps. Each step has sub steps for explaining "how to do" for implementing the main step. Sub steps of the model contain procedures specialized for the Internet-based system design.

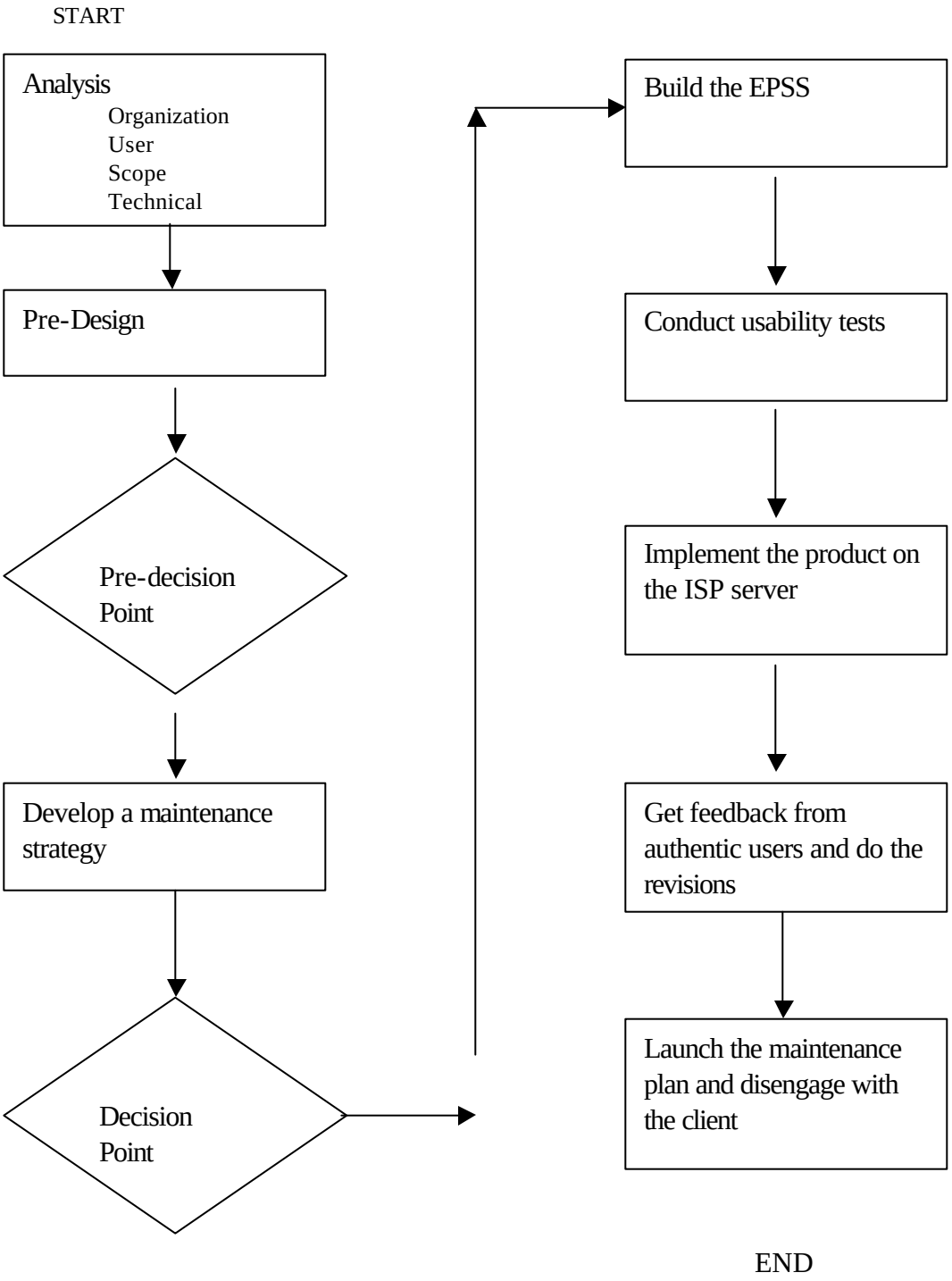

Figure 1. The Model for Designing an Internet-based EPSS

The model is an enhanced application of the ADDIE model. The difference from the ADDIE model is that the model has two design steps (step 2 and step 6) and two decision points (step 3 and step 5) before taking further steps towards building the system. Since the available tools and data communication bandwidth are limited on the Internet medium, the designers have to consider these variables in their design decisions. Because of these limitations, the designers have to consult with the client and get the approval of the client before building any part of the system.

The Internet allows the designers to disseminate the knowledge to a broad audience with easy and low update costs. In order to maintain and to update the EPSS with the most current information, a maintenance strategy should be designed. After compiling all the data about design plans, maintenance, and total and on-going costs of the system, the designers should meet with the client to decide whether the system should be developed or not.

Components of the Model

1. Analysis
   - 1.1. Organization's or individuals' needs (client's needs): What performance will be increased. How and in which direction performance will be increased.
   - 1.2. User analysis: Demographics and computer literacy level of the potential users.
   - 1.3. Scope analysis: Content analysis; according to the needs of the client what content will be covered. Task analysis; tasks involved in the content will be analyzed.
   - 1.4. Technical analysis: Feasibility - Connection speeds – Internet Service Provider (ISP) software support capability - Browsers that are going to be used - Site address

2. Pre-Design
   - 2.1. Set-up the specific objectives for the EPSS; what it is going to be accomplished.
   - 2.2. Determine functional specifications according to the needs.
   - 2.3. Determine forms of the functions.
   - 2.4. Determine the connections between the functions based on task analysis. By visiting the task analysis these connections can be determined.
   - 2.5. Chunk the information. With the help from content creator or subject matter expert, chunk the information based on five plus or minus two rule.
   - 2.6. Determine connections between information chunks. After determining the information chunks, determine the connections between them if there are.
   - 2.7. Determine the components of the EPSS as performing technical functions. What components serve as technical functions of the system.
   - 2.8. Perform feasibility of the functions. Determine if the functions can be implemented according to technical analysis and user analysis.
   - 2.9. Provide alternatives for the functions.
   - 2.10. Revise compatibility of functions and components.
   - 2.11. Determine the responsibilities of the client in the design process.

3. Pre-Decision Point: In this step, client and the development team meet in order to go further or to terminate the project based on the collected data and the resources required to develop the system.
   - 3.1. Prepare a general outline of the EPSS to the client.
   - 3.2. Discuss the functions with the client.
   - 3.3. Discuss the alternatives of the functions.
   - 3.4. Discuss the possible costs with the client.
   - 3.5. Discuss the responsibilities of the client.
   - 3.6. Make DO or DO NOT DO decision.

4. Develop a maintenance strategy
   - 4.1. Identify on-going maintenance requirements.
   - 4.2. Develop skill/personal requirements.
   - 4.3. Estimate cost of maintenance as one time cost and continuous costs.

5. Decision Point

5.1. Discuss with the client total system and maintenance costs, procedures.
5.2. Get approval of the client before starting the development of the EPSS.

6. Build EPSS
   6.1. Prepare a big picture / outline of the system
      6.1.1. Components
      6.1.2. Connections
   6.2. Determine content of each element / component.
   6.3. Select appropriate software for each component and its function.
   6.4. Manipulate the content according to data flow speed.
   6.5. Determine file name hierarchy in the site.
   6.6. Determine general rules for interface design to assure consistency throughout the product.
   6.7. Assign the tasks to the teams.
   6.8. Integrate the elements.

7. Conduct usability tests: Usability tests should be conducted on potential users of the system to fix or eliminate problematic parts.

8. Implement the product on the Internet Service Provider (ISP) server. Install the system to ISP server. In order to protect the product from outside threats, appropriate security settings should be configured.

9. Get feedback from authentic users and do the revisions as needed. After implementing the EPSS, authentic users (in our case systemic change facilitators) send their comments and feedback about the product. According to the change requirements, the designers should change the parts as necessary.

10. Launch the maintenance plan and disengage with the client. After the design of the system is finished, in order to keep the site updated and running, maintenance plan should be launched. Depending on the complexity of the system and the skill level of the maintenance personnel, the designers should make decisions about the support level they will provide and how the maintenance personnel training will be accomplished.

Limitations of the Model

The presented model here has a narrow scope. It is for the design of Internet-based EPSSs. Although it was initially generated starting with the generic ADDIE model, it is different from ADDIE model and it may not be generalized or utilized in instructional design and development processes. The model does not have a great flexibility. Since the details make a difference, all of the steps of the model should be implemented in the design process. When using the model, the design team needs to collect scrutinized data. This requires a lot of time for front-end analysis.

Conclusion

We applied a formative research approach to the EPSS design. A review of the literature on EPSS design models indicated that ADDIE model was largely utilized for the design of the EPSSs. Our model is also an enhanced version of the ADDIE model. The difference from ADDIE model is that the model has two design steps and two decision points before taking further steps. In addition, we provide detailed guidelines on how to implement certain steps. With the help of our case, a systemic change EPSS, we are still in the process of developing this model.

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