iBudget Project Planning using
Usability Engineering Lifecycle by Mayhew

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ABSTRACT
This report is a design outline of the project called iBudget, according to the method stated by Deborah J. Mayhew in her book of “The Usability Engineering Lifecycle”. This report gives an introduction of the main idea of the usability engineering lifecycle proposed by Mayhew. Afterward, we use Mayhew’s process to conduct our iBudget project. The report gives key steps of the project processes of iBudget, which are adopt from Mayhew. Also we state some drawbacks for Mayhew’s lifecycle and make some changes to suit our iBudget project.

KEYWORDS
Usability Engineering Lifecycle, iBudget
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1. INTRODUCTION

This iBudget project is designed based on the methodology of Usability Engineering process. In this part of report, the main concept of Usability Engineering Lifecycle stated by Mayhew will be introduced. Also, the main idea of the project iBudget will be stated in this chapter.

1.1 An overview of Usability Engineering Lifecycle

When we talk about Usability Engineering, we need to define usability at first. Mayhew stated **Usability** is a measurable characteristic of a product user interface that is present to a greater or lesser degree. The measure of goodness of usability is how easy to learn the user interface is for novice and causal users; how easy to use the user interface is for frequent and proficient users, after they have mastered the initial learning of interface. Also she stated the definition of **Usability Engineering**, “it is a discipline that provides structured methods for achieving usability in user interface design during product development”. This kind of discipline is combined with several disciplines from other subjects, such as cognitive psychology, experimental psychology, ethnography, and software engineering. Moreover, She thought to produce usable interactive products needs at least two things: **Knowledge and application of known user interface design principles and guidelines; Knowledge and application of structured methods for achieving usability.**

Mayhew’s book provides a detailed, structured approach to product user interface design in the form of a Usability Engineering Lifecycle. The main part of her book is like a guide line for readers, which they can check every detail process while conducting their projects. There are four types of tasks consisted by the Usability Engineering Lifecycle:

- Structured usability requirements analysis tasks;
- An explicit usability goal setting task, driven directly from requirements analysis data;
- Tasks supporting a structured, top-down approach to user interface design;
- Objective usability evaluation tasks for iterating design towards data.

The main idea of Mayhew’s book is dividing Usability Engineering into three lifecycle phases:

**PHASE ONE: Requirements Analysis**

There are FIVE tasks need to be conduct by this lifecycle phase, and one document will be produced as a result documentation.

**User Profile:** A description of user characteristics, which is relevant to user interface design, of the intended user population needs to be clarified. To achieve this purpose, questionnaire and interviews will be used.

**Contextual Task Analysis:** A user-centered model of work for the product needs to be obtained. A study of users in their actual work environment performing their real work is the main approach.
**Usability Goal Setting:** Specific qualitative and quantitative usability goals which drive UI design in further are established within this task. Those goals are extracted from user profile and contextual task analysis, and also from general business goals.

**Platform Capabilities/Constraints:** The capabilities and constraints of technology platform need to be stated by this task, since they may limit UI design alternatives. The chosen technology platform for product needs to be studied in this phase, by reviewing platform documentation and interviewing platform experts.

*By then, there should be a documentation called “the product Style Guide”, which documents the first four Requirements Analysis Tasks.*

**General Design Principles:** By this task, relevant general user interface design principles and guidelines available in Usability Engineering literature are gathered and reviewed.

**PHASE TWO: Design/Testing/Development**

The lifecycle phase is divided into THREE levels, with the first one deals with High-level design issues, the second one deals with setting standards, and the third one deals with detailed design which will also be completed within tasks of this level. Basically, Mayhew break the whole design task into smaller and simple-to-embedded design tasks, which she thought the best way of conducting design task.

**LEVEL 1**

*Work Reengineering:* This task is used to re-do the current user model and document it in the way describing a model, including how product functionality will be organized and structured. Also the user should be informed of this reengineered work model.

*Conceptual Model Design:* Design the abstract UI design framework and interaction rules, and identify major displays and navigational pathways.

*Conceptual Model Mock-ups:* Provide Conceptual Model Design the support evaluation, refinement, and validation.

*Iterative Conceptual Model Evaluation:* Generate evaluation plan, materials, and data. And then do the data analysis to give conclusions and recommendations for design changes. This task is conducted by formal usability testing and usability inspection methods.

**Level 2**

*Screen Design Standards (SDS):* This is the second level of UI design, which gives out a set of design standards. The standards should also meet the unique usability requirements of the product. Making standards before detailed UI design make the design process simpler and more efficient. Those chosen standards will be adopted or adapted from any platform UI standards which will be followed later.

*Screen Design Standards Prototyping:* It is a support to the evaluation of the SDS. Asking user to evaluate the SDS prototyping helps to continue the iterative process of addressing user requirements.

*Iterative Screen Design Standards Evaluation:* SDS evaluation is designed to get early feedback on the usability of the prototypes. It can be conducted before the detailed design and code has been made. Thus, changes can be made easily.

*Style Guide Development:* This task is used for complete the product Style Guide in the earlier phase, and bring all single documents. It contains three types of information: principles, guidelines and standards.
Level 3

Detailed User Interface Design: Design and documentation of the detailed and completed product of UI are given in this task.

Iterative Detailed User Interface Design Evaluation: apply one specific objective evaluation techniques to iteratively evaluate, and refine the detailed UI Design.

PHASE 3: Installation

User Feedback: Gather feedback from users after the product installed, in order to support the enhancement design and new releases or related products.

Basically, Mayhew’s principle idea is stated very well by the picture below.

1.2 Adapt Usability Engineering Lifecycle to iBudget

The iBudget will help users record their expenses. All record can be sorted by day, week, month, year, and even by two given date. The iBudget can let users categorize their expenses and income, such as “daily life”, “education”, “amusement”, or “salary”. Then user can calculate the yearly income, or yearly expense for education. Moreover, users can set up an iBudget, which means Family Budget, to relate two or more family member’s individual iBudget database. Thus, there will be some sample functions to help users count their family expense, family income, and family debt. Also iBudget has some standard algorithms to help users predict their planning expenses for both individual and family. However, as we all know, each user or family has different situation, so iBudget gives the users freedom to make their own algorithms to suit the specific situation. To sum up, this is the iBudget project’s design idea and main function. Our project plan will be made based on the goal of achieving this design, and of course according to Mayhew’s usability engineering process.
Although Mayhew’s Lifecycle is well structured for usability engineering, it is still a little bit over detailed and complex for the quite simple iBudget project. In order to make our iBudget project efficient, we need to simplify Mayhew’s lifecycle.

The iBudget project is going to conduct a small database for personal financial use. It will support personal financial state tracking, budget making, and financial problem predict. This is a medium size of project. The potential users are individual person, which may belong to the same family, including employee, student, self-employed, and etc.

As iBudget is not a huge project, we do not want to have a too complex usability engineering process. So we tailored Mayhew’s lifecycle to adjust our project as below:

For the first phase, we need to finish four tasks, and skip General Design Principles. So the tasks are User Profile, Task Analysis, Platform Capabilities/Constraints, and then come out with Usability Goals. And also a document the product style Guide.

In the second phase, we are going to keep Mayhew’s three level, which is a quite good idea, but we need to simplify those steps within each level. Our phase two should have Conceptual Model (CM) Design & Mockups and Iterative CM Evaluation for Level 1; Screen Design Standards (SDS) Prototyping and Iterative SDS Evaluation for Level 2; and Detailed UI Design and Evaluation as Level 3. Also all the information needs to be document in the Style Guide documentation.

Finally, we come to phase three. The User Feedback will be collected with in it.
2. Usability Engineering Lifecycle of iBudget

2.1 Requirements Analysis

User Profiles

Setting up User Profiles is the first important thing we need to do for our iBudget, since users are the crucial factor of deciding requirements. Who will use iBudget? This question should be answered with the characteristics of users. Characteristics are the description of our potential users. They include Psychological characteristics, such as attitude, motivation; Knowledge and experience, such as typing skill, task experience; Job and task characteristics, such as frequency of use, task structure; and Physical characteristics, such as color blindness.

As Mayhew suggested, we choose to use questionnaires to obtain a User Profile. Moreover, we decide to use the Alternative Techniques---Interview also, which will be conduct after questionnaires.

Task leader:
Usability Engineer

Step-by-step:
1) Determine potential user characteristics
2) Develop a draft questionnaire
3) Interview two users from each category based on the draft questionnaire, and then revise it.
4) Send 100 questionnaires to each major user category by email, with expecting 10% response to us.
5) Design a data entry format based on template, and then enter data.
6) Analysis data come out with a synopsis of the key characteristics of each user category (Single, Married, Married with children under 18, Senior) and specific implications for UI design.
7) Present results with the product Style Guide, which contents the narrative conclusions and design implication, to UI designer and other team member.

Products:
User Profile (UP) Questionnaire
UP Data Entry Format
UP Conclusions and Design Implications document within the product Style Guide.

Task Analysis

This task is to obtain a user-centered model of work. That is to learn how iBudget’s users currently think about, talk about, and do their work in the actual work environment. Since when we design iBudget and its user interface, we need to find an optimal compromise between maximizing the power and efficiency of iBudget and minimizing the retraining users.
**Task Leader:**
Usability Engineer

**Step-by-step:**
1) Gather background information about people doing their budget:
   - Assume we already have requirements specifications, review it.
   - Meet with user representatives to get a high-level picture of how the budget be automated.
   - Identify and document key Actors and Use Case.
2) Collect data from observations of users do budget in their actual work environment, such as at home, office place, or anywhere with laptop, and then document the work environment analysis.
3) Construct task scenarios for iBudget including 2-5 high-frequency tasks.
4) Construct a organization model of the users’ current task

**Product:**
Task scenarios
User task organization model
Task analysis document

**Platform Capabilities/Constraints**
This task is going to define the user interface related capabilities and constraints of the hardware and software platform for iBudget. It helps UI designer to know what design options are and are not available.

**Task Leader:**
UI designer

**Step-by-step:**
1) Identify all relevant aspects of all hardware and software platforms, such as workstations, OS.
2) Review user interface standards of any platform documentation.
3) Interview technical staff.
4) Document Platform Capabilities and Constraints.

**Product:**
Platform Capabilities and Constraints documentation

**Usability Goals**
Setting usability goals is the key task of PHASE ONE. Specific usability goals help us to focus UI design efforts. They are used to serve as acceptance criteria during usability evaluation. Usability Goals are based on the User Profile and the Task Analysis, as well as on general business goals.

**Task Leader:**
Usability Engineer

**Step-by-step:**
1) Refer to User Profile and Task Analysis
2) Research business goals
3) Identify and draft qualitative usability goals, such as iBudget must support users working in a high-interrupt environment.
4) Formulate quantitative usability goals, such as average time to perform a benchmark set of tasks
5) Document prioritized usability goals
6) Conduct user review and refine (5).

Product:
Prioritized Usability Goals documentation

2.2 Design/Testing/Development

2.2.1 Conceptual Design Level

Conceptual Model (CM) Design

In this task, we only consider highest level of UI design and make such decisions as:
Whether to design a product-process-oriented Conceptual Model
How to define products or processes
How to present products or processes
What rules to follow for the use of window types
How to define major displays and the navigational pathways between them

Task Leader:
UI Designer

Step-by-step:
1) Define the CM as either product or process oriented. We choose process oriented CM for iBudget. Since our information are stored and retrieved, but usually our user access to the same information, they are not creating individual work products every time.
2) Design presentation rules for processes.
3) Identify major displays.
4) Define and design major navigational pathways
5) Document CM designs in sketches and explanatory

Product:
Documentation of CM design including Sketches

Conceptual Model (CM) Mockups

The purpose of this task is to support formal evaluation of the CM Design, comparing alternative CM designs in the next step, and recruiting users to evaluate very early. As Mayhew said, evaluation at this earliest stage of design helps you determine if you are on the right track before your invest a lot of time in design.

Task Leader:
UI designer

Step-by-step:
1) Select the functionality based on the variations in CM Design, which we want to test and compare.
2) Sketch the UI design. Just put some explanatory text in parentheses in empty windows to explain the general purpose of the window.
3) Build mock-ups. Either construct paper-based mock-ups, or implement the design as a running prototype. We are going to using paper-based mock-ups, which is easy and efficient for changes.

Product:
CM Mock-ups

Iterative CM Evaluation
This task is used to get some quick and early feedback on the usability of the Conceptual Model. This evaluation is conducted when no major investment or commitment in detailed design or code has been made to a particular user interface design.

Task Leader:
Usability Engineer

Step-by-step:
For each iteration of testing
1) Plan the test and develop supporting materials
2) Run the test users and collect data as specified in the test plan
3) Analyze and interpret the data and formulate redesign recommendations
4) Modify the CM design and Mock-ups
5) Modify the test plan and materials.

Product:
Testing Documentation, New CM Design and Mock-ups, new part of the documentation “Style Guide”

2.2.2 Screen Design Level

Screen Design Standards (SDS)
SDS can ensure quality. It is based on the User Profiles, Contextual Task Analysis, and Usability Goals. There are some issues should be standardized, such as use of controls (e.g., check boxes, list boxes), Location and format of standard display components, Terminology, use of color, keyboard shortcuts. We are going to define our platform standards based on today’s GUI.

Task Leader:
UI designer

Step-by-step:
1) Draft control standards.
2) Draft product/process window standards.
3) Draft dialog box standards.
4) Draft input device interaction standards.
5) Draft feedback standards.
6) Document all draft standards.
Product:
Documentation of SDS

Screen Design Standards (SDS) prototyping
This task is based on the last one and prepare for the next one. The purpose of this task is just like CM Mock-ups, for involve users to evaluate the resent design result. Unlike the CM mock-ups, prototypes include complete functional and user interface detail for the selected subset of functionality. We are supposed to use low-fidelity prototyping which is as effective as high-fidelity, but it is cheaper and faster to produce.

Task Leader:
UI designer

Step-by-step:
1) Select functionality to be prototyped based on the issues of most concern and interest.
2) Prepare an informal paper-and-pencil specification.
3) Build the specified prototype.

Product:
SDS prototype

Iterative SDS Evaluation
This task is to evaluate the complete, detailed and fully interactive running SDS prototype. The iteration is terminated when all major problems are eliminated and quantitative usability goals reached.

Task Leader:
Usability Engineer

Step-by-step:
For each iteration of testing
6) Plan the test and develop supporting materials
7) Run the test users and collect data as specified in the test plan
8) Analyze and interpret the data and formulate redesign recommendations
9) Modify the SDS and prototypes
10) Modify the test plan and materials.

Product:
Testing Documentation and New SDS and prototypes

2.2.3 Detailed Design Level

Detailed UI Design (UID)
In this task, we define and document the design based on CM design and SDS design.

Task Leader:
Developer. Since iBudget is not a complex and huge project, the developers themselves might design and produce detailed user interface code directly from the product Style Guide. And they should
communicate closely with one another and the UI designer to resolve any questions, conflicts, and other raised issues.

**Step-by-step:**
1) Complete the identification of all pathways between windows, dialog boxes, and message boxes.
2) Complete the design of menu bar and all other action controls.
3) Complete the design of content of all windows, dialog boxes, and message boxes.
4) Complete the design of all interactions with input devices.

**Product:**
The detailed UI design specification

**Iterative Detailed UID Evaluation**
The keystone of this task is to evaluate the final interface against usability goals.

**Task Leader:**
Usability Engineer

**Step-by-step:**
For each iteration of testing
1) Plan the test and develop supporting materials
2) Run the test users and collect data as specified in the test plan
3) Analyze and interpret the data and formulate redesign recommendations
4) Modify the Detailed UI Design
5) Modify the application code
6) Modify the test plan and materials.

**Product:**
Evaluation documentation and New Detailed UID
the whole Style Guide Documentation.

### 2.3 Installation

**User Feedback**

This is last step in Mayhew’s Lifecycle, which is after the conduction of our iBudget. The purpose of this task is to give us the input to maintenance and enhancements phase of the product lifecycle, give us information about future releases of the product, give us feedback for related products design and development, and also give us a lesson about usability engineering.

**Task Leader:**
Usability Engineer

**Step-by-step:**
1) Develop draft questionnaire
2) Pilot/revise questionnaire
3) Distribute questionnaire
4) Analyze data
5) Draw and document conclusions

**Product:**
User feedback questionnaire and Feedback documentation
### 3. Time Plan

<table>
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<tr>
<th>Phase</th>
<th>Task</th>
<th>Hours/Usability</th>
<th>Hours/Developer</th>
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<td>User Profile</td>
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<td>Task Analysis</td>
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<td></td>
<td>Platform Capabilities/Constraints</td>
<td>22/Developer</td>
<td>8/Developer</td>
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<td></td>
<td>Usability Goals</td>
<td>85/2</td>
<td>23</td>
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<td><strong>Phase Two</strong></td>
<td>Conceptual Model (CM) Design</td>
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<td>CM Mockups</td>
<td>40/3</td>
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<td></td>
<td>Iterative CM Evaluation</td>
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<tr>
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<td>SDS Prototyping</td>
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<td><strong>Phase Three</strong></td>
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The iBudget project needs about 28 weeks of man hours. With two usability engineers and a UI designer, this project should at least 10 calendar weeks to be finished.
4. Conclusion

4.1 Advantages

There are many good features of Mayhew’s Usability Engineering Lifecycle. Mayhew gave a new way to think about Usability Engineering. She related Usability Engineering to software engineering. She gave the methods of identifying requirements, designing, evaluation and prototype. The three level stages of UI design is a good idea, which can scaled down a big project for small projects. And also her Lifecycle employs interactive design for usability process, which always helps projects very much. Furthermore, her book is like a good styled and detailed guide book for all the readers.

4.2 Drawbacks

Although Mayhew bring many good ideas to Usability Engineering Lifecycle, there are still some factors of this lifecycle which are not perfect to conduct a real product. First, Mayhew’s lifecycle is a little bit over structure. When conduct a real project, those fussy steps may cost too much as a usability engineering process. Thus, when we use her lifecycle we need to tailor it to our own project, according to our human resource, project funding, and time demand. For instance, we omit the task “General Design Principles” in phase one, since most of our usability professionals are with experience. This task should be done when a new team member join our group during the training of new usability engineer. This task can only be done once for each professional. It will save both time and money for the entire company.

Another drawback of Mayhew’s lifecycle is that it is a strict top-down structure. There are iterations, but there is no two single tasks can be conduct at the same time. That means the whole usability engineering process will be so long that all developer team need to wait for the process. To solve this problem still using Mayhew’s Lifecycle, I think that will be a good idea to give the usability engineering process to a usability consulting group with more usability engineers and UI designers. This group could work for each company’s Usability engineering lifecycle conducting. Since their member will be more competitive and they have more professionals, they could probably conduct such a lifecycle more quickly and help a software company achieve their goals more efficient.
5. REFERENCES

The Usability Engineering Lifecycle, Deborah J. Mayhew, 1999, Morgan