LSPU Self-Paced Learning Module (SLM)

Course	**Human Computer Interaction 1**
Sem/AY	**Second Semester/2022-2023**
Module No.	**3**
Lesson Title	**USER-CENTERED DESIGN AND PROTOTYPING**
Week Duration	**11-14**
Date	**April 3 - 28, 2023**
Description of the Lesson	In this module, the principles on user-centered design will be discussed. This will help students to be familiar with the systematic methodology in developing information systems. They will learn in depth about the iterative design cycle and design models in HCI. Also, they will learn how to implement ideas into tangible forms from paper to digital using prototyping.

Learning Outcomes

Intended Learning Outcomes	Students should be able to meet the following intended learning outcomes: • Get familiar about the principles in user-centered design • Learn iterative system development methodology • Implement experimental prototypes
Targets/ Objectives	At the end of the lesson, students will understand: • user-centered design principles • iterative systems methodology • HCI models • prototyping

Student Learning Strategies

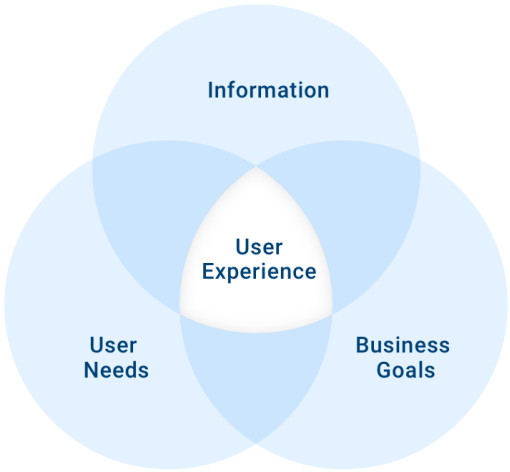
Online Activities (Synchronous/ Asynchronous)	**A. Online Discussion via Pre-Recorded Video on the Topic** For this module you will be directed to engage in a one- to two-hour synchronous discussion via Google Meet and three-hour asynchronous laboratory activities via our class LMS. To access the online course materials please check the post on LSPU-SPCC College of Computer Studies Page. These are the list of course materials provided on the LMS

	✔ **Module 3** User-Centered Design and Prototyping – SLM ✔ **Module 3** User-Centered Design and Prototyping – Presentation The one- to two-hour synchronous discussion will be on weeks 11 to 14 of the semester. Please be reminded to prepare and be ready 15 minutes prior to the said schedule to lessen connection issues. For those who cannot attend the session, recordings are available on our class LMS. Please be reminded of the web conference etiquettes and reminders uploaded on your LMS. You will be given time to complete all assessment tasks and activity provided on the LMS. (For further instructions, refer to your Google Classroom and see the schedule of activities for this module)
Offline Activities (e-Learning/Self-Paced)	**For online classes**, accomplish the following activities: 1. Watch the video lecture 2. Read the SLM 3. Accomplish performance tasks using work sheet provided ● Engagement Activity 5 ● Laboratory Activity 5 ● Engagement Activity 6 ● Laboratory Activity 6
Module Contents	**Lesson 5: What is User-Centered Design?** **User-Centered Design: Process and Benefits** To be a UX designer you need to be optimistic about coming up with new solutions to a problem. I think that the big challenge is to believe that it's even doable. And the larger the challenge, the more essential optimism is to drive you forwards. **User-centered design (UCD)** is an optimistic approach to invent new solutions. It starts with human beings and ends with the answers that are tailored to their individual needs. When you understand the people you are trying to reach, and then design from their perspective, you come up with unusual answers. UCD is both how you are thinking and what you are doing. It is all about building a deep empathy with the individuals you're designing for. Generating heaps of ideas and building a bunch of prototypes. Sharing what you've got created with the people you're designing for. Failing and trying again. And finally putting your innovative solution out in the world.

How To Design In User-Centric Way?

Dr. Donald Norman, a cognitive science researcher was the first to explain the importance of user-centered design. He said that design decisions should be based on the needs and wants of users. The value system of user-centered design contains:

- empathy,
- optimism,
- iteration,
- creative confidence,
- belief in making,
- embracing ambiguity,
- learning from failure.



UCD Considerations

User-centered design creates a unique chance to design together with communities.
User-centered designers deeply understand the folks they're trying to serve. They create lots of ideas and make innovative new products rooted in people's actual needs.
To design in a user-centric way, identify the people who will use the product, what they'll use it for, and the conditions under which they will use it. Observe people's lives, hear their hopes and needs, and get smart about your challenge.

User-centered design provides a common language for scientists, stakeholders and end users. For example, the Lunar Rover Mission of NASA integrated user-centered design techniques. NASA also benefits from user interviews, user observations in context, and wireframing.
User-centered design process goes through six phases:

1. Specify the use context and users' needs;
2. Specify business requirements;
3. Build design solutions from rough concept to finished design;
4. Evaluate designs with usability testing;
5. Implementation — develop and deliver the product;
6. Deployment — the final product is evaluated, as consumer needs change.

Methods Of User-Centered Design Research

What is special regarding UCD is that it is scientific and above all values experiment, iteration, learning from failure and research. For instance user research is all about talking with people about their challenges, goals, and limitations. However there will be moments where you'll need more context, history, or data than a man-on-the-street style interview can offer.

Speak with people you're designing for directly through personal, group or expert interviews. There's no better way to perceive their hopes, desires, and aspirations. Write down the feedback you hear and use this chance to ask more questions and push your ideas further. Responsive principles of user-centered design:

- clear understanding of the users, tasks and environments;
- evaluation-driven design;
- considering the general consumer experience;
- involving the client within the design process.

Impact And Opportunities Of UCD

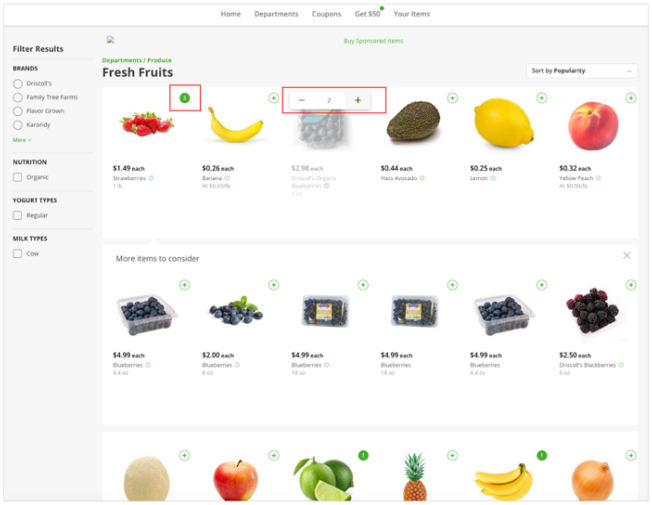
User-centered design has a human bias in its DNA. By beginning with humans, their hopes, fears, and needs, the designers tend to discover what's most desirable. But that's only one lens through which we glance at our solutions. Once the designers have determined the solutions for the target community, it is time for technical expertise. Also, they need to figure out the way to make the solution financially viable. Finding balance is completely crucial to designing solutions that are successful and sustainable.

When the goal is to get impactful solutions out into the world, you can't live in abstractions. You have to make the solutions that are desirable, workable, and viable.

User-Centered Design Examples

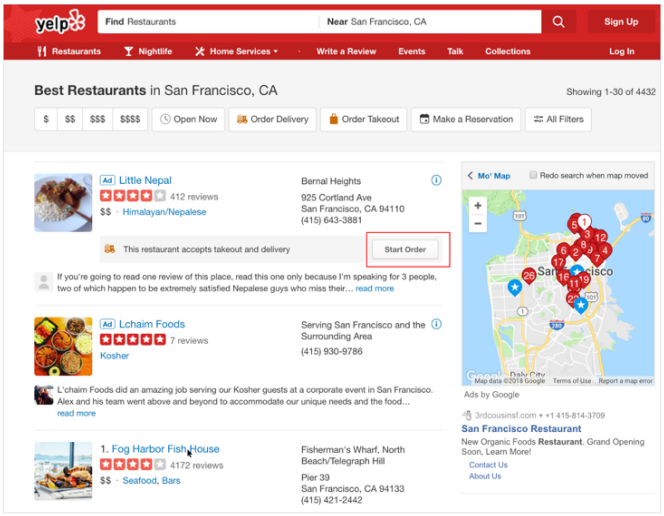
Carter.com Homepage

A great example of a UCD website is Carters.com — a website to shop for children's clothing. On the site, navigation helps the user promptly reach the desired section by specifying a child's age (for example, Shoes: Newborn — 3 years). At the same time, this navigation helps new customers by quickly directing them to the desired section.



Instacart.com

Instacart.com is a perfect showcase of adapting a website for the people with visual impairments. There is high contrast version of the website. Designers thought about the users and introduced the small details that improve the UX. For example, when a user clicks Add a product to the delivery list, he or she can immediately select the quantity in the interface. Also, the user always sees the number of already selected goods.



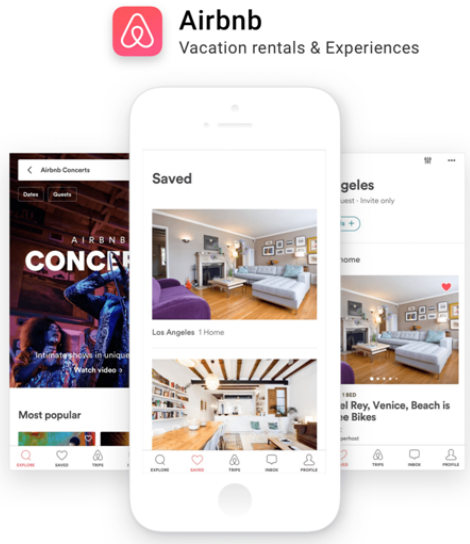
Yelp.com

In addition to convenient navigation, the Yelp service for online reservation visually displays the number of free tables at the restaurant you choose. The map with its location always

remains visible for the convenience of users. The button “Start order” allows the possibility to start the order with one click.

Duolingo App

Anyone who has used Duolingo understands the simplicity of the app. By finishing one task or a game, you’ll be able to move on to the more advanced categories. Incorporating the addictiveness of a mobile gambling app and using it to teach the users new languages is a brilliant idea. And the amazing UX is what keeps people coming back again and again.



AirBNB App

With their added ability to book a room instantly, having a clean-cut mobile presence has become a necessity for Airbnb. Just like their innovative website, their mobile app is

uncomplicated, smooth, and easy. The users put in where they want to stay, what dates, and how many guests they're going to have. And in the twinkling of an eye, they get a range of homes that meet their needs, right at their fingertips.

Key Aspects of User-Centered Design

1. **Early focus on users, tasks and environment**
   The characteristics of the intended users
   The tasks the users will perform
   The environment in which the users will use the system

2. **The active involvement of users**
   Consider the methods on how users are actively participating
   The key strength of user-centered design
   Involving end-users can also enhance the acceptance and commitment to the new software as staff some to feel that the system is being designed in consultation with them rather than being imposed on them.

3. **An appropriate allocation of function between user and system**
   Determining which aspects of a task should be handled by people and which can be handled by software and hardware is of critical importance. (Task Allocation)
   The allocation of function should be based on an appreciation of human capabilities, and their limitations.
   This allocation benefits from the input of end-users which will also help to ensure that the results are acceptable to the people who will be affected.

4. **Iterative design whereby a prototype is designed, tested and modified / Iterative of design solutions**
   The users attempt to accomplish 'real world' tasks using the prototype and the feedback from the exercise is used to develop the design further.

5. **Multi-disciplinary design teams**
   User-centered design is a collaborative process which benefits from the active involvement of various parties, each of whom have insights and expertise to share. Design teams may include managers, usability specialists, training and support staff, software engineers, and of course the end user themselves.

UCD Methodology

User-centered design (UCD) is a project approach that puts the intended users of a site at the center of its design and development. It's achieved by talking directly to the user at key points in the project to make sure the site will deliver upon their requirements.

The stages are carried out in an iterative fashion, with the cycle being repeated until the project's usability objectives have been attained. This makes it critical that the participants in these methods accurately reflect the profile of your actual users. The UCD methodology has the following characteristics:

- the involvement of users throughout the design process
- the use of an iterative design cycle

Design decisions should be based on the needs and wants of users. It contains empathy, optimism, iteration, creative confidence, belief in making, embracing ambiguity (open to other interpretations), and learning from failure. UCD seeks to identify the people who will use the product, what they will use it for, and the conditions under which they will use it and also to observe people's lives, hear their hopes and needs and get smart about the challenges are also being taken into major considerations.

ISO 13407 outlines four essential activities in a user-centered design project:

1. **Requirements gathering:** understanding and specifying the context of use
2. **Requirements specification:** specifying the user and organizational requirements
3. **Design**: producing designs and prototypes
4. **Evaluation**: carrying out user-based assessment of the site

The following is a typical top-level characterization of the most popular user-centered design methods:

Method	Cost	Output	Sample size	When to use
Focus groups	Low	Non-statistical	Low	Requirements gathering
Usability testing	High	Statistical and non-statistical	Low	Design and evaluation
Card sorting	High	Statistical	High	Design
Participatory design	Low	Non-statistical	Low	Design
Questionnaires	Low	Statistical	High	Requirements gathering and evaluation
Interviews	High	Non-statistical	Low	Requirements gathering and evaluation

1. **Focus groups**
   What are they? A focus group involves encouraging an invited group of intended/actual users of a site (i.e. participants) to share their thoughts, feelings, attitudes, and ideas on a certain subject. Organizing focus groups within an organization can also be very useful in getting buy-in to a project from within that company.

When to use? Focus groups are most often used as an input to design. They generally produce non-statistical data and are a good means of getting information about a domain (e.g. what people's tasks involve).

Issues: It's necessary to have an experienced moderator and analyst for a focus group to be effective.

2. **Usability testing**
What is it? Usability testing sessions evaluate a site by collecting data from people as they use it. A person is invited to attend a session in which they'll be asked to perform a series of tasks while a moderator takes note of any difficulties they encounter. Users can be asked to follow the think-aloud protocol which asks them to verbalize what they're doing and why they're doing it. You can also time users to see how long it takes them to complete tasks, which is a good measure of efficiency (although you should bear in mind that using the 'think aloud' protocol will slow users down considerably). Two specialists' time is normally required per session – one to moderate, one to note problems.

When to use? Usability testing can be used as an input to design or at the end of a project. It represents an excellent way of finding out what the most likely usability problems with a site are likely to be. Usability testing can be used to generate non-statistical or statistical data.

Issues: Usability testing requires some form of design to be available to test, even if it's only on paper. Testing works best if it focuses either on gathering non-statistical feedback on a design through 'talk aloud' or statistical measures.

3. **Card sorting**
What is it? Card sorting is a method for suggesting intuitive structures/categories. A participant is presented with an unsorted pack of index cards. Each card has a statement written on it that relates to a page of the site. The participant is asked to sort these cards into groups and then to name these groups. The results of multiple individual sorts are then combined and analyzed statistically.

When to use? Card sorting is usually used as an input to design. It's an excellent way of suggesting good categories for a site's content and deriving its information architecture. Card sorting can be used to generate statistical data.

Issues: Providing participants with a trial run on some easy cards (e.g. sports, animals, etc.) can reassure them about what they are expected to do and result in a more productive session.

4. **Participatory design**
What is it? Participatory design does not just ask users for their opinions on design issues, but actively involves them in the design and decision-making processes.

When to use? Participatory design is usually used within a mini-project to generate prototypes that feed into an overall project's design process. An example would be a participatory design workshop in which developers, designers and users work together to design an initial prototype. This initial prototype would then feed into a more traditional design process. Projects which only utilize participatory design are very rare.

Issues: Participatory design sessions can be very fluid and require an experienced moderator with thorough knowledge of the domain to guide them.

5. **Questionnaires**

What are they? Questionnaires are a means of asking users for their responses to a pre-defined set of questions and are a good way of generating statistical data.

When to use? Questionnaires are usually employed when a design team:

- ✔ Can only gain remote access to users of a site
- ✔ Is seeking a larger sample size than can be realistically achieved through direct contact

It is for this reason that questionnaires are usually administered through post or electronic means.

Issues: Questionnaires allow statistical analysis of results, which can increase a study's credibility through its scientific appearance. This makes it all the more important that the questionnaire is well-designed and asks non-biased questions.

6. **Interviews**

What are they? An interview usually involves one interviewer speaking to one participant at a time. The advantages of an interview are that a participant's unique point of view can be explored in detail. It is also the case that any misunderstandings between the interviewer and the participant are likely to be quickly identified and addressed. The output of an interview is almost exclusively non-statistical. It's critical that reports of interviews are carefully analyzed by experienced practitioners.

When to use? Interviews are usually employed early in the design process in order to gain a more detailed understanding of a domain/area of activity or specific requirements.

Issues: Interviewing places a high premium on the experience and skill of the interviewer and analyst.

Iterative Design Cycle

Iterative design is a process where an interface is progressively developed and improved over a series of iterations, each the result of user testing and feedback. The iterative design cycle involves *design*, *test*, and *redesign*. These phases operate in a continual cycle that designs are continually evaluated and improved.

To be specific, UCD goes through six phases as previously discussed:

1. Specify the use context and users' needs;
2. Specify business requirements;
3. Build design solutions from rough concept to finished design;
4. Evaluate designs with usability testing;
5. Implementation—develop and deliver the product;
6. Deployment—the final product is evaluated, as consumer needs change.

The Benefits of Iterative Design

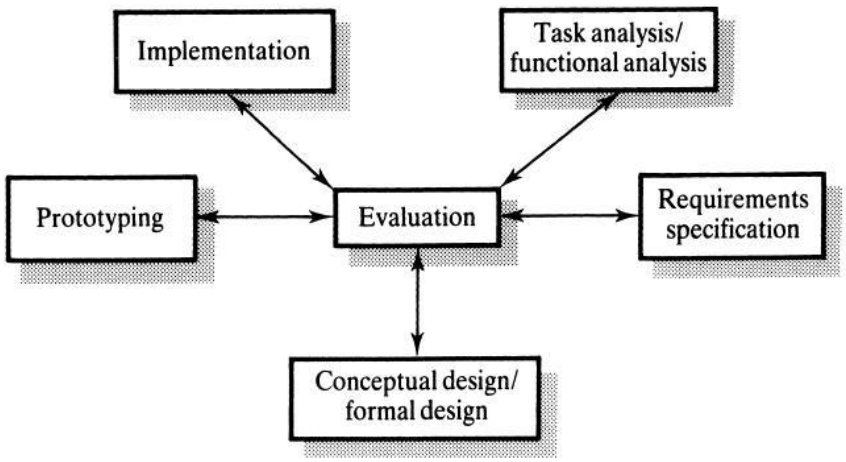
There are some simple benefits of the iterative design approach over and above its cost-effectiveness including:

- It allows for rapid resolution of misunderstandings within the project team and established clarity early in the development lifecycle.
- It brings out user feedback to ensure that system requirements meet user needs.
- It can help with client relationships to show the evolution of a design rather than "dumping" a finished product on them.
- It gives the development team some certainty that their efforts are being focused on adding value for users.
- It provides regular testing which can provide a strong desired performance framework for acceptance testing.
- It allows for easy incorporation of "lessons learned" in the final product.
- It gives stakeholders better visibility of progress at each iteration.

HCI Design Models

1.

The Star Life Cycle



The star life cycle (adapted from Hix and Hartson, 1993).

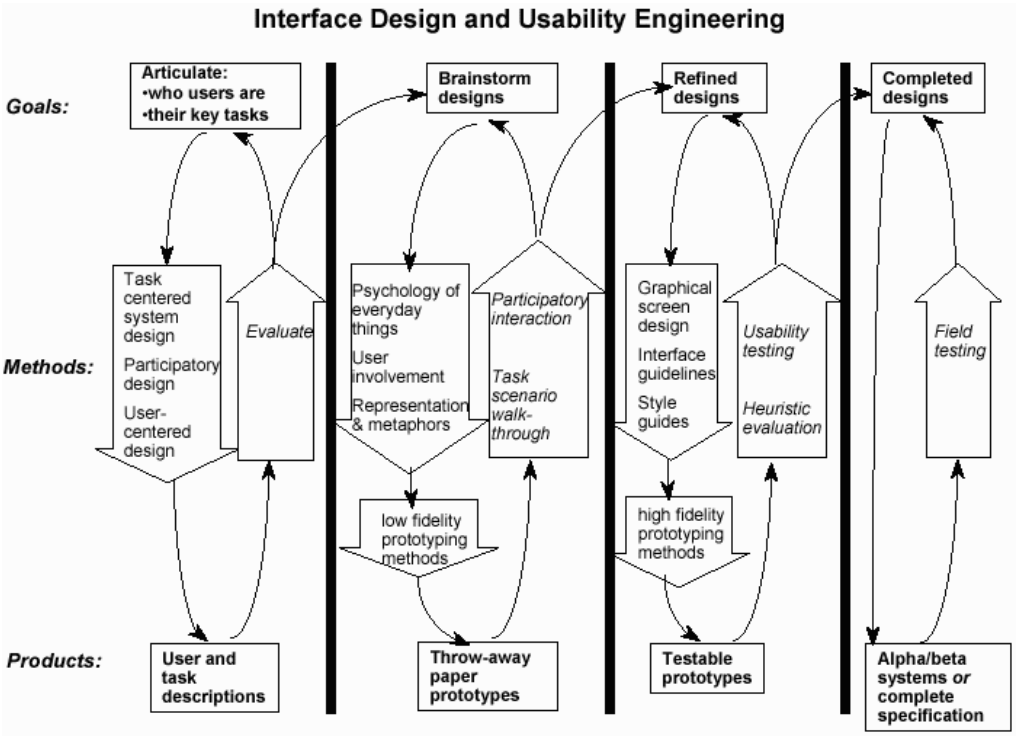
Here, evaluation is at the center of the design process; we must be doing evaluation at all stages of the design process, and we move around the star from analysis clockwise. We can consider two modes of design activity:

1. Analytic mode - top-down, organizing and formal; working from the systems view towards the user's view
2. Synthetic mode - bottom-up, free-thinking, creative and ad-hoc; working from the user's view to the systems view

Interface designers need to flip between these two modes. The star life cycle captures something important about the real design process - that we need to work from both ends of the problem, from the user's perspective and from the perspective of the technology, but it doesn't tell us very much about the ordering and nature of the different processes involved in design and how to move a design forward.

Interface Design and Usability Engineering

This diagram captures the major topics in the course and how they fit together as a process defining interface design and usability engineering.



Interface Design and Usability Engineering Phases

The process goes left to right, where each major block shows the typical things that interface designers have to do. Each block indicates the goals to be accomplished, the methods (or tricks of the trade) that help accomplish those goals, and the products.

In practice, not every step or method is followed. Rather, the interface developer will choose methods appropriate to the time and budget of the project.

The LUCID Design Framework

LUCID (Logical User Centered Interaction Design) began as a way of describing the approach to interface design at Cognetics Corporation. Over the years, it has evolved into a framework to manage the process of designing an interface in a way which can, if not guarantee, at least encourage software usability. Its goals are:

- To provide UI designers with a framework within which to apply best practices
- To allow for seamless integration of design and usability activities with software
- development methodologies
- To support a user-centered approach to interface design
- To enhance the usability of the finished software

LUCID		
Logical	**User Centered**	**Interaction Design**
The design process builds on a strong conceptual model. Iterative review and refinement includes user feedback at all critical stages. Successive prototypes and team reviews allow opportunities for technical review and ensure viability of the design	Software is designed in the context of the overall tasks and work flow (including both manual and computerized activities). Design is based on user activity and employs the user's language and context. The design model fits the user's mental model rather than the technical implementation model.	Interaction design is treated as distinct from technical design. The scope of the design is "everything but code" and includes: ❑ look and feel ❑ language ❑ screen objects & layout ❑ navigation ❑ user assistance

LUCID Framework's Focus

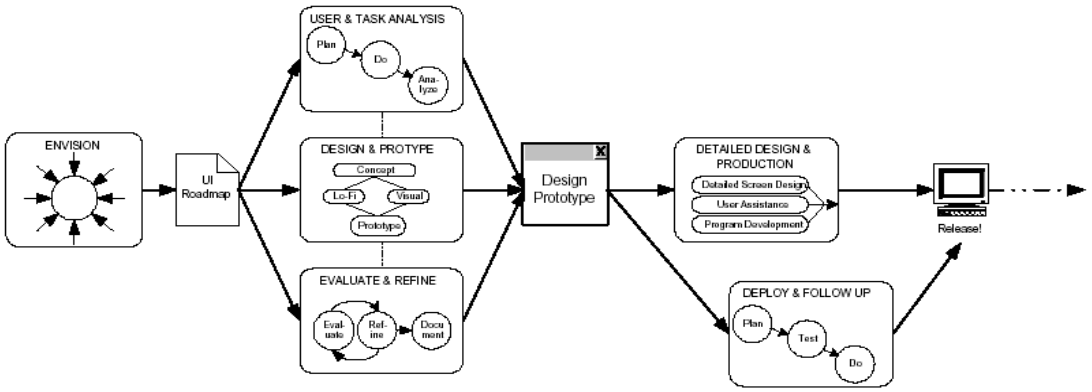
Over the past 30 years, several techniques for managing software development projects have been developed and documented. While these techniques have helped large software development projects meet time, budget, and quality goals, they do not directly address usability issues. Because most systems being developed today are interactive, software development methodology must be expanded to include the design of the user interface.

The LUCID Framework was developed to fill this need. It is a methodology for designing the interactional components or "front end" of a software product. The LUCID Framework can be integrated with other software engineering methodologies or, for small product development efforts, can be used as a stand-alone methodology.
LUCID is organized into six stages:

Stage 1: **Envision**	Develop UI Roadmap which defines the product concept, rationale, constraints and design objectives.
Stage 2: **Analyze**	Analyze the user needs and develop requirements.
Stage 3: **Design**	Create a design concept and implement a key screen prototype.
Stage 4: **Refine**	Test the prototype for design problems and iteratively refine and expand the design.
Stage 5: **Implement**	Support implementation of the product making late stage design changes where required. Develop user support components.
Stage 6: **Support**	Provide roll-out support as the product is deployed and gather data for next version.

LUCID Six Stages

Each of these stages is completed in sequence building the elements of the interface until the design is complete. Many of the tasks within a stage are iterative – repeated in a rapid cycle with review tasks until the result is a satisfactory conclusion. In addition, key documents such as the UI Roadmap and the requirements analysis are reviewed at the end of the design stages to ensure both that any new information is incorporated and that the design work has stayed within the scope outlined in them.



LUCID Framework

Interactive Design Using Prototype

Iterative design is a process where an interface is progressively developed and improved over a series of iterations, each the result of user testing and feedback. In its simplest form, the iterative design cycle can be said to have three phases: design, test, redesign. These phases operate in a continual cycle (in theory that is; in practice iterations are limited by budgetary considerations) so that designs are continually evaluated and improved.*

**The topic "Iterative Design Approach" was discussed extensively in Module No. 2*

Lesson 6: Prototyping

What is Prototyping?

Prototyping is an experimental process where design teams implement ideas into tangible forms from paper to digital. Teams build prototypes of varying degrees of fidelity to capture design concepts and test on users. With prototypes, you can refine and validate your designs so your brand can release the right products.

Remarkable Reasons for Prototyping

Prototyping is the fourth phase of both design thinking and design sprints. It's an essential part of user experience (UX) design that usually comes after ideation, where you/your team have created and selected ideas that can solve users' needs. In prototyping, you craft a simple experimental model of your proposed product so you can check how well it matches what users want through the feedback they give. You should consider prototyping from early on—using paper prototyping, if appropriate—so the feedback you gather from users can help guide development. The advantages of prototyping are that you:

- Have a solid foundation from which to ideate towards improvements—giving all stakeholders a clear picture of the potential benefits, risks and costs associated with where a prototype might lead.
- Can adapt changes early—thereby avoiding commitment to a single, falsely-ideal version, getting stuck on local maxima of UX and later incurring heavy costs due to oversights.
- Show the prototype to your users so they can give you their feedback to help pinpoint which elements/variants work best and whether an overhaul is required.
- Have a tool to experiment with associated parts of the users' needs and problems—therefore, you can get insights into less-obvious areas of the users' world (e.g., you notice them using it for additional purposes or spot unforeseen accessibility issues such as challenges to mobile use).
- Provide a sense of ownership to all concerned stakeholders—therefore fostering emotional investment in the product's ultimate success.
- Improve time-to-market by minimizing the number of errors to correct before product release.

Prototyping can help catch potentially costly errors well in advance.

Prototyping is an integral part of the design process for two key reasons:

1. **Visualization**—Prototypes help UX designers show stakeholders how the final product would look and function.
2. **Feedback**—Prototypes generate feedback from team members as well as test groups of users. Potential customers can interact with a near-final product and highlight areas that are less than user friendly. The design team can then iterate the design before the product team rolls out the final product, saving the company both time and money.

Low Fidelity and High Fidelity Prototypes

Fidelity refers to the level of detail and functionality you include in your prototype. Usually, this will depend on your product's development stage. You can construct one that gives a wide view of the entire system or subsystem (called a horizontal prototype – e.g., an entire website) or one that gives a detailed view of just one feature (a vertical prototype – e.g., a checkout process). The level of fidelity you choose should be appropriate for presenting to users in user testing so they can give focused feedback. Consider the differences:

1. **Low-fidelity**
   Example: Paper prototypes
   Pros: Fast and cheap; disposable; easy to make changes and test new iterations; allow a quick overall view of the product; anyone can produce them; encourage design thinking since prototypes are visibly not finalized.
   Cons: Lack of realism, so users might have a hard time giving feedback; hard to apply results from crude early versions; may be too basic to reflect the user experience of the finished product; can oversimplify complex issues; lack of interactivity deprives users of direct control; users must imagine how they would use the product.
2. **High-fidelity**
   Example: Digital prototypes created on software such as Sketch or Adobe XD
   Pros: Engaging—all stakeholders have the vision realized in their hands and can judge how well it matches users' needs and solves their problems; testing will yield more accurate, more applicable results; versions closest to the final product enable you to predict how users will take to it in the marketplace.
   Cons: Longer/costlier to create; users are more likely to comment on superficial details than on content; after hours of work, you the designer are likely to dislike the idea of making changes, which can take considerable time; users may mistake the prototype for the finished product and form biases.

Some designers split high-fidelity prototyping into "mid-fidelity" (where prototypes can have basic digital interactivity or be slick wireframes) and "high-fidelity" (where they're far closer to the final version). Interactive prototypes yield far more useful results in user tests. However, fidelity is relative—a static mockup of a landing page, for example, is of higher fidelity than sketched cut-outs users can move. Overall, you should always commit to prototyping with the users' needs in mind, particularly with an eye for user flow.

Low-Fidelity Prototypes

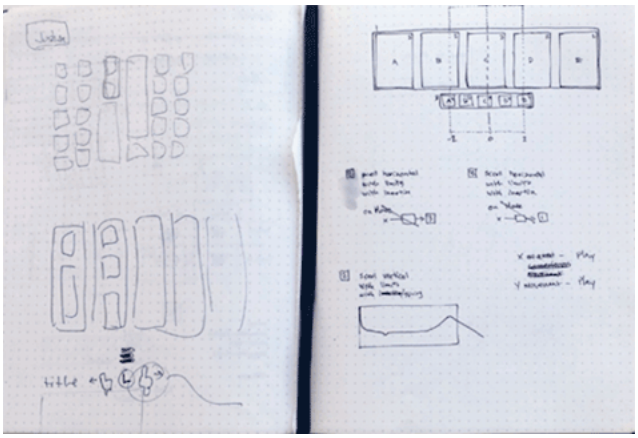
Low-fidelity prototyping is a quick, simple way of evolving a design idea into a somewhat more tangible representation of a software product. The goal of a low-fidelity prototype is to outline a product's flow and test the usefulness and usability of its functionality. Thus, low-fidelity prototypes are not as visually refined as high-fidelity prototypes. Examples of low-fidelity prototypes include:

- sketches
- paper prototypes
- click-through prototypes

Of course, there are pros and cons to creating low-fidelity prototypes that a UX designer must weigh before beginning a project. The key benefits of low-fidelity prototypes are that they are fast, easy, and affordable to create and strongly support collaboration. However, on the flip side, most low-fidelity prototypes are not clickable, and those that are have limitations. Low-fidelity prototypes are not as aesthetically pleasing as high-fidelity prototypes. Plus, fully understanding their functionality requires a bit of imagination.

1. **Sketches**

   Sketched prototypes are often free-form, pen-and-pencil drawings that map out an initial idea—similar to those shown in the figure. They're the most rudimentary form of prototype. UX designers typically use sketches to generate ideas and collaborate with product teams.



Sample Sketch

When to Create Sketches

You'll often create sketches to spark discussions about usability and project goals and generate design ideas. Typically, you'll use sketching at the earliest stage of design. You'll often create sketches to spark discussions about usability and project goals and generate design ideas. Either a UX designer can create the sketches or an entire product team can create them as a collaborative process. The sketching process might also involve other members of the UX team—designers and researchers—the marketing team, or other stakeholders. Once your product team has aligned on a sketch, you can use it to communicate the initial idea to other stakeholders and teams.

Benefits of Sketching

There are many benefits of sketching, but the key advantage is that it's fast. You can create a sketch in just a minute—either with pencil and paper, at a whiteboard, or using software. Sketching doesn't require any programming knowledge. It is also cheap. When sketching is a collaborative process, it's a helpful way of getting all stakeholders involved in the design process. Plus, sketches are easy to revise—either with an eraser or by re-arranging a collection of images.

2. Paper Prototypes

Paper prototyping is often collaborative and is a good first step before moving on to an interactive prototype. Paper prototypes are not the same thing as sketches. While teams also use them during the earliest phase of the design process, the structure of paper prototypes is more defined than that of a set of sketches. While you'll often draw sketches freehand, paper prototypes typically involve using stencils and cardboard to create more substantial, detailed mockups of various Web pages or application screens for use during usability testing. You can also couple these with Post-it Notes or other paper addons. Similar to sketching, paper prototyping is often collaborative and is a good first step before moving on to an interactive prototype. The figure below shows the use of tools for creating paper prototypes.

Paper Prototyping

When to Create Paper Prototypes

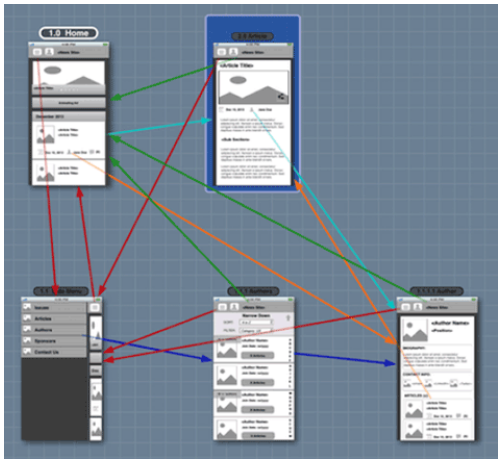
Just like sketches, you'll usually create paper prototypes at the beginning of the design stage. Paper prototypes can be the first step of prototyping or the next step after completing your initial sketches. You can elaborate on simple sketches by adding Post-it Notes or using index cards to better show user flows or depict drop-down menus and other on-screen elements. Use paper prototypes to represent a user interface during usability testing early in the design process.

Benefits of Paper Prototyping

Similar to sketching, creating paper prototypes is fast, easy, inexpensive, and requires no technical knowledge. The process of creating a paper prototype is often collaborative. Paper prototypes are easy to revise, allowing teams to explore various user-flow options and design details.

3. **Click-Through Prototypes**

Click-through prototypes… link various screens through hotspots. Click-through prototypes depict the elements on the pages of a Web site or the screens of an app, as shown in the figure below. They link various screens through hotspots. These prototypes are more advanced versions of low-fidelity prototypes, as well as the simplest versions of interactive prototypes. Some applications help you create prototypes from scratch, while others let you upload your early sketches or paper prototypes, creating a digital form of those prototypes, so you can test and iterate your designs.



When to Create Click-Through Prototypes

While sketches and paper prototypes are great initial steps, click-through prototypes help you to take things one step further. Creating a click-through prototype is a great way of testing product flows early in the design process.

Benefits of Click-Through Prototypes

Clickable prototypes more closely mimic a real user experience than sketches and paper prototypes do. Thus, they require less imagination on the part of your teammates. While they are more time consuming to create than their other low-fidelity counterparts, creating them is much less involved than creating high-fidelity prototypes.

High-Fidelity Prototypes

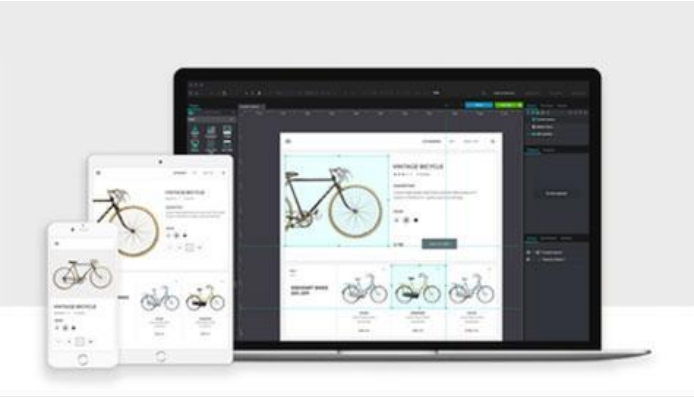
High-fidelity prototypes are more aesthetically pleasing, and their function is closer to that of the final product. High-fidelity prototypes are more advanced than their low-fidelity counterparts. They are more aesthetically pleasing, and their function is closer to that of the final product. You'll typically create high-fidelity prototypes further along in the design process, once a team has a firm grasp of what they want the finished product to embody. High-fidelity

prototypes are sometimes better for usability testing than low-fidelity prototypes. Examples of high-fidelity prototypes include:

- interactive prototypes
- digital prototypes
- coded prototypes

1. **Interactive Prototypes**

   Interactive prototypes, such as that shown in figure below, are more advanced versions of click-through prototypes that can be created using a prototyping application that supports interactivity, but only medium-fidelity visual design. In a sense, they are the culmination of the process of sketching, then creating paper prototypes or click-through prototypes. Interactive prototypes are both clickable and responsive, enabling users to interact with them and see animations in response, and they're more aesthetically pleasing than their low-fidelity prototype precursors.



Creating an interactive prototype in justinmind

When to Create Interactive Prototypes

Because interactive prototypes are more realistic than low-fidelity prototypes, they're better for soliciting feedback and doing usability testing.

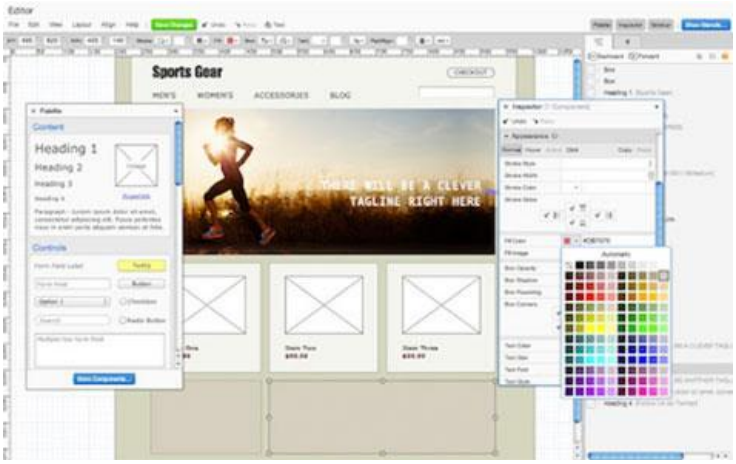
You'll typically create interactive prototypes later in the design and prototyping process, once a product's design and functionality are fairly well established. Because interactive prototypes are more realistic than low-fidelity prototypes, they're better for soliciting feedback and doing usability testing.

Benefits of Interactive Prototypes

Interactive prototypes look somewhat more realistic than low-fidelity prototypes. They are also clickable and responsive, so they give stakeholders a pretty good idea of how the final product will look and behave. However, since you create these prototypes before the product is under development, there is still time to make design changes. You probably don't need to know how to code to create such interactive prototypes because a variety of applications offer drag-and-drop user interfaces that make creating these prototypes a breeze.

2. **Digital Prototypes Created with Prototyping Software**

The most common type of high-fidelity prototype is a digital prototype that is developed using prototyping software that lets UX designers create aesthetically rich, interactive, and even animated product prototypes of a user interface that is almost ready for implementation. As shown in the figure below, these prototypes are realistic looking and support more accurate testing of user-interface elements.



Creating a realistic-looking, digital prototype in Protoshare

When to Create Digital Prototypes

Create a digital prototype only once a product and its flow are well thought out and have been approved by key stakeholders for final testing and implementation.
Create a digital prototype only once a product and its flow are well thought out and have been approved by key stakeholders for final testing and implementation. Digital prototypes take much time and effort to construct, so creating them should never be the first step in the prototyping process.

Benefits of Digital Prototypes

Digital prototypes look—but don't behave—as close to the final product as possible. However, they can be dynamic, animated, and offer smooth transitions between pages.

3. **Coded, HTML/CSS Prototypes**

Creating a coded prototype is more complex because it requires the UX designer or prototypes to know how to code. These prototypes are the closest to the final design of a product and are the best option for generating user feedback.

A coded prototype

When to Create Coded Prototypes

Coded prototypes both look and behave as much like the final product as possible. A coded prototype should be the final type of prototype you create. Because coded prototypes are the most realistic and closest to the final product, they're ideal for usability testing. While digital prototypes look, but don't behave like the final product, coded prototypes both look and behave as much like the final product as possible.

Benefits of Coded Prototypes

Coded prototypes are neither fast and easy to create, nor easy to revise. They are natively responsive, so people can view them on phones, tablets, or desktops. Creating coded prototypes is usually less collaborative than creating a low-fidelity prototype. However, these prototypes are very realistic. They both look and behave like the final product so are the best prototype for obtaining user feedback. Plus, you can host these prototypes on any Web server—whether public or private—so they are very easy to share with teammates, stakeholders, and potential customers or users—unlike other digital prototypes, which require specific applications to view them.

Engagement Activity 5

True or False. Write True if the statement is True, if otherwise write False.

_____1. In a user-centered design, decisions should be based on the needs and wants of programmers.
_____2. One of the user-centered design considerations is the business goals.
_____3. Prototyping is both relatively cheap to do and quick to create.
_____4. Iterative process primarily involves prototyping.
_____5. The easiest and fastest way of prototyping is sketching.
_____6. Low fidelity prototypes are the closest to the final design of a system and the best option for producing a more thorough user feedback.

_____7. Clickthrough prototypes are often free-form, pen-and-pencil drawings that map out an initial idea.
_____8. Bottom Up Design methodology starts with a foundation and works up towards a solution.
_____9. Fidelity refers to the level of detail and functionality you include in your prototype.
_____10. Web developers are responsible for the visual layout and style of print publications, products, and media productions.

Engagement Activity 6

Identification. Write "**Lo-Fi**" if the statement pertains to low-fidelity prototype. Otherwise, write "**Hi-Fi**" if the statement describes high-fidelity prototypes.

_____1. Often paper-based and do not allow user interactions
_____2. Assumed to be much more effective in collecting true human performance data.
_____3. Are computer-based, and usually allow realistic (mouse-keyboard) user interactions
_____4. Take you as close as possible to a true representation of the user interface
_____5. Helpful in enabling early visualization of alternative design solutions, which helps provoke innovation and improvement
_____6. When using rough sketches, users may feel more comfortable suggesting changes
_____7. Assumed to be much more effective demonstrating actual products to clients, management, and others
_____8. They range from a series of hand-drawn mock-ups to printouts
_____9. Quick and easy way to translate high-level design concepts into tangible and testable artifacts
_____10. Requires more time, specialized skills and resources

Performance Tasks

Laboratory Activity 5

Using your previous project proposal documentation, add the flowchart of the system. Please do not forget to add statements that explain the system flowchart. Read the following articles about flowcharting to guide you:

- https://www.visual-paradigm.com/tutorials/flowchart-tutorial/
- https://creately.com/blog/diagrams/all-you-need-to-know-about-flowcharting/

Laboratory Activity 6

Using your application proposal, make a low-fidelity prototype, particularly, paper prototype. You can read the articles below to help you in making paper prototypes:

- https://youtu.be/4ZRzJTczMCE
- https://www.uxpin.com/studio/blog/paper-prototyping-the-practical-beginners-guide/
- https://www.justinmind.com/blog/paper-prototype/
- https://youtu.be/8mo3A6hUJSc

Using your application proposal, make a high-fidelity prototype, particularly, digital prototype.

Understanding Directed Assess

Learning Resources

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