User Interfaces

EECS 3461 – Sections A & B
Fall 2021

R-Design-V
Prototyping

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Dependencies

This module assumes that you are already familiar with:

- R-Design-IV
- R-Humans-I
- R-Knowledge-I
- R-Interaction-I

Key Questions

1. What recap is needed?
2. Is there a best practice for design?
3. What is the Double Diamond design process model? How do we use it? Where does prototyping fit in?
4. When in the design process does prototyping take place?
5. What is prototyping?
6. What are some of the key concepts?

1. What recap is needed?

Recap

- recall the prior resource pack (R-Knowledge-I) :
- ***methodology***: a system of methods used in a particular activity; has an underlying rationale and implements a particular strategy
- ***method***: a particular procedure for accomplishing or approaching something (akin to a tool)

Recap

- recall the 4 core activities in design:
  - Research (Observing/Discovering requirements)
  - Generating Ideas/Designing alternatives
  - Prototyping
  - Evaluating/Testing
- there are methodologies for each of these:
  - research methodologies
  - ideation methodologies
  - prototyping methodologies
  - evaluation methodologies

Recap

- research:
  - methodologies: approaches based on the use of empirical evidence (science-based, non-science based); on the use of argumentation and critical analysis
  - methods: many methods of qualitative, quantitative data
    - e.g., thematic analysis of qualitative data via coding
- ideation methodologies
  - methodology: e.g., Six Thinking Hats (+ other generalized approaches)
  - method: e.g., SCAMPER (+ other specific brainstorming techniques)

Recap

- prototyping:
  - methodologies: …
  - methods: …
- *we will discuss in this resource pack…*
- *but first, some framing…*

2. Is there a best practice for design?

What is a 'best practice' and 'benchmarking'?

- a 'best practice' refers to a procedure that is accepted or prescribed as being the 'correct' one or 'most effective'
- *benchmarking* is the practice of comparing business processes and performance metrics to industry bests and practices from other companies
  - benchmarking studies can be undertaken internally or externally
  - serve several purposes: help organizations identify performance gaps, help understand current standard of performance in an industry

Is there a ‘best practice’ for design?

- short answer: no

Is there a 'best practice' for design?

"The general consensus is that there is **no set best practice** in design process. However, there is agreement that there are some commonalities across processes used, and that these typically consist of four or five distinct phases."

[British Design Council, 2007, Desk Research Report]
emphasis added

- although **there is no single best practice design process**, there are core activities which can be adapted to fit a particular project or situation (Best, 2006)

Is there a 'best practice' for design?

- Clarkson & Eckert (2005):
  - there is a central core of generic stages that constitute a commonality between design processes
  - these commonalities are modified and adapted to reflect the problem or user need
  - there are constraints and drivers that influence the direction of the design process give the process its project-specific characteristics

Clarkson, P.J. and Eckert, C.M. (2005)
'Design process improvement - a review of current practice', Springer

Design Process Benchmarking Study

- in ~2005, the British Design Council (now called just the 'Design Council') undertook a benchmarking study of design processes:
- this was an **external** study: an outside organization conducting a study of a large a set of companies within an industry
- purpose:
  - gather insights to inform the development of internal design processes in UK businesses
  - build capacity (improve economic growth) for the UK business community
- study consisted of:
    - site visits to 11 companies + interviews + review of scholarly materials

Design Process Benchmarking Study

- the British Design Council's benchmarking study generated a knowledge output: the **Double Diamond Design Process Model**
- the 'Double Diamond' model has become hugely popular
- it is important to understand what it is and how to use it

3. What is the Double Diamond design process model? How do we use it? Where does prototyping fit in?

What is a **design process model?**

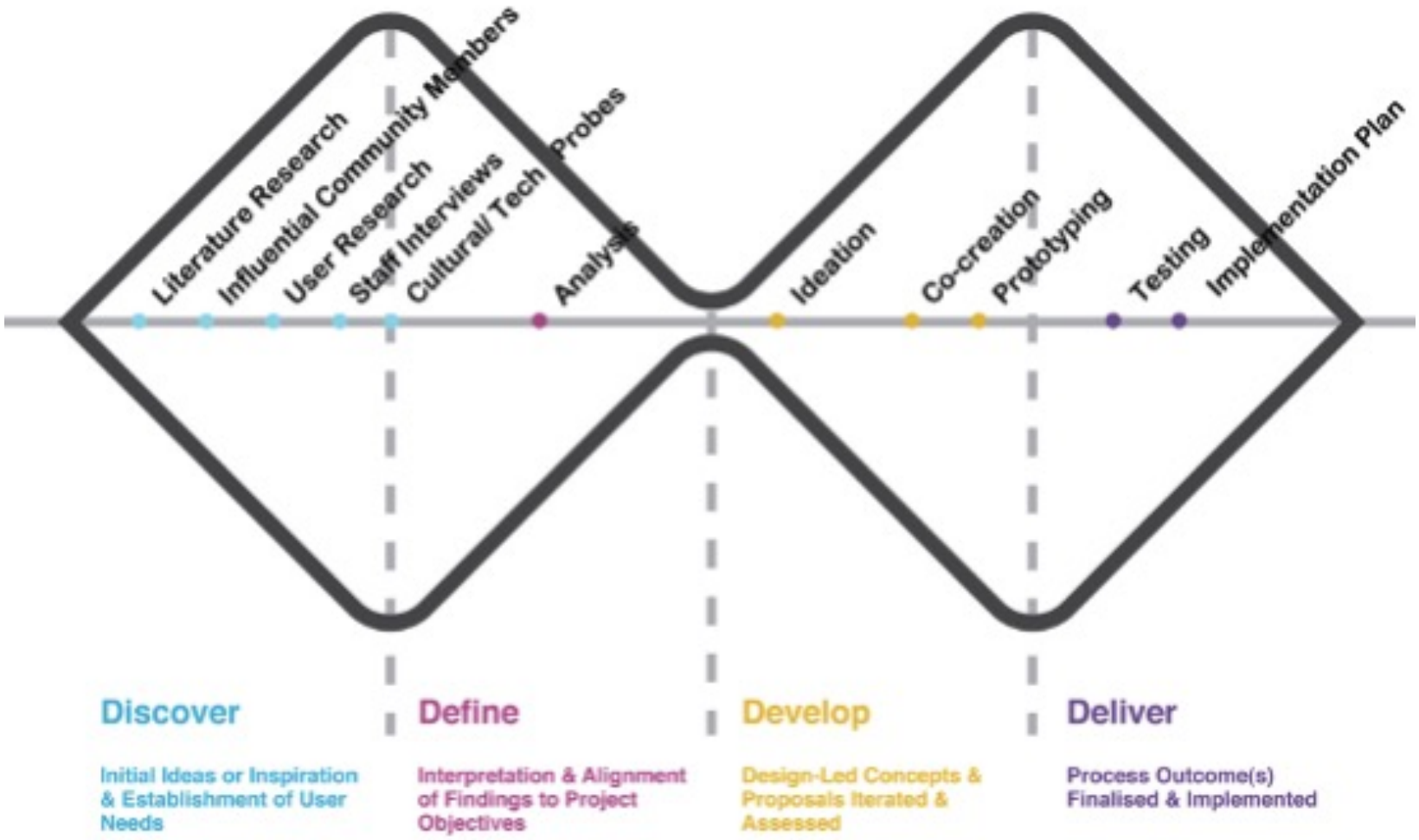
- The Double Diamond is a design process model, which means that it is a model of the design process
  - it is an **explanatory/descriptive** model
  - it is **not a predictive** model
- What the Double Diamond model **does not** do:
  - **does not** give you a not a recipe
  - **does not** tell you the steps that need to be followed
- What the Double Diamond model **does** do:
  - does provide an overall structure and set of processes
  - does provide a set of choices and approaches, from which choices can be made

Double Diamond…

- needs an overall a project management approach, such as agile, waterfall, lean, iterative/incremental, etc)
- needs management/decision-making structure
- need process tools (e.g., documents, visualizations, diagrams)
- needs goal setting, timelines, and provisions for iteration
  - goals and timeline for each of the diamonds
  - within each diamond, timeline for shifting between divergence-convergence
  - provision for revisiting earlier phases, timeline flexibility (e.g., see back tracking arrows in diagram above)

To illustrate, here is one example of a design process that fits the structure of Double Diamond…
This is **one possible example**, there are many other approaches that could be taken that fit the structure

One Example

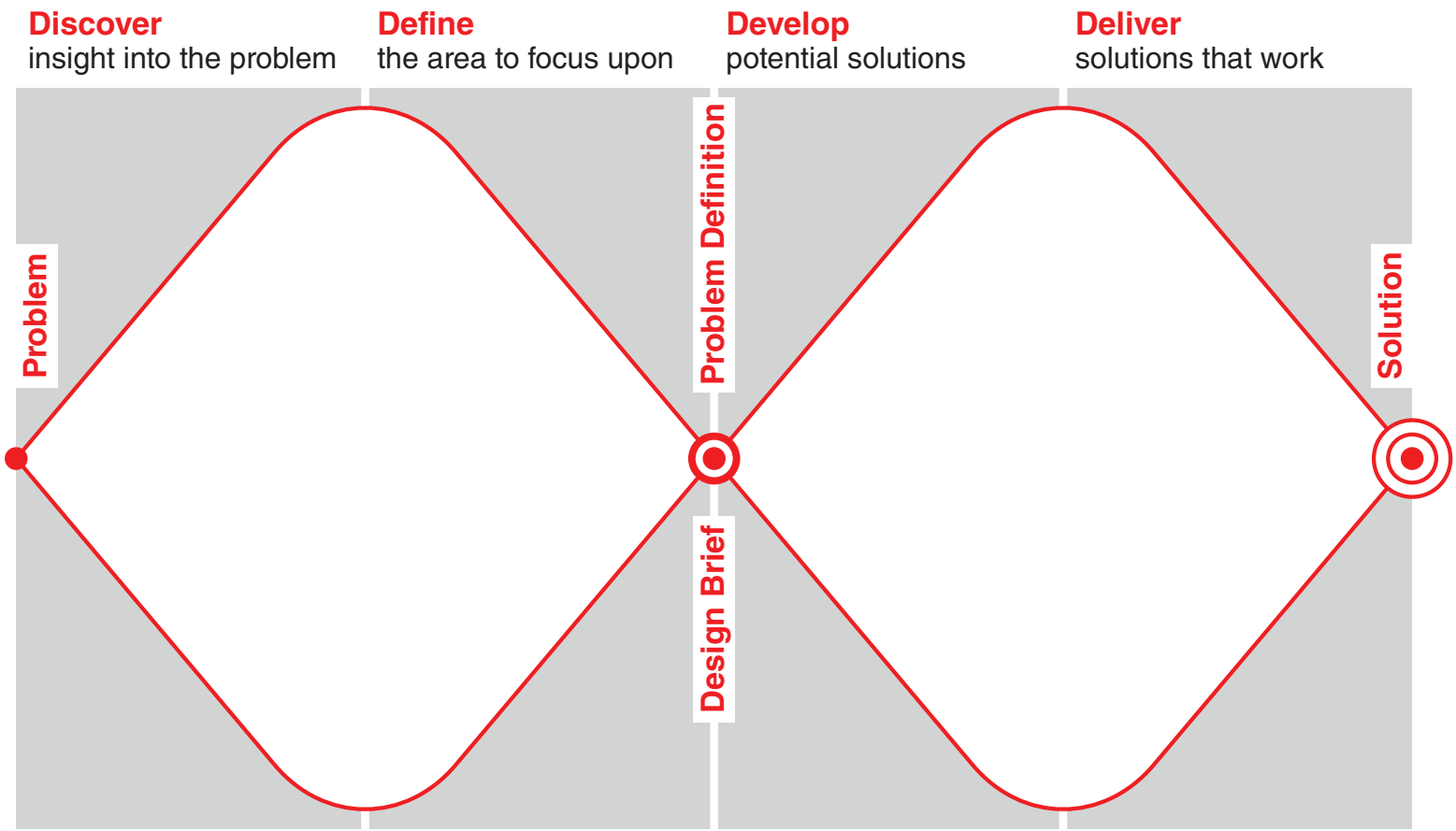


The Gist of the Double Diamond

"Start with an idea, and through the initial design research, expand the thinking to explore the fundamental issues. Only then is it time to converge upon the real, underlying problem. Similarly, use design research tools to explore a wide variety of solutions before converging upon one. (Slightly modified from the work of the British Design Council, 2005.)"

Norman, the Design of Everyday Things, 2013

The Double Diamond design process model



"Start with an idea, and through the initial design research, expand the thinking to explore the fundamental issues. Only then is it time to converge upon the real, underlying problem."

"Similarly, use design research tools to explore a wide variety of solutions before converging upon one."

The Four Phases

"The double diamond is formed from four distinct phases. These are Discover, Define, Develop and Deliver. The shape is generic throughout projects but stretched and morphed depending on the project's characteristics such as the type of product or service, whether there are external suppliers involved, or if it is a completely new product or the development of an existing one. **Each of the phases consists of a series of iterative loops where exploration and testing of ideas can happen**."

emphasis added

Core Activities

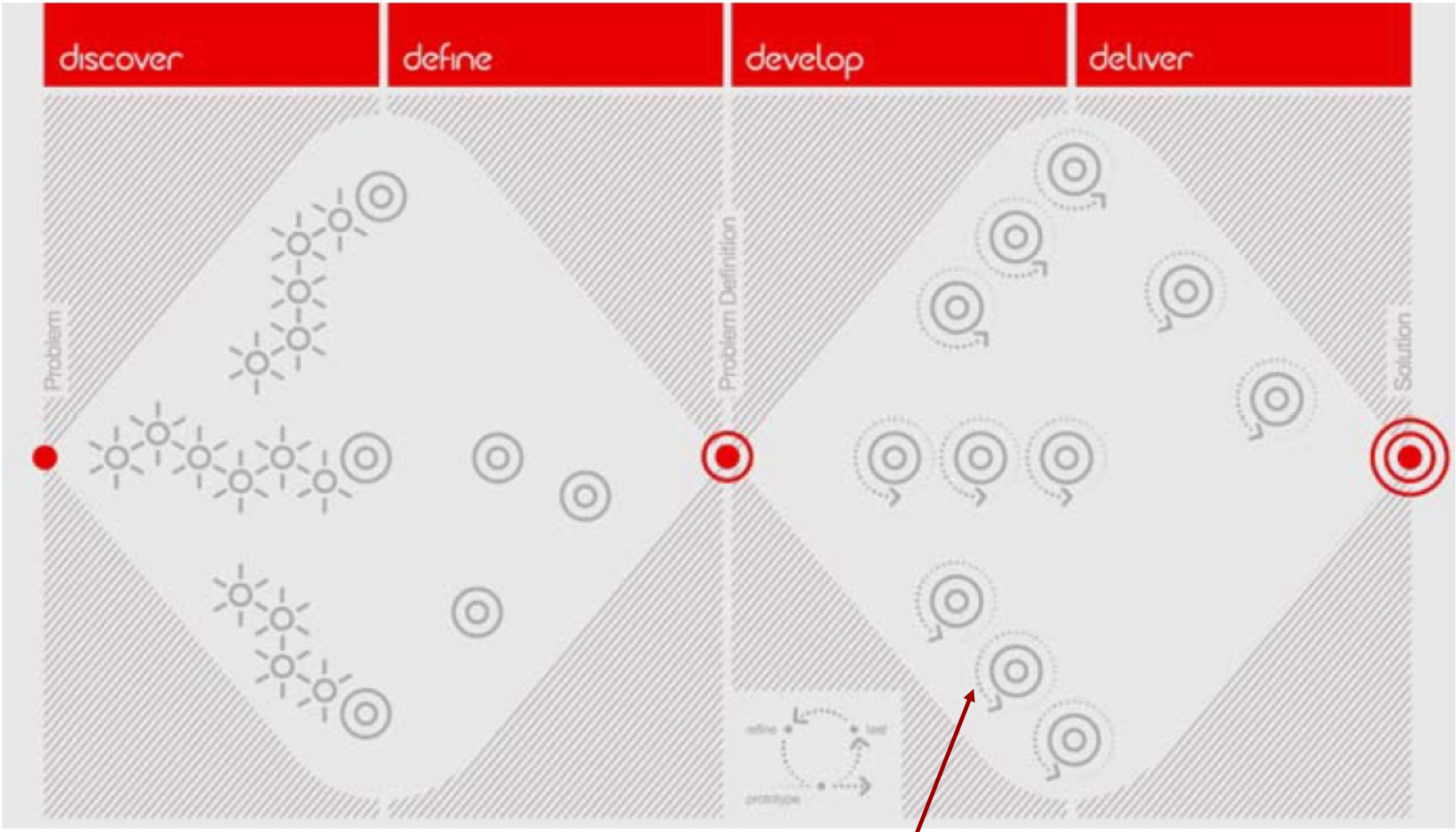
"Each of the phases consists of a series of iterative loops where exploration and testing of ideas can happen"

…. the activities within the iterative loops will consist of the following core activities* (Norman, 2013):

1. Research (Observing/Establishing requirements)
2. Generating Ideas/Designing alternatives
3. Prototyping
4. Evaluating/Testing

**assuming a human-centered design process, not technology-centered design process*

The Double Diamond design process model



Convergence vs Divergence

- the Double Diamond model provisions for two phases of divergence and two phases of convergence

….

Divergence

- the purpose is **to generate variants/options**
- **success criteria**: number and quality of different variants/options generated
  - having a large slate of options is crucial to the subsequent convergence phase
- examples:
  - generate a large set of ideas about design problems/opportunities
  - generate a large set of design concepts
  - generate a large set of interface variants
  - generate a large set of user scenarios
  - generate a large set of storyboards, prototypes, design element variants, possible layouts,
  - etc…

Convergence

- the purpose is to refine and narrowing down
- **success criteria**: quality of the choice made among all the many possible variants/options
- examples:
  - of a large set of different prototypes, select one for further development
  - of a large set of personas, select one to be the primary
  - of a large set of design problems/opportunities, select one to be the focus of a design response
  - etc….

Two Diamonds

- Diamond #1: Discover/Define
- Diamond #2: Develop/Deliver

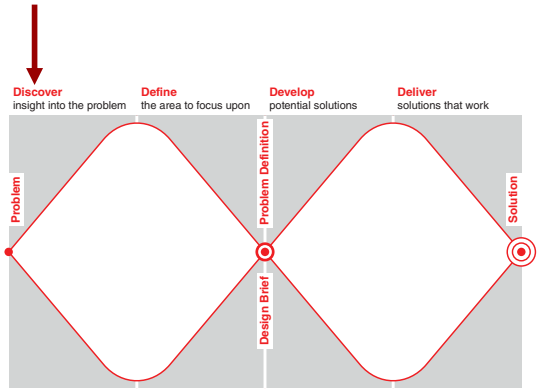
- both diamonds make use of iterations of the core activities, but the core activities will look different
- in the Discover/Define diamond, the iterations are most legible

Diamond #1: Discover/Define

- Discover is a phase of divergent thought
- Discover pivots into Define
- Define is a phase of convergent thought
- The result of Discover/Define will be an **artefact**
  - **project brief**
  - **problem statement**
  - **statement of requirements**
  - **design concept**
  - … other possible names for this artefact

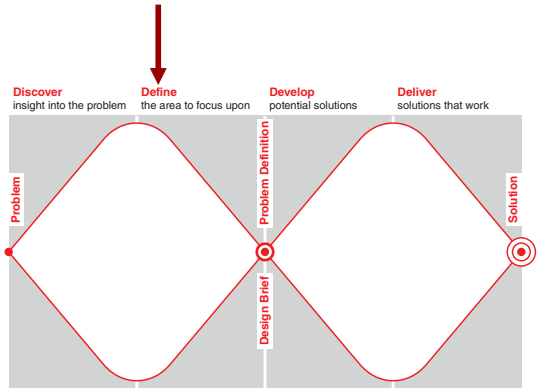
  - basically, the artefact spells out what the second diamond is responding to…

Discover Phase



- a divergent phase; the fuzzy front end (FFE); the phase during which ideas form
- is **critical** to the (eventual) definition of the nature of the problem that is being addressed through design (Rhea 2003)
- unstructured, can make use of different methods
  - e.g., market research; qualitative user research methods (focus groups, interviews, probes), ethnography; use of team approaches; brainstorming; target user visioning, rapid sketching
- often covers a significant amount of design activity that goes on within an organization, which may not be actively acknowledged as being design (Gorb and Dumas, 1987)

Define Phase



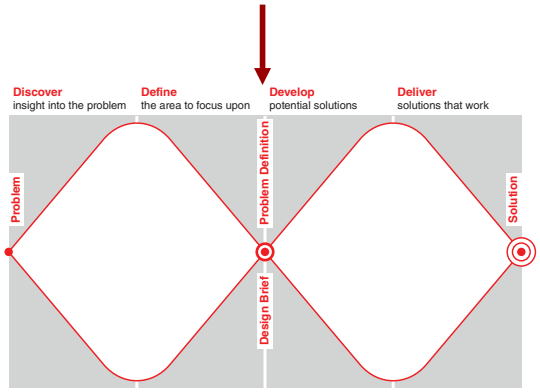
- a filtering phase
- a convergent phase
- various tools and methods used to accomplish the convergence – techniques for analysis and synthesis:
  - e.g., visual thematic analysis, motivation/obstacle analyses, customer journey maps
- results in a *design brief* or *the concept*
- the design brief contains *actionable tasks*
  - analogous to a *statement of requirements* or *problem statement*

Result of Diamond #1: Discover/Define

- an **artefact**
  - **project brief**
  - **problem statement**
  - **statement of requirements**
  - **design concept**
  - … other possible names for this artefact

  - basically, the artefact spells out what the second diamond is responding to…
- design materials (research materials, ideation materials, etc)

The Transition Point

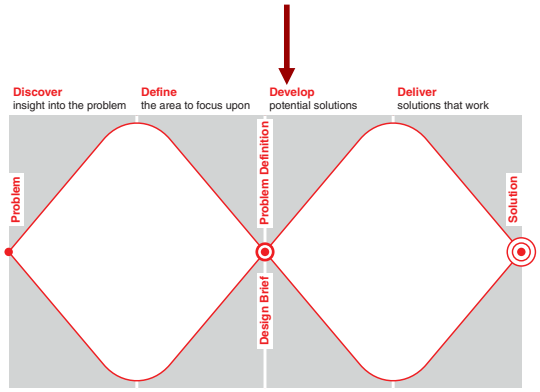


- this will look different depending on the design contexts
- in some design contexts, there will not be a formal sign-off
- in organizational/corporate contexts, the design process does not move to the second diamond until there is *sign-off* and/or *'concept approval'*
- sign-off is not given until:
  - the design brief and the overall corporate objectives have been be aligned
  - outcome measurements have been agreed
  - potential bottlenecks, opportunities and no-go areas are defined

Diamond #2: Develop/Deliver

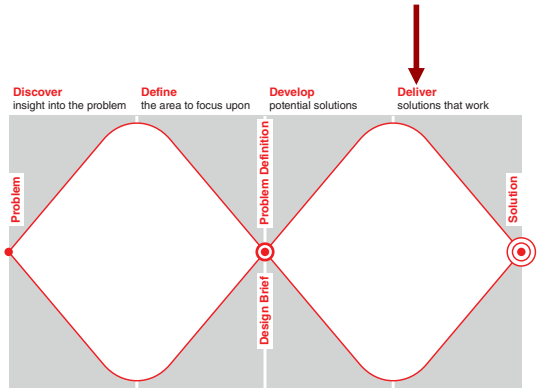
- again, a sequence of diverge/converge

Develop Phase



- a divergent phase
- often employs multidisciplinary teams with diverse viewpoints
- employs successive iterations of core activities
- use of visual techniques for the team to see iterations of sketches, prototypes, and other design work on the product or service concept
- multiple variants, repeated iterations of core activities:
  - Research (Observing/Establishing requirements) and Generating Ideas/Designing alternatives
    - e.g., scenario and persona development, storyboards, Plus/Minus scenarios
  - Prototyping
    - e.g., lo-fidelity techniques, prototyping software, etc
  - Evaluating/Testing
    - e.g., observational studies, walkthroughs, Wizard of Oz simulations, usability testing

Deliver Phase



- a convergent phase
- employs successive iterations of core activities
- 'final' testing, planning for launch into 'production' environment
- decisions about targets and in-use evaluation measures
- provisioning for feedback from production environment, information needs to flow back into organization

In Sum

- What is the best practice for design? this is a trick question. There is no single best practice.
- Effective practice will consist of certain core activities, undertaken in phases (4-5 phases)
- Each project will have its own specific characteristics, which will be a product of various constraints and drivers
- now-popular Double Diamond Model – this is not 'the' best practice, but an overarching model of many successful practices

In Sum

- the Double Diamond model is explanatory/descriptive model of the design process; it explains the purpose of and the methods that are potentially used within each phase
- an explanatory/descriptive model is not the same thing as a design methodology
- the Double Diamond model can provide a basis or framework for a methodology
- a design methodology can be based on the systematization of the phases of the Double Diamond model (with the addition of components that implement constraints and drivers, and build

3. When in the design process does prototyping take place?

Prototyping in Human Centered Design

- before talking about prototyping, it is important to clarify that we will be discussing prototyping in a Human Centered Design (HCD) process

Technology Centered Design (TCD)

- Technology Centered Design (TCD) puts the technology as the central focus
  - SW design puts SW as the central focus
- Premises:
  - requirements gathering is a key activity (alternatively: requirements elicitation, requirements gathering, automatic requirements analysis, etc)
  - the design process then **responds** to the requirements
  - the user's role is via their participation in the development of requirements
- Collorary
  - the statement of requirements **mediates** the user's involvement in the process
- Illustrative scenario (exaggerated to make a point):
    - user: you built this system for me, but I don't like how it behaves
    - developer: but you said you wanted X when we collected requirements and the system does X

Human Centered Design (HCD)

In HCD

- the focus is not on the technology
- the focus is on the **users**, their **tasks**, and their **environments**

Human Centered Design (HCD)

There are three core principles in HCD:

these principles are discussed in Sharp et al, 2019, sec 2.2.4, although I'm presenting them in a different order

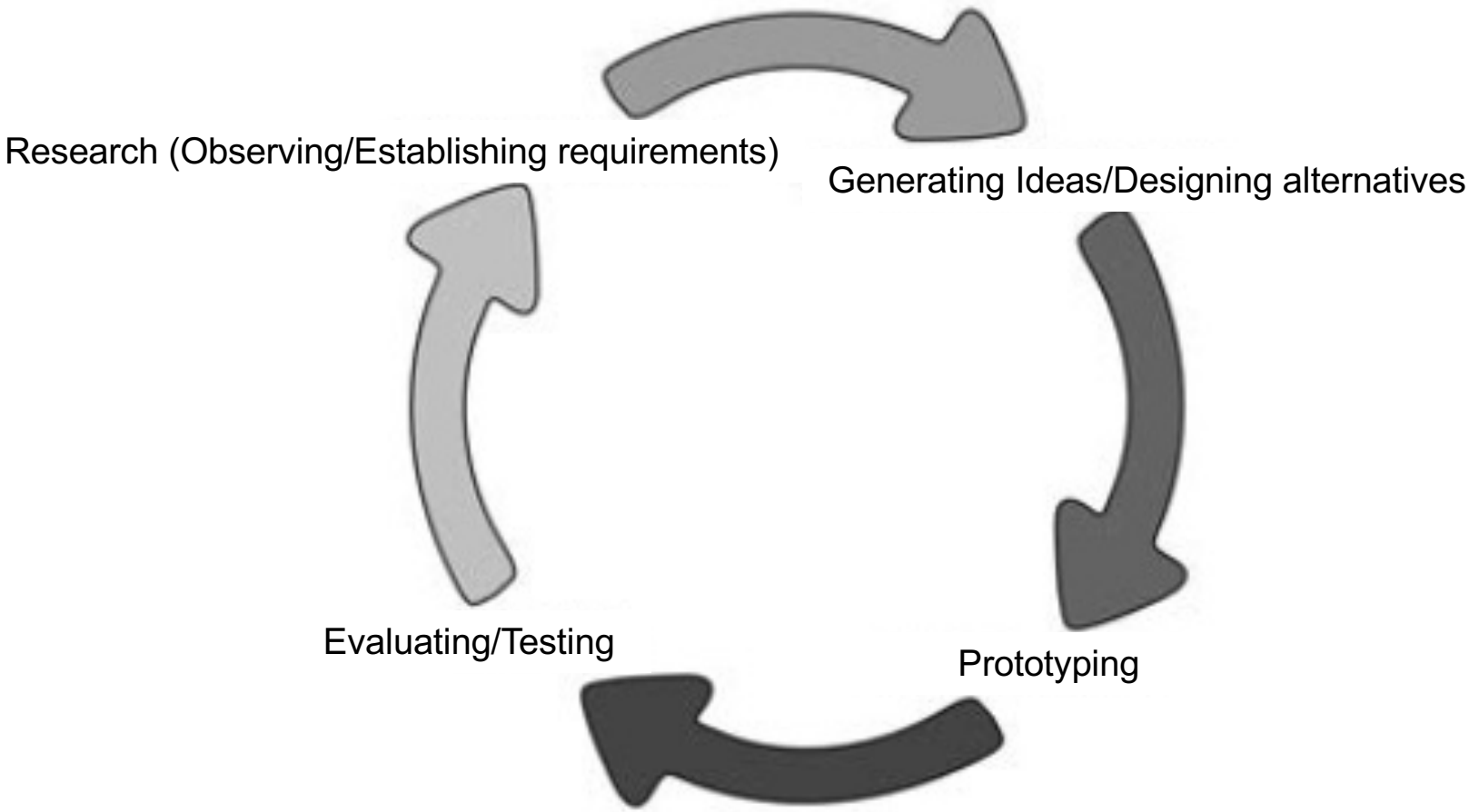
- employ an iterative approach
- the focus on users must come in the early, not late, iterations
- decisions should be made empirically

HCD Principle: Employ an iterative approach

- there are four core activities, undertake these in sequence and iteratively

Four Core Activities

the output of one activity generally feeds into the next activity



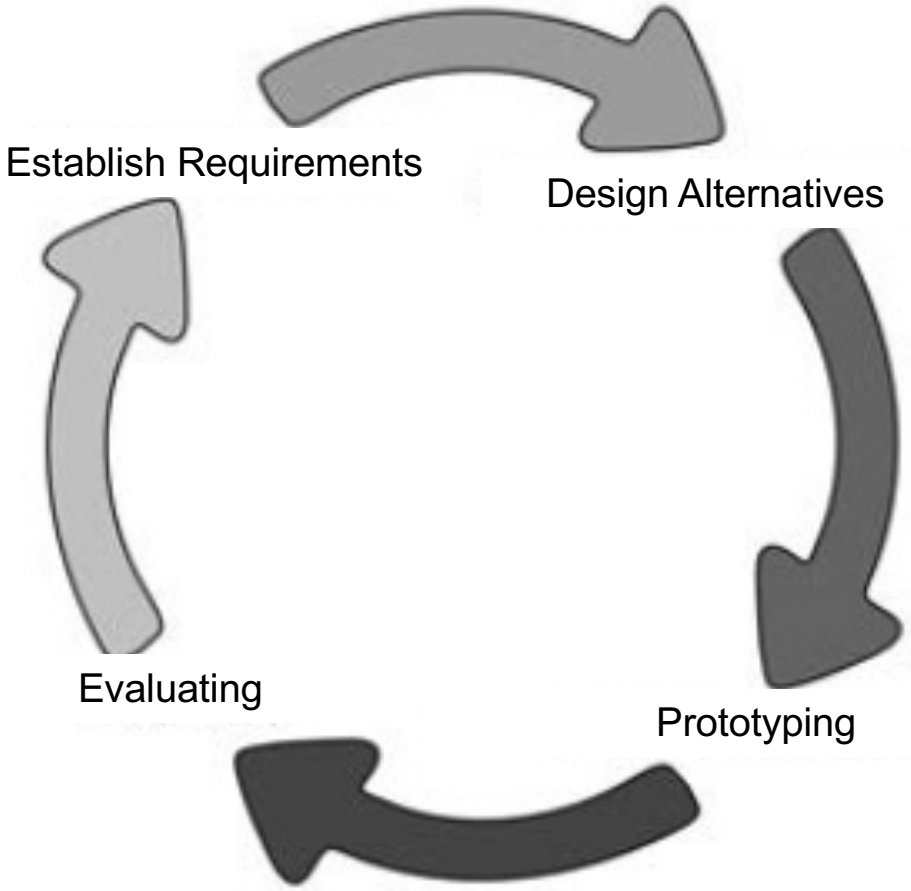
Four Core Activities

Textbook:

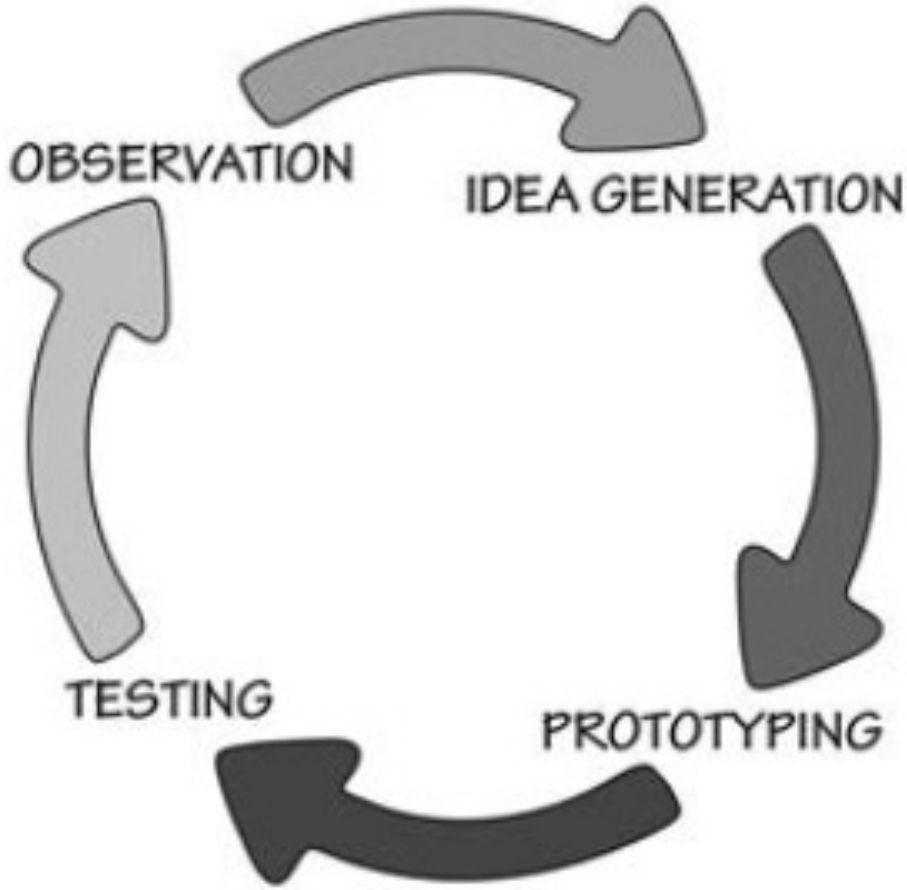
1. Establish requirements
2. Designing alternatives
3. Prototyping
4. Evaluating

Norman, DOET:

1. Observing (research)
2. Generating Ideas
3. Prototyping
4. Testing



Sharp et al (2019), Ch 2



Donald A. Norman, The Design of Everyday Things, New York : Basic Books, 2013.

HCD Principle: Early Focus on Users

- the focus on users comes in the early, not late, iterations
- the persona technique is often used as a was to characterize users (via the creation of archetypes)
- in characterizing users, many different frameworks:
  - cognitive, behavioral, attitudinal, affective, social
- there should be a focus on users engaged in activities in their environments (situated action)
  - there are many different approaches to capturing this data: scientific observation, anthropological, sociological
- there should be a focus on *involving* users in the design process (e.g., during idea generation)

HCD Principle: Empirical Decisions

- before discussing empirical decision making, we first need to discuss prototyping

https://www.interaction-design.org/literature/topics/prototyping

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.

> *"They slow us down to speed us up. By taking the time to prototype our ideas, we avoid costly mistakes such as becoming too complex too early and sticking with a weak idea for too long."*
>
> *— Tim Brown, CEO & President of IDEO*

Video, Alan Dix

- embedded in https://www.interaction-design.org/literature/topics/prototyping

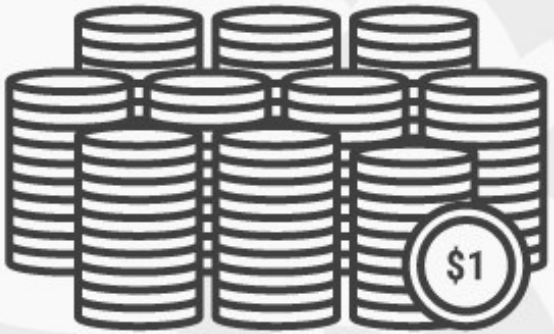
The 1-10-100 Rule: How Early Prototyping Prevents Costly Errors in Advance

Prevention Cost: $1

E.g., evaluating usability through early paper prototypes

Correction Cost: $10

E.g., fixing usability errors discovered through usability tests with hi-fidelity prototypes



Failure Cost: $100

E.g., fixing the code and lost revenue from an error in the final product

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Motivations for Prototyping, I

- to establish a foundation from which to ideate towards improvements
- to employ a concrete form for ideas, provides a basis for communication
- to provide a sense of ownership to all concerned stakeholders—therefore fostering emotional investment in the product's ultimate success.
- to provide a basis for discussion with stakeholders – provides a picture of the potential benefits, risks and costs associated with where a prototype might lead
- to provision for adaptability – can make changes early (avoiding commitment to a single, falsely-ideal version, getting stuck on initial idea)
- to improve time-to-deployment, by minimizing the number of errors to correct

Motivations for Prototyping, II

- to have something to show users, so they can give you their feedback to help pinpoint which elements/variants work best and whether an overhaul is required
- to have something that provides a basis for experimentation (can observe the prototype in use, gain insights and gather feedback data, can spot unforeseen issues concerning accessibility and usability)

Wireframe

- a wireframe is a schematic or blueprint of something
- at one time, wireframe implied web design, but now used more generally for a schematic representation
- the schematic representation consists of the components and the layout

Low-Fidelity Prototypes

- quick and simple, outlines the interactive system's flow
- not visually refined (as compared to high-fidelity prototypes)
- Examples:
  - sketches (pen and pencil drawings)
  - paper prototypes (using office or craft supplies)
  - click-through prototypes (e.g., Sprint 07 activity)
    - the prototype is not "natively" responsive

Figure 1—A sketched prototype

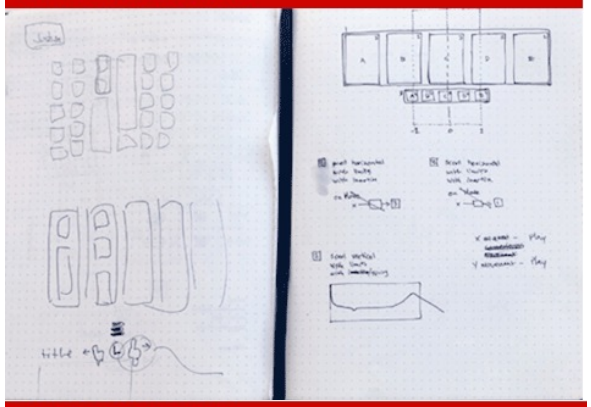
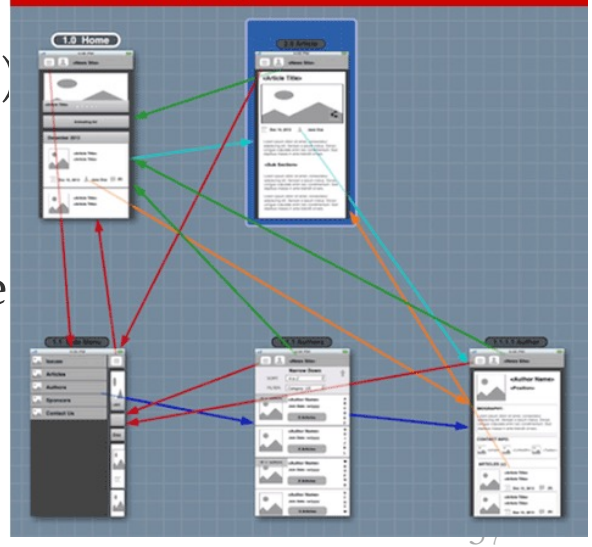


Figure 2—Paper prototyping

Figure 3—A clickable prototype



High-Fidelity Prototypes

- more advanced than their low-fidelity counterparts
- aesthetically elaborated
- their function is closer to that of the final product
- Examples:
  - interactive prototypes
    - flows are more elaborated, but visual elements are still medium-fidelity
  - digital prototypes
    - aesthetically rich, typography, colour palette
    - animations and other effects may be included
  - coded prototypes
    - coded in html/css, natively responsive

HCD Principle: Empirical Decisions

- during the design process, design concepts can be expressed via one or more prototypes
  - a prototype establishes a foundation from which to ideate towards improvements (several possible routes may be possible)
  - different prototypes express design concept variants (need to choose among them)
- thus, prototypes represent decision to be made
- these decisions will depend upon users
  - their preferences, their ability to perform tasks and accomplish goals, aspects of their user experience, reactions, etc
- what is the source of information for these decisions?
  - the design team could presume to know, to guess, or to anticipate the user's performance
  - the design team could create occasions to collect the relevant data (user provides feedback or user's behaviour is observed)
- the idea is to base decisions on 'authentic' information rather than presupposed information

HCD Principle: Empirical Decisions

- notice this principle contrasts very strongly with Saffer's (2010) identification of "Genius Design" [Box 2.1]

- "…**genius design** …relies largely on the experience and creative flair of a designer. Jim Leftwich, an experienced interaction designer interviewed by Dan Saffer (2010, pp. 44–45), prefers the term **rapid expert design**. In this approach, the users' role is to validate ideas generated by the designer, and users are not involved during the design process itself. Dan Saffer points out that this is not necessarily by choice, but it may be because of limited or no resources for user involvement."

Connect to Module 04 activity

- the module activity will be used to establish these key concepts in prototyping
  - frame
  - components
  - flows, actions