Software Engineering

LECTURE: TRADITIONAL MODELS

Traditional Models

- **Waterfall**
- **Incremental Vs Iterative**
- **Prototyping**
- **Spiral**
- **RAD**

Discussion

What does iterative and incremental development mean to you?

Discuss

Definitions

- **Iterate**
  - to utter or do repeatedly
    - **iteration *n*. – iterative *adj***
- **Increment *n***
  - 1. amount of increase
  - 2. a becoming greater or larger; increase
    - **incremental *adj***

How does all this apply to a software development project??

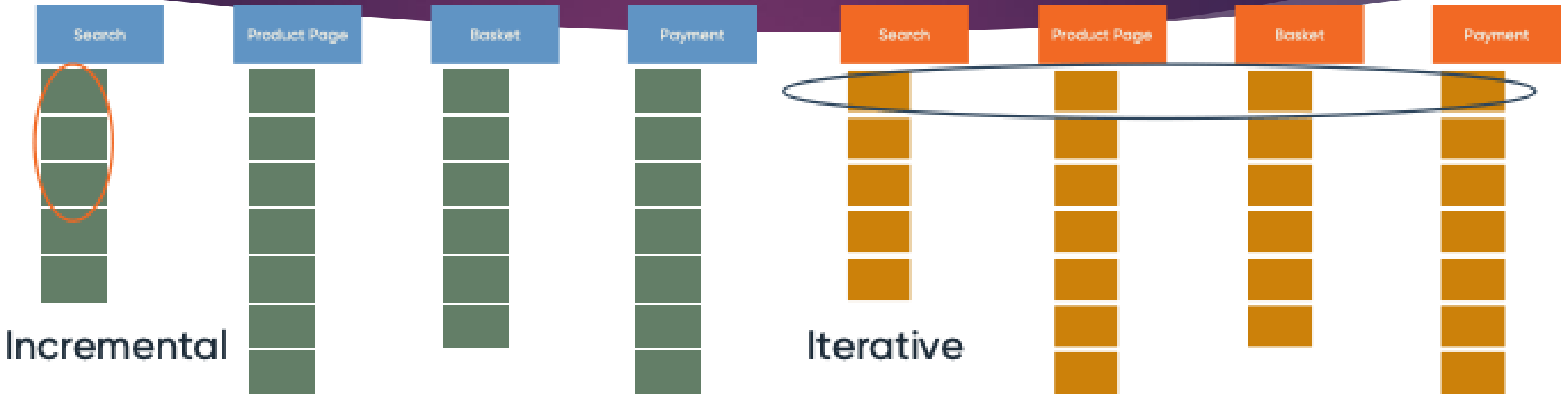
How does a project team work iteratively while incrementally developing a product?

What Is Incremental Development?

- In incremental development,
  - You have all the requirements
  - you design the complete product first. You only leave out details that you can safely decide later.
  - Then you slice it up into chunks and build each separately.
  - When you finish a chunk, aka module, you integrate it with previously completed parts, so they work as a whole.

What is Iterative Development

- Iterative development is a lot like inventing: discovering what and how you need as you go.
- You start with a fair idea of what you want the product to accomplish, and you use a process of successive approximation to design and build it.
- You begin by designing, building, and testing the tiniest version of what you have in mind. When you're happy, you show it and collect feedback from everybody with a stake in the product.
- If what you created was well received, you keep it and expand on it in the next iteration. If what you created got the thumbs down, you discard it and go back to the drawing board.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Iterative

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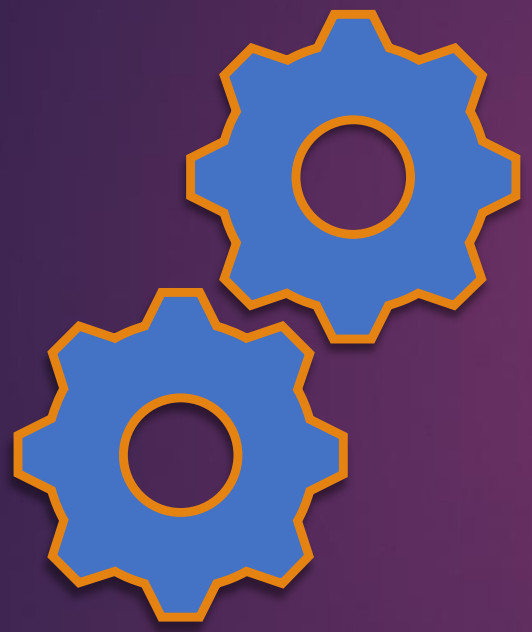
Incremental



SOFTWARE PROTOTYPING

Software prototyping

- A prototype is an initial version of a system used to demonstrate concepts and try out design options.
- A prototype can be used in:
  - The requirements engineering process to help with requirements elicitation and validation;
  - In design processes to explore options and develop a UI design;
  - In the testing process to run back-to-back tests.

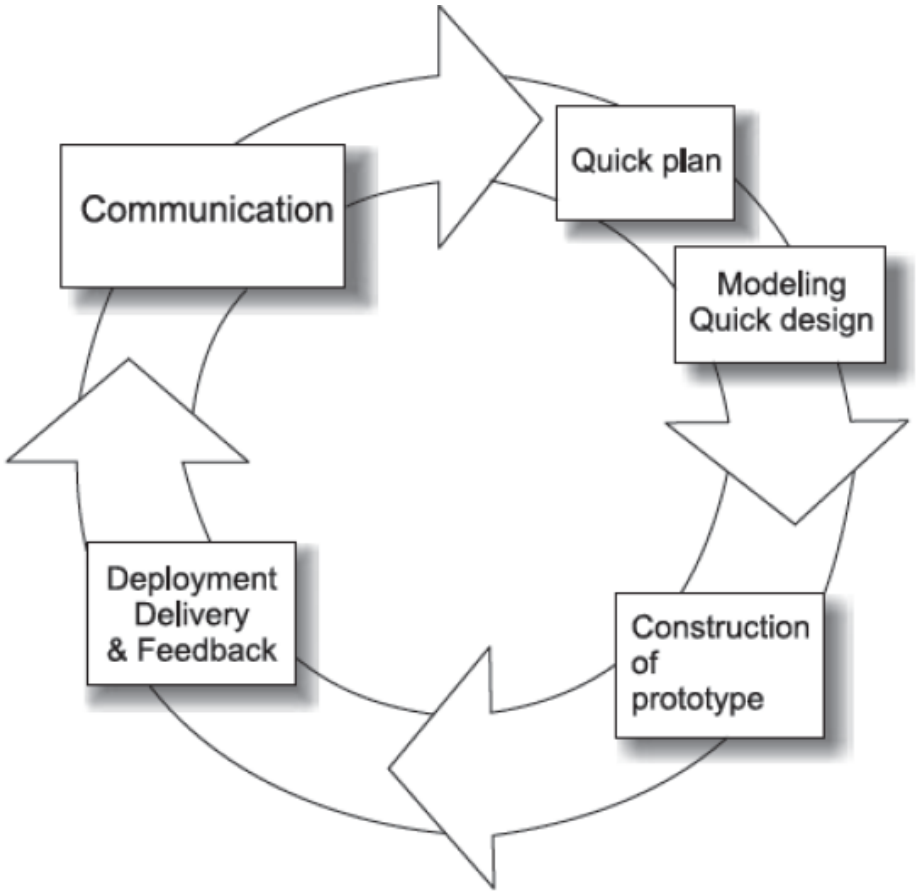
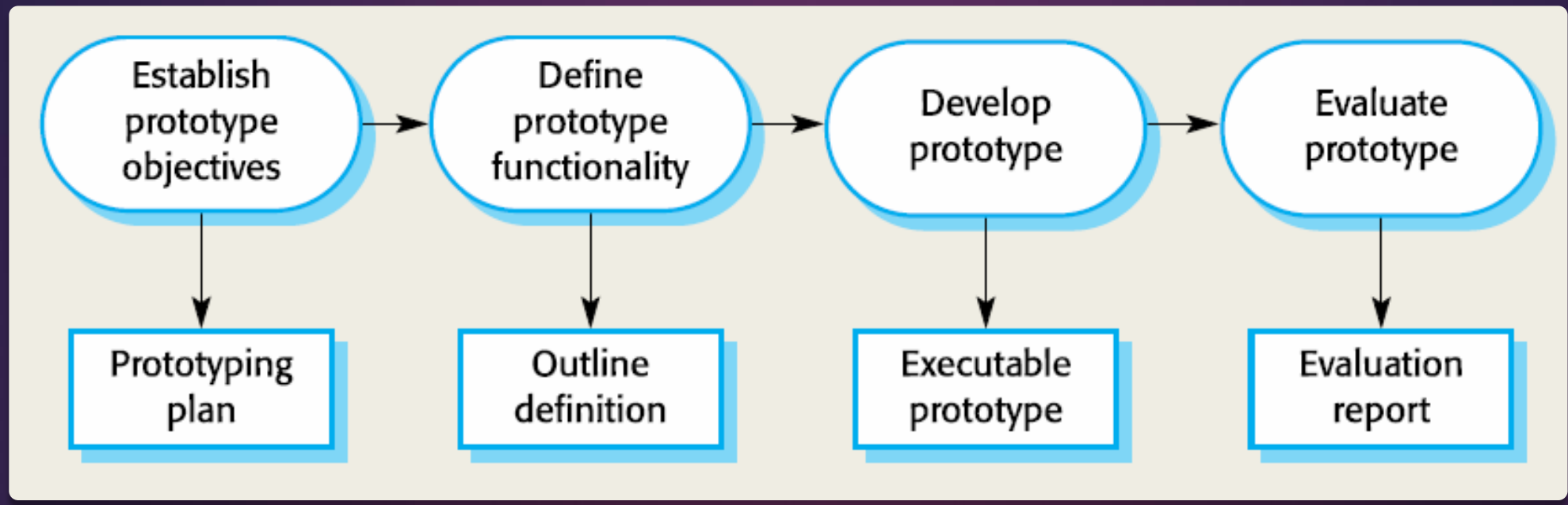


FIGURE 2.4 Prototyping Model

Prototype Model

- Bottom-up approach
- Problem domain or requirements not well defined or understood.
- Create small implementations of requirements that are least understood.
- Requirements are “explored” before the product is fully developed.
- Developers gain experience when developing the “real” product.



Prototype Development Process Model

Benefits of prototyping

Improved system usability.

A closer match to users' real needs.

Improved design quality.

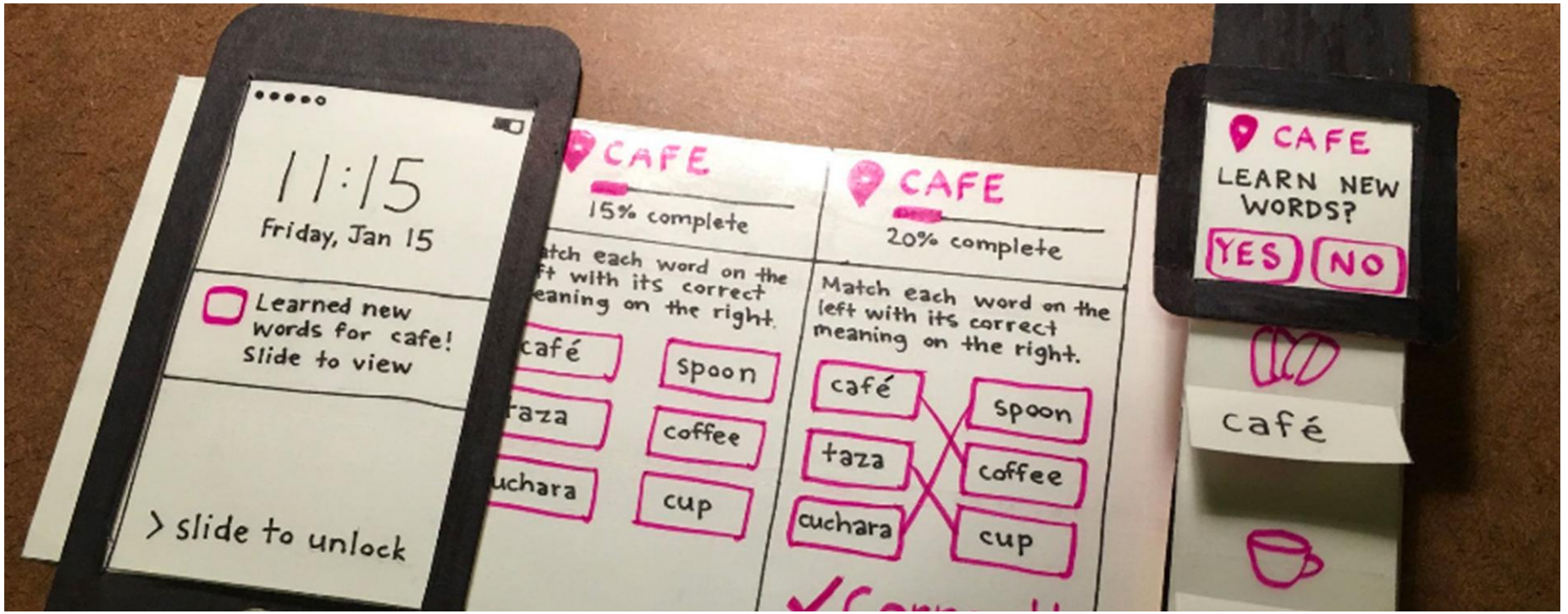
Improved maintainability.

Reduced development effort.

Prototype development

- May be based on rapid prototyping languages or tools
- May involve leaving out functionality
  - Prototype should focus on areas of the product that are not well understood;
  - Error checking and recovery may not be included in the prototype;
  - Focus on functional rather than non functional requirements such as reliability and security

Examples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Friday, Jan 15
Learned new words for cafe! Slide to view
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CAFE
15% complete
café
taza
cuchara
Spoon
coffee
cup
CAFE
20% complete
Match each word on the left with its correct meaning on the right.
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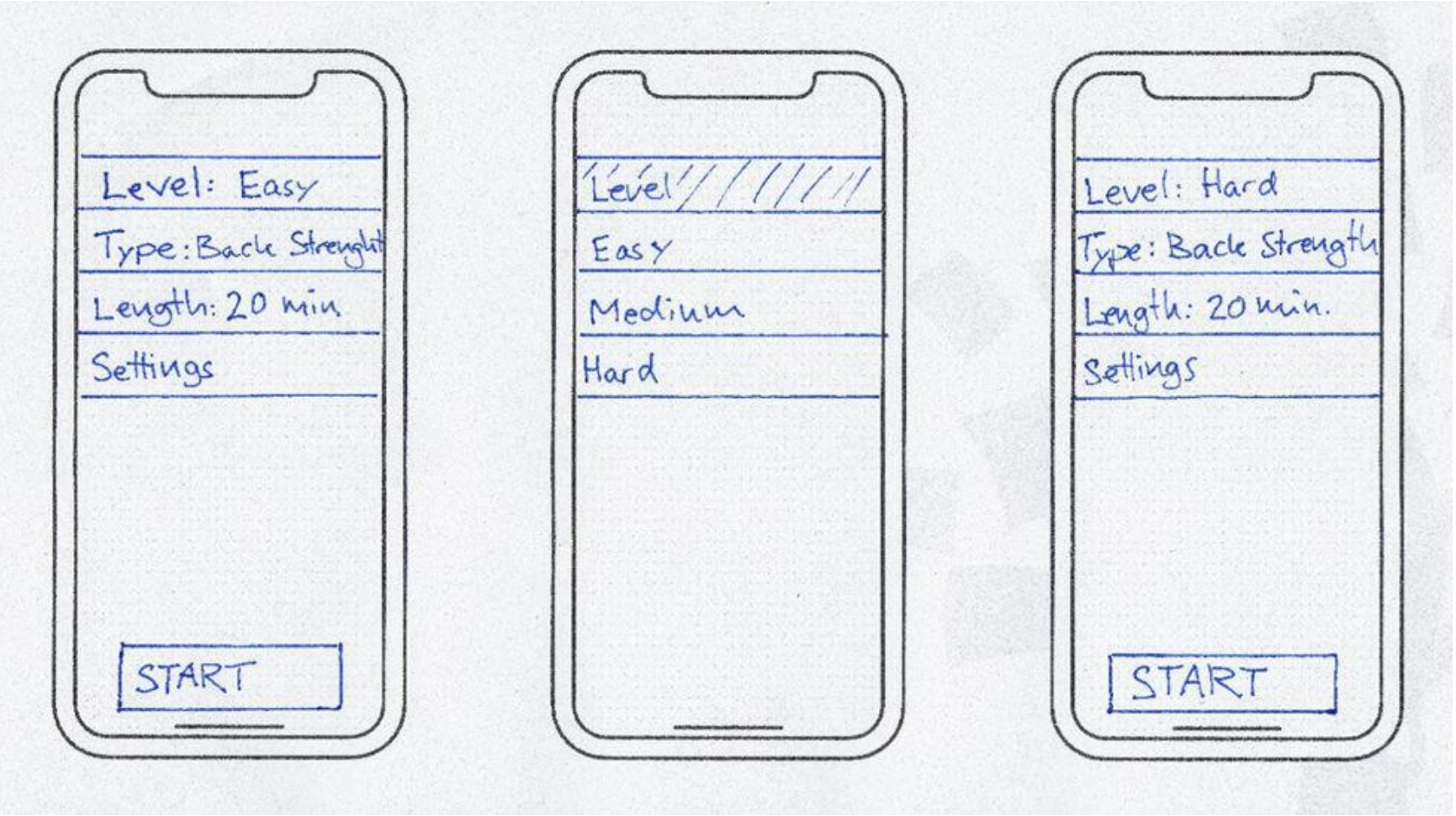
taza
cuchara
spoon
coffee
cup
CAFE
LEARN NEW WORDS?
YES
NO
café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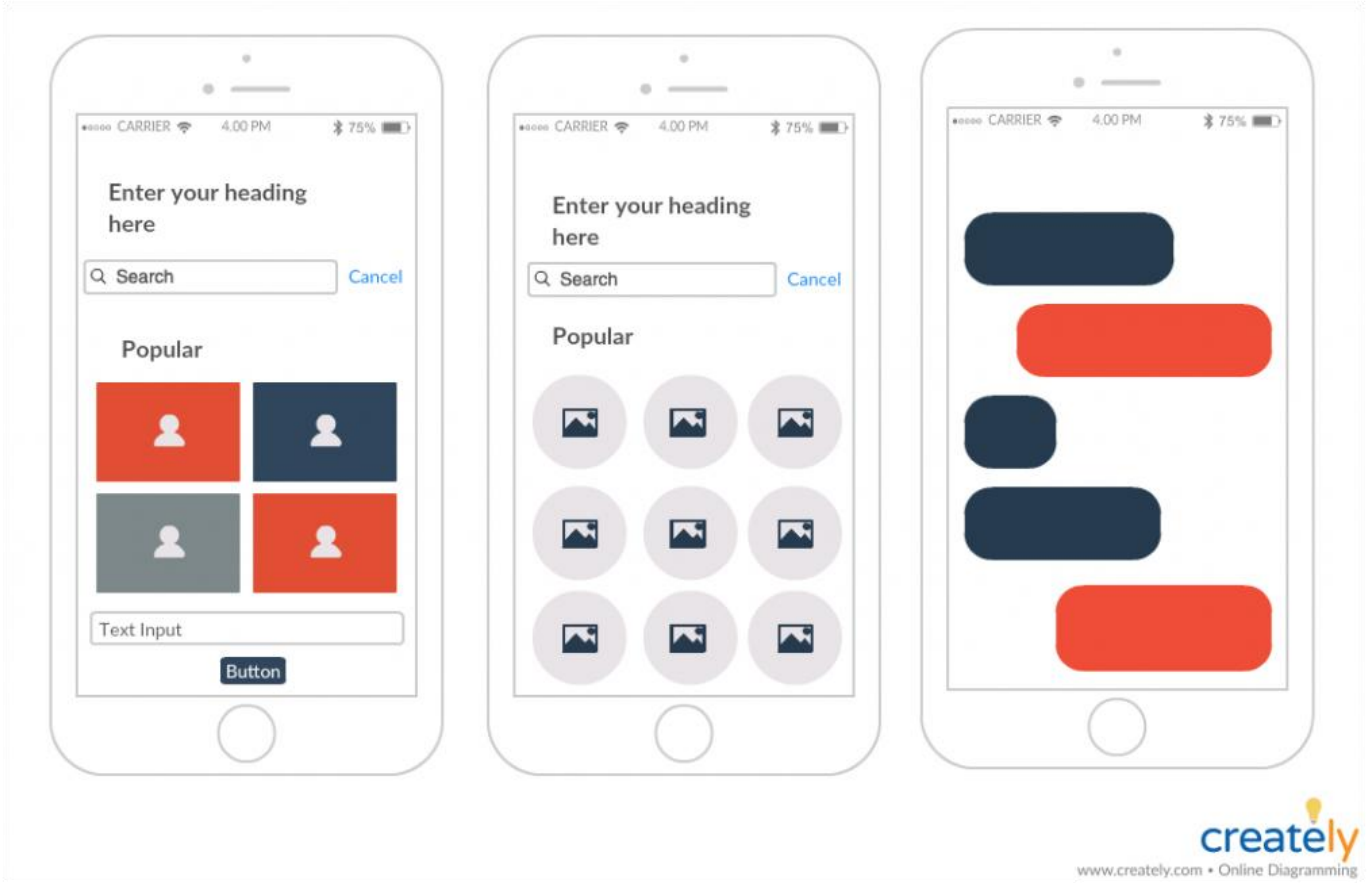
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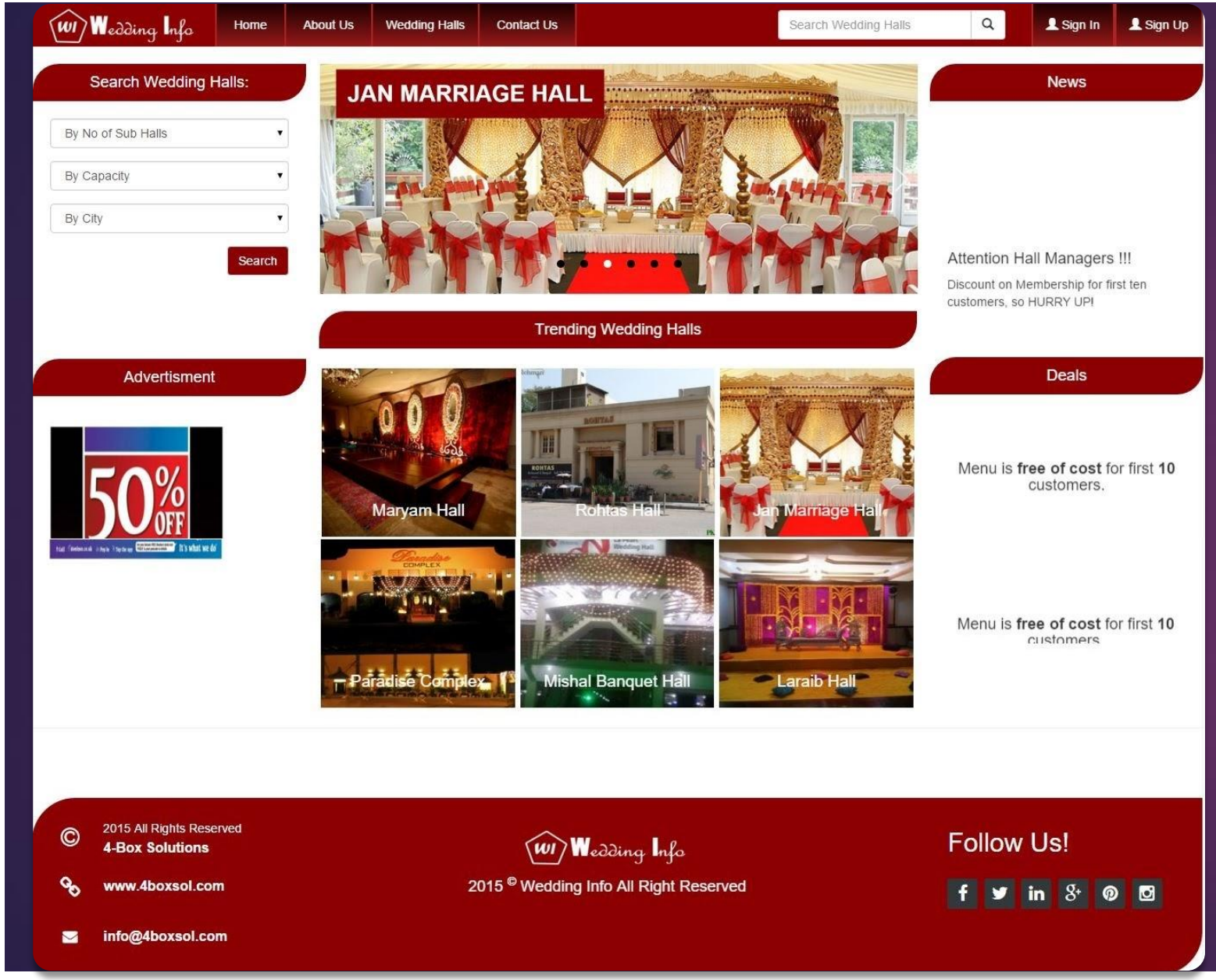

My own prototypes

Maryam Hall - *03331234567*

Book Now !

Sub Hall Name	M One	M two
Capacity	300	400
Parking	✔	✔
Catering	✔	✖
Electricity Backup	✔	✔
Lift Available	✖	✖
Sound System	✔	✖
Stage Designing	✖	✖
Photo Studio	✔	✔
Bridal Room	✔	✔
Air Conditioning System	✔	✔
Heating System	✔	✔
Price Per Event	Rs. 2000	Rs. 3000
Pictures and Videos	Pictures/Videos	Pictures/Videos

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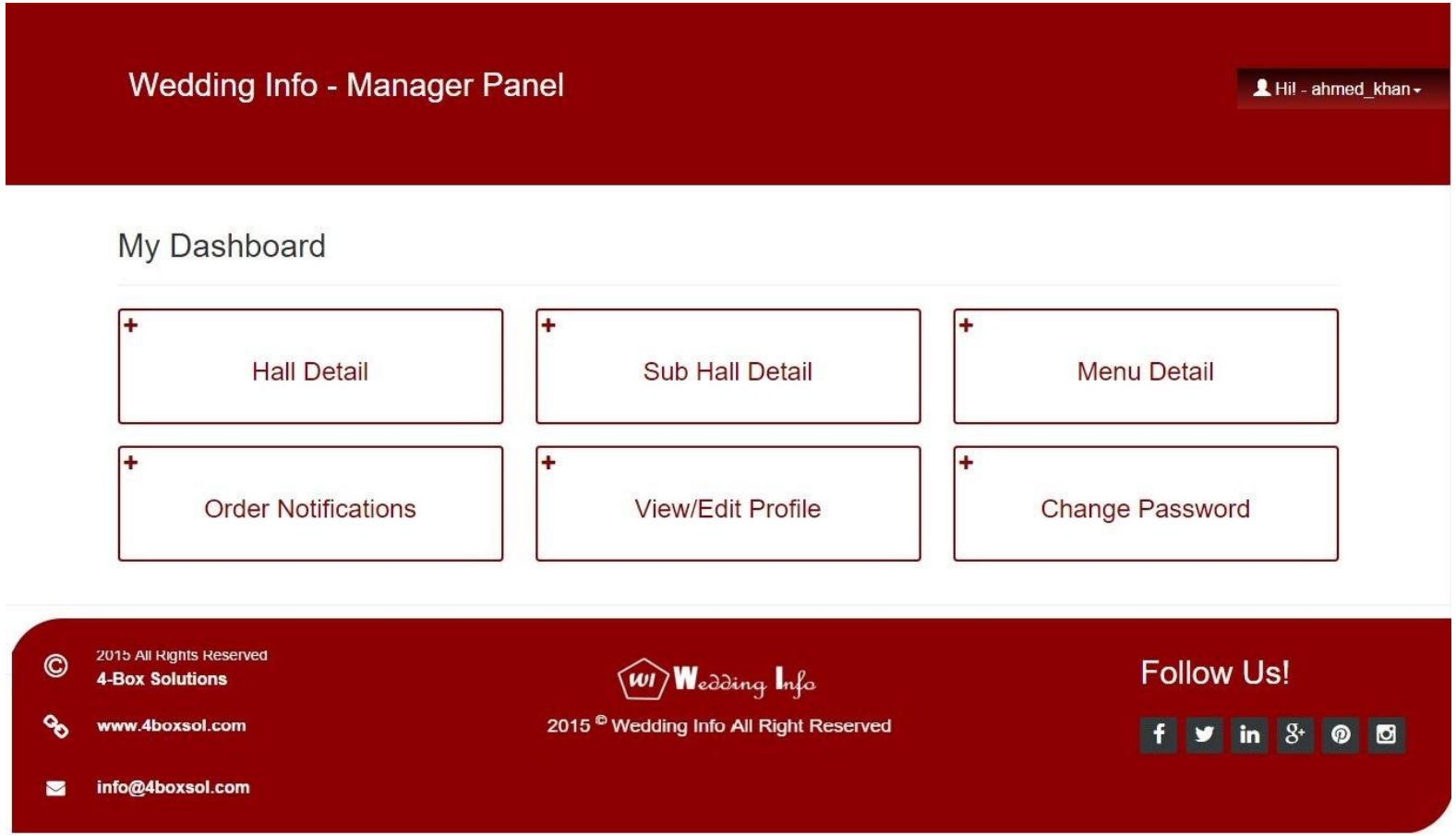
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Hi! - ahmed_khan
My Dashboard
Hall Detail
Sub Hall Detail
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Throw away prototypes

- Prototypes should be discarded after development as they are not a good basis for a production system:
  - It may be impossible to tune the system to meet non functional requirements;
  - Prototypes are normally undocumented;
  - The prototype structure is usually degraded through rapid change;
  - The prototype probably will not meet normal organizational quality standards.

Controlling changes with prototyping

- **Cosmetic (about 35% of changes)**

  These are simply changes to the layout of the screen. They are:

  (*a*) Implemented.

  (*b*) Recorded.

- **Local (about 60% of changes)**

  These involve changes to the way the screen is processed but do not affect other parts of the system. They are:

  (*a*) Implemented.

  (*b*) Recorded.

  (*c*) Backed-up so that they can be removed at a later stage is necessary.

  (*d*) Inspected retrospectively.

- **Global (about 5% of changes)**

  These are changes that affect more than one part of the processing. All changes here have to be the subject of a design review before they can be implemented.

Advantages

- Client involvement and early feedback.
- Improves requirements and specifications.
- There is scope of refinement, it means new requirements can be easily accommodated.
- It is ideal for online system.
- It helps developers and users both understand the system better.
- Integration requirements are very well understood and deployment channels are decided at a very early stage.
- Reduces risk of developing the “wrong” product.

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Disadvantages

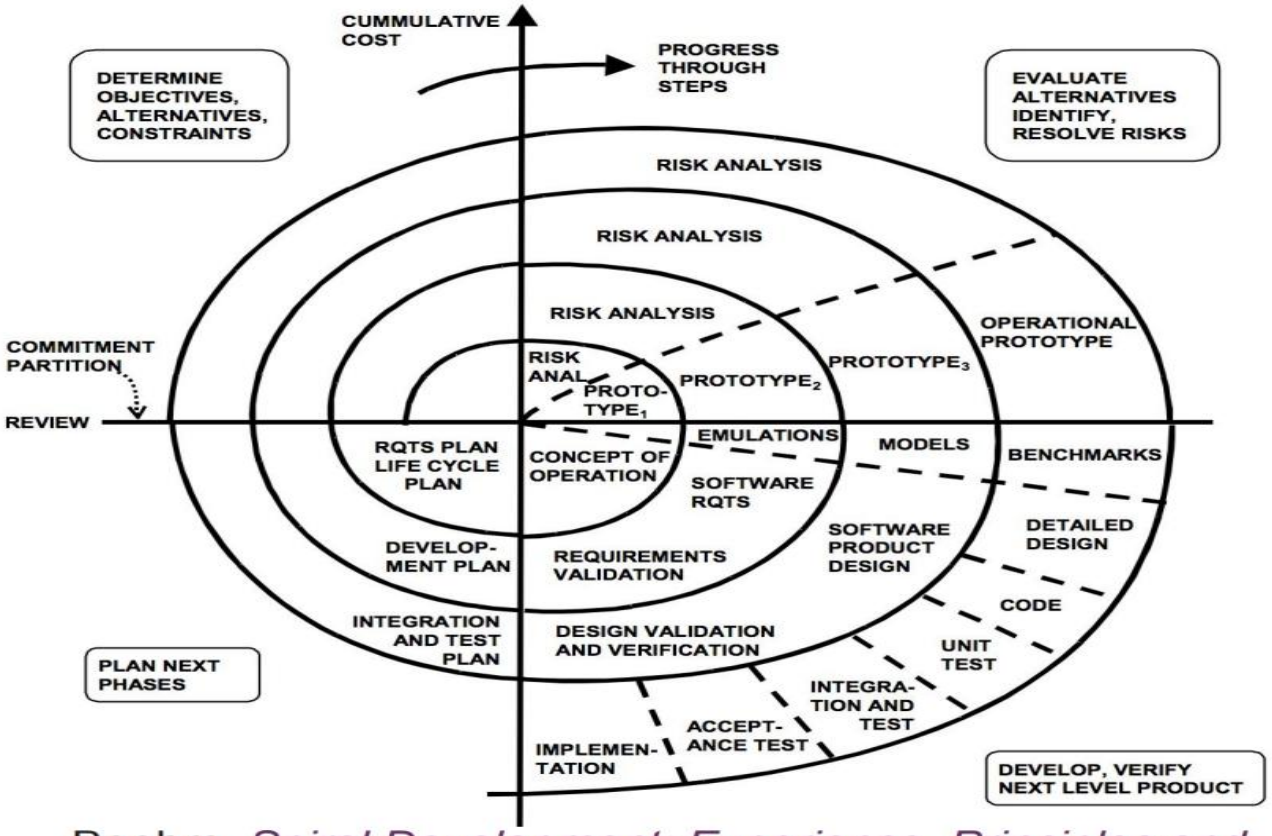
- This model is costly.
- It has poor documentation because of continuously changing customer requirements.
- There may be too much variation in requirements.
- Customers sometimes demand the actual product to be delivered soon after seeing an early prototype.
- Customers may not be satisfied or interested in the product after seeing the initial prototype.
- Focus may be too narrow (no thinking outside the box)

When to use prototyping

- Prototype model should be used when the desired system needs to have a lot of interaction with the end users.
- Typically, online systems, web interfaces have a very high amount of interaction with end users, are best suited for Prototype model. It might take a while for a system to be built that allows ease of use and needs minimal training for the end user.
- Prototyping ensures that the end users constantly work with the system and provide a feedback which is incorporated in the prototype to result in a useable system. They are excellent for designing good human computer interface systems.

SPIRAL MODEL

- Incremental/iterative model (combines the waterfall model and prototyping).
- Iterations called spirals.
- Activity centered:
  - Planning
  - Risk analysis
  - Engineering
  - Evaluation



Boehm, *Spiral Development: Experience, Principles,and Refinements*, CMU/SEI-2000-SR-008

Boehm's spiral model

Process is represented as a spiral rather than as a sequence of activities with backtracking.

Each loop in the spiral represents a phase in the process .

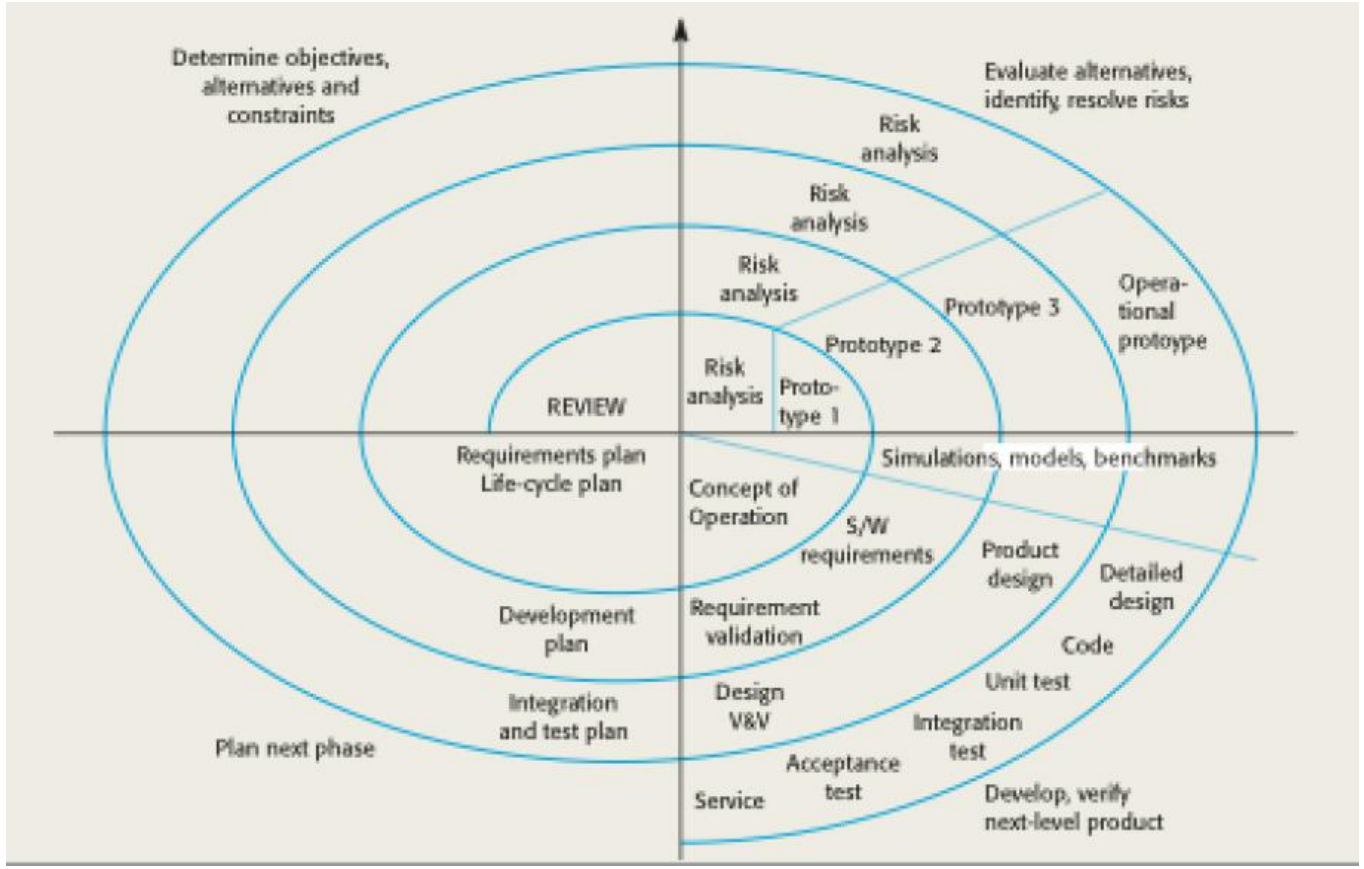
No fixed phases such as specification or design loops in the spiral are chosen depending on what is required.

Risks are explicitly assessed and resolved throughout the process.

Spiral model sectors

- Objective setting
  - *Specific objectives for the phase are identified.*
- Risk assessment and reduction
  - *Risks are assessed and activities put in place to reduce the key risks.*
- Development and validation
  - *A development model for the system is chosen which can be any of the generic models.*
- Planning
  - *The project is reviewed and the next phase of the spiral is planned.*

Boehm's spiral model of the software process



Spiral model usage

- Spiral model has been very influential in helping people think about iteration in software processes and introducing the risk driven approach to development.
- In practice, however, the model is rarely used:
  - Can be a costly model to use
  - Risk analysis requires highly specific expertise
  - Doesn't work well for smaller projects.

When to use Spiral Model

- When costs and risk evaluation is important
- For medium to high risk projects
- Long term project commitment unwise because of potential changes to economic priorities
- Users are unsure of their needs
- Requirements are complex
- New product line
- Significant changes are expected (research and exploration)

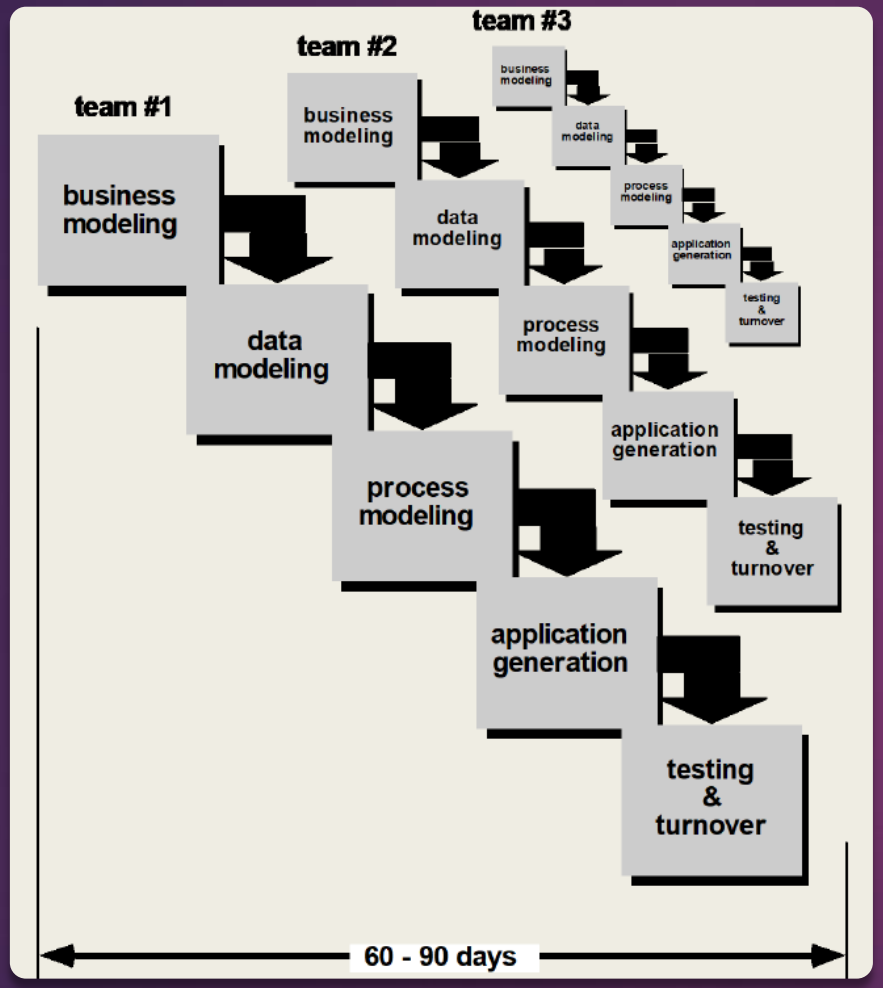
Benefits & drawbacks:

Benefits	Drawbacks
Allows the use prototyping	Management is more complex
Client can see the system early on	Should not be used for small projects
Changes in requirements can be made easily	This method requires a lot of documentation

Rapid Application Development (RAD)

Benefits of RAD

- Rapid application development (RAD) is a linear sequential S/W development process model that emphasizes on extremely short development cycle.
- high speed RAD is achieved by using a component based project construction approach.
- If requirements are well understood and project scope is constrained (i.e. goals/ are fixed / freezed)
  - the RAD enables a development team to create a "fully functional system" within very short time (e.g. 60 - 90 days).


team #1
team #2
team #3
business modeling
data modeling
process modeling
application generation
testing & turnover
60 - 90 days

RAD MODEL

RAD Phases

- **1. Business Modeling (Business Processes)**
  - What information is generated?
  - Who generates it?
  - Where does the information go?
  - Who processes it?
- **2. Data Modeling**
  - The information flow is refined into a set of data objects that are needed to support the business
  - Characteristics
    - of each object are identified and
  - Relationships between these objects are defined

RAD Phases (2)

- **3. Process modeling**
  - The data object defined in the data modeling phase are transformed to achieve the information flow necessary to implement a business function (i e transformation of input object to output object defines flow of information in a process/function)
  - Such processing descriptions are created for adding, modifying, deleting, or retrieving a data object
- **4. Application Generation**
  - RAD process works to re use existing components (when possible)
  - Create re useable components (when necessary) In all cases automated tools are used to facilitate construction of S/W

RAD Phases (3)

- **5. Testing and Turnover**

  New components must be tested and all interfaces must be fully exercised.

- **<u>Drawbacks</u>**
  - For large scalable projects RAD requires sufficient human resources to create right number of RAD teams
  - RAD requires developers customers committed to complete a system in a short time frame, other wise if commitment is lacking from either side, RAD projects will fail


Thank
You