Introduction in Design and Research Processes (DRP):
Interactive Product Development Life-Cycle Models

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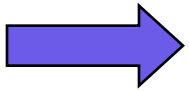
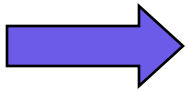
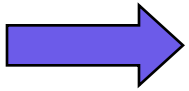
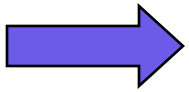
Four Essential Phases of any ProductDevelopment Process

- **Requirements** Elicitation, Analysis, Specification
- **Design**
- **Prototyping**
- **Test/Evaluation**

Each Phase has an "Output"

Phase	Output
Requirements analysis	Product/user Requirements Specification, Use Cases
Design	Design Document, Design Sketches
Prototyping	Prototype
Evaluation	Evaluation Report, Change Requests

Models

- Different projects may interpret these phases differently.
- Each particular style is called a

"Prodcut Life-Cycle Model"

"Life-Cycle" Models

- Single-Version Models
- Incremental Models
  - Single-Version with Prototyping
- Iterative Models

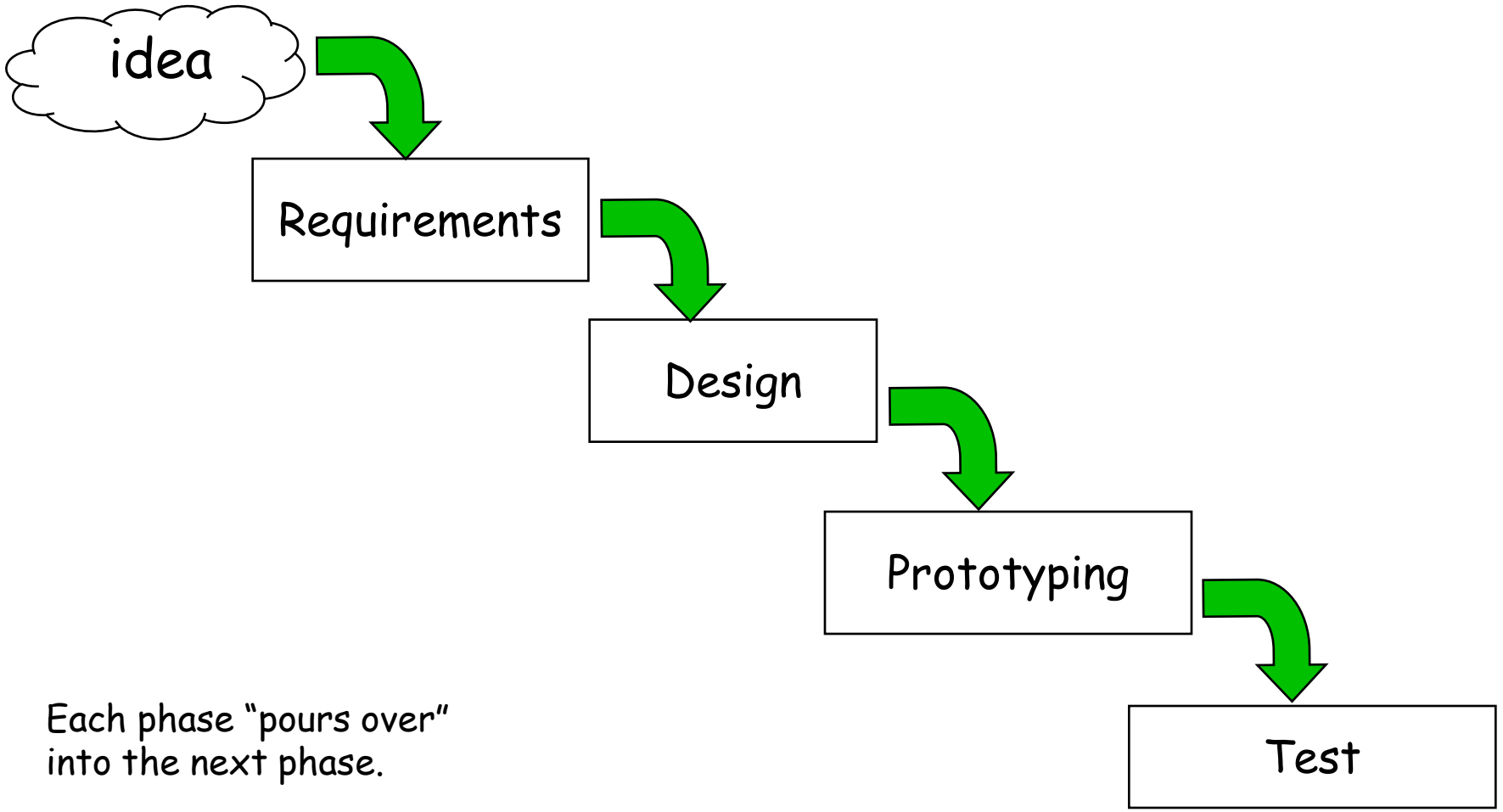
"Life-Cycle" Models (1)

- Single-Version Models
  - Big-Bang Model
  - Waterfall Model
    - Waterfall Model with "back flow"

Big-Bang Model

- Designer receives problem statement.
- Designer works in isolation for some extended time period.
- Designer delivers result.
- Designer hopes client is satisfied.

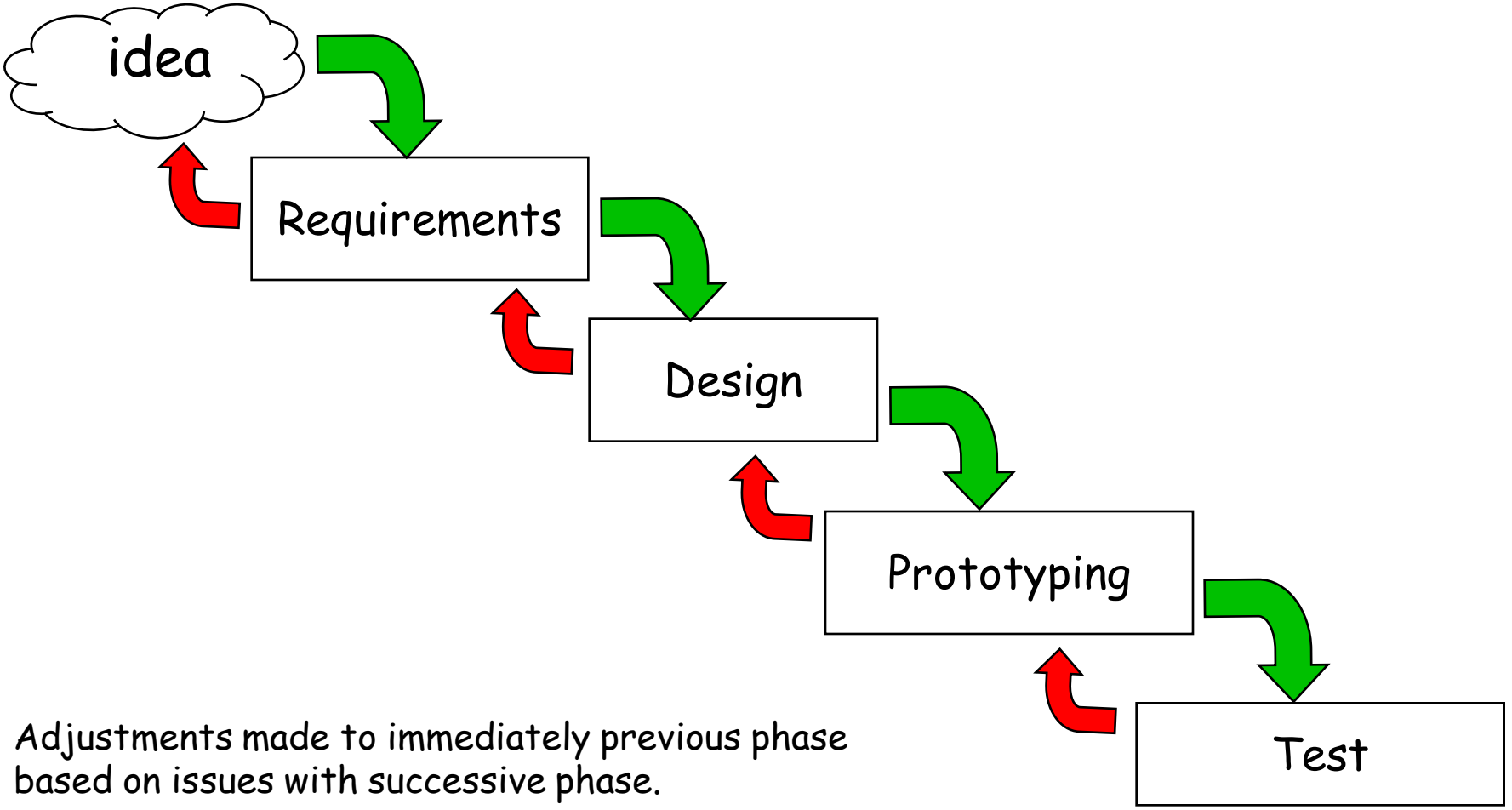
Waterfall Model



Each phase "pours over"
into the next phase.

Waterfall Model with Back Flow

(sometimes this is implied by "waterfall")



Adjustments made to immediately previous phase based on issues with successive phase.

Incremental vs. Iterative

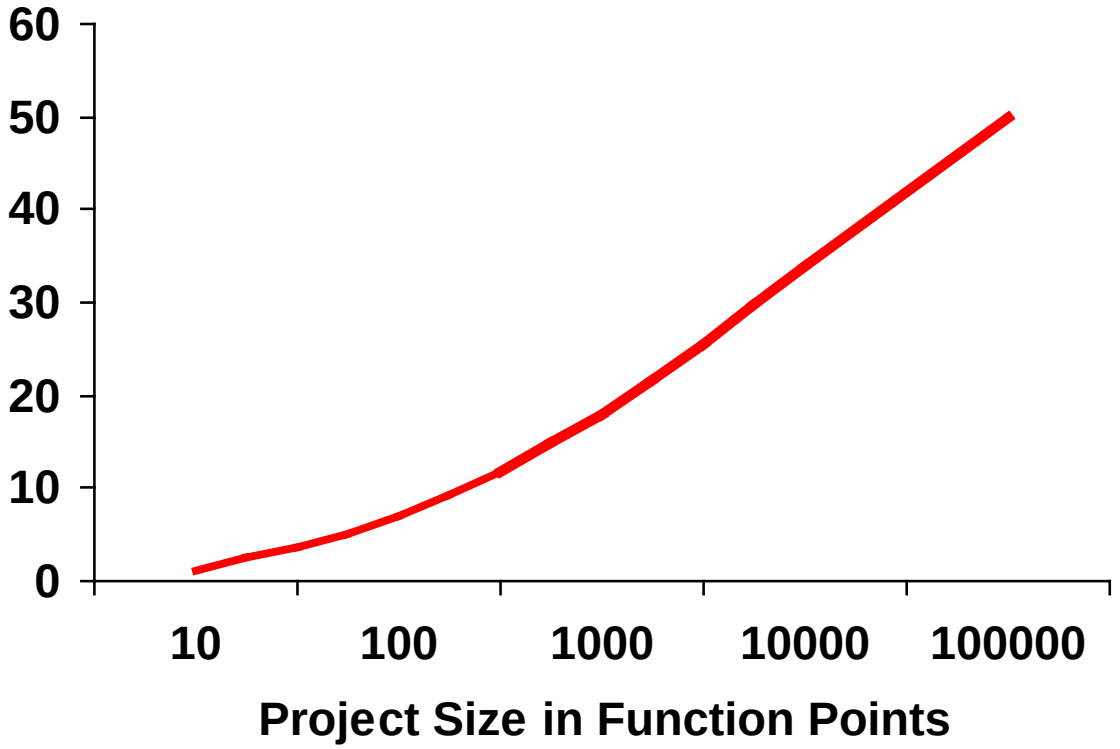
- These *sound* similar, and sometimes are equated.
- Subtle difference:
  - **Incremental**: *add to* the product at each phase
  - **Iterative**: *re-do* the product at each phase
- Some of the models could be used either way

Example: Building a House

- **Incremental**: Start with a modest house, keep adding rooms and upgrades to it.
- **Iterative**: On each iteration, the house is re-designed and built anew.
- Big Difference: One can live in the incremental house the entire time! One has to **move** to a new iterative house.

Why **Not** Waterfall?

1. Complete Requirements Not Known at Project Start



Source: Applied Software Measurement, Capers Jones, 1997. Based on 6,700 systems.

Function Point?

- A **function point** is a unit of complexity used in product cost estimation. Function points are based on number of user interactions, functions to be used, etc.
- **NOC** means number of components, also a measure of product complexity.

Why **Not** Waterfall?

2. Requirements are not stable/unchanging.

- The market changes—constantly.
- The technology changes.
- The goals of the stakeholders change.

Source: Craig Larman

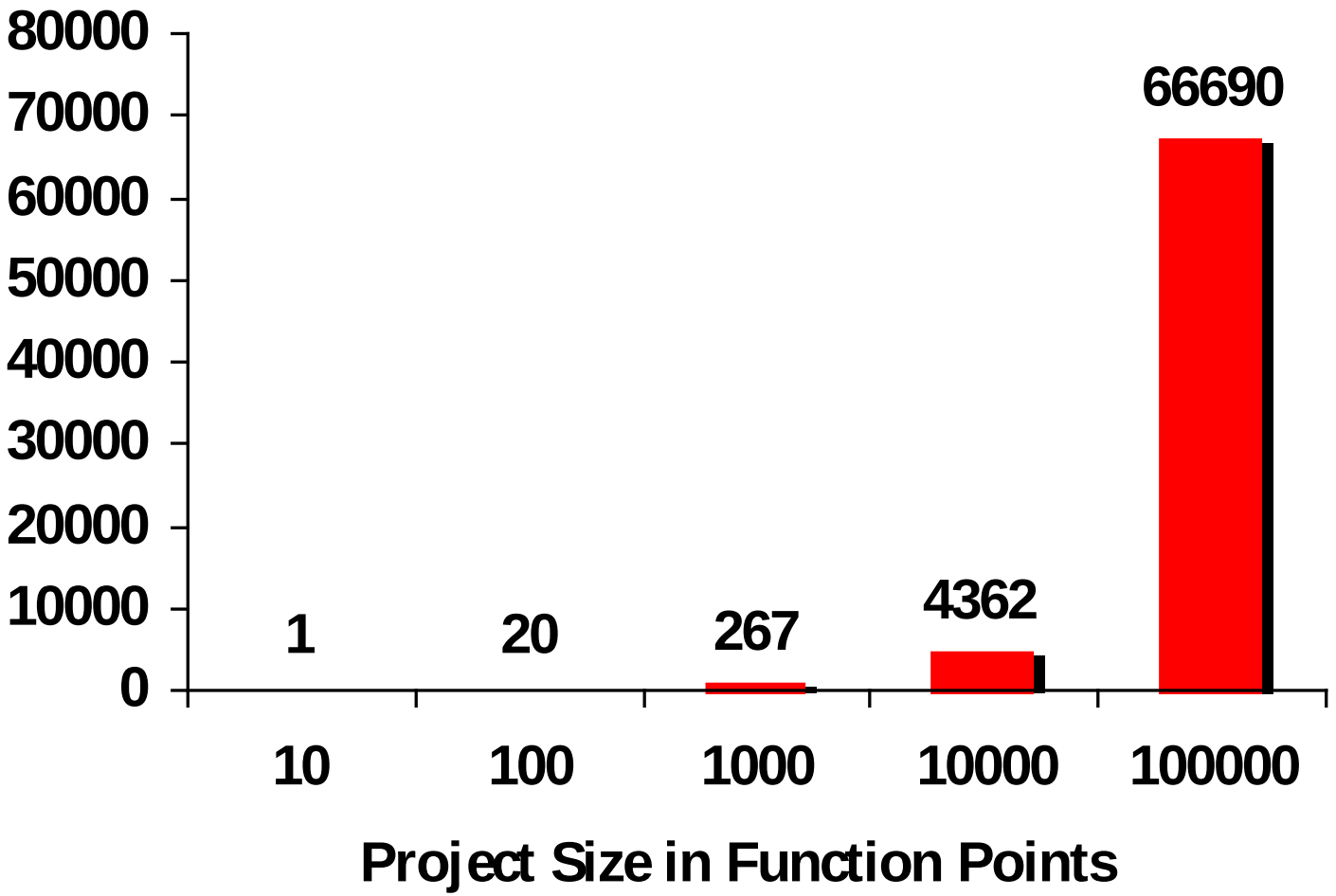
Why Not Waterfall?

3. The design may need to change during implementation.
   - Requirements are incomplete and changing.
   - Too many variables, unknowns, and novelties.
   - A complete specification must be as detailed as product itself.

Source: Craig Larman

Large vs. Small Steps:

Project Duration



Source: Craig Larman

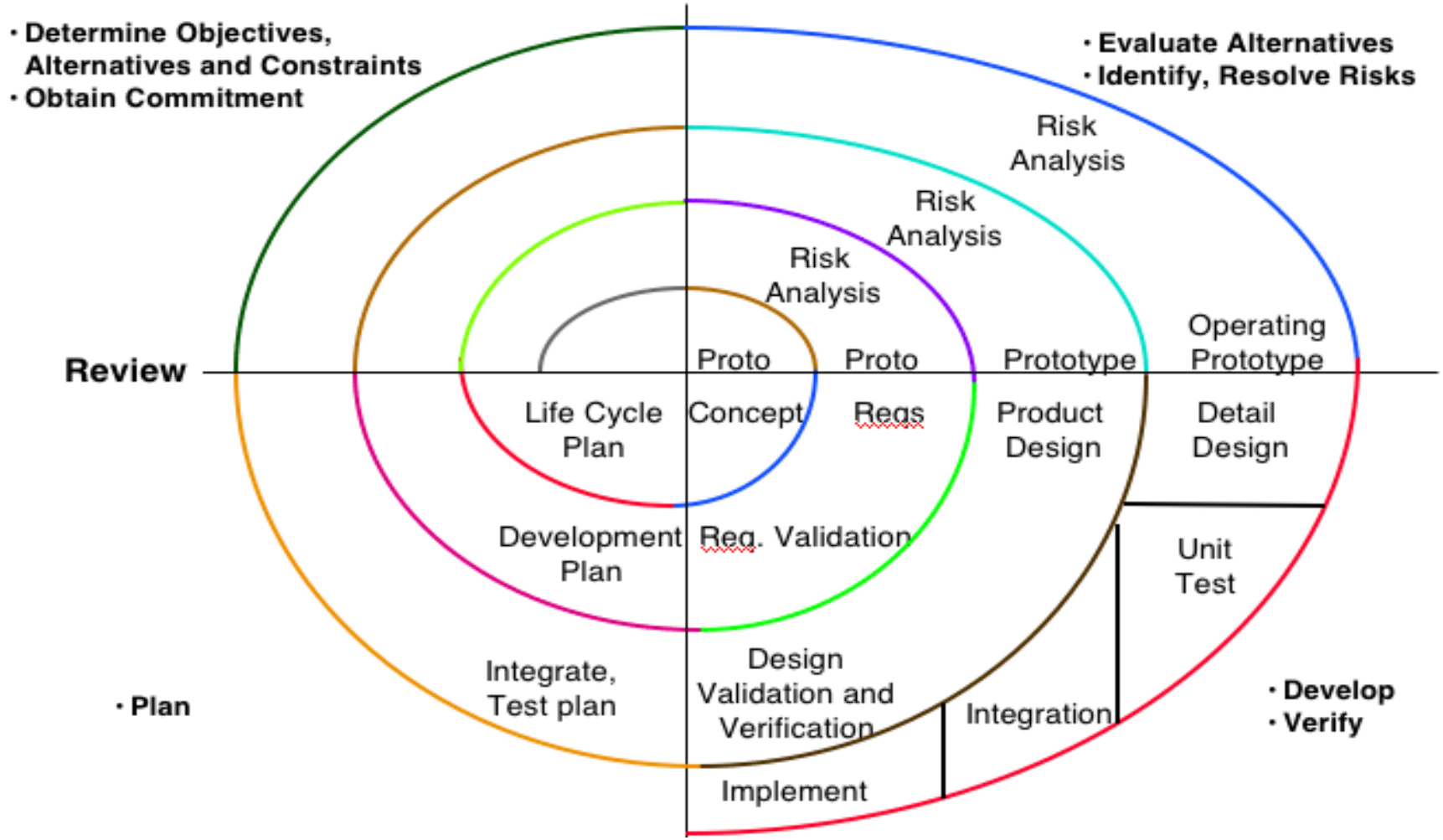
Boehm Spiral Model

(of which some other models are variants)

- An iterative model developed by Barry Boehm (1988)
- Iterates cycles of these project phases:
  1. Requirements definition
  2. Risk analysis
  3. Prototyping
  4. Simulate, benchmark
  5. Design, implement, test
  6. Plan next cycle (if any)

Prof. Barry Boehm

Boehm Spiral Model



Risk? What risk?

- One major area of risk is that the scope and difficulty of the task is not well understood at the outset.

- This is the so-called "wicked problem" phenomenon.

"Wicked Problems"

- Many software development projects have been characterized as "wicked problems", meaning:

  "problems that are fully understood only after they are solved the first time" (however poorly)

- Does not apply only to product design

Some Roots of Wickedness

- **Risk**: *A customer* not knowing exactly what he/she wants; changing expectations as project progresses.
- **Risk**: *Staff* who are inexperienced in the problem domain, or with the appropriate implementation techniques.

The Prototyping Principle

- "Plan to throw the first one away; you will anyhow."

  Fred Brooks, "The Mythical Man-Month: Essays on Software Engineering", Addison Wesley, 1975. Revised in 1995.

- another indication that building a large interactive product is wicked

Wicked Problems

- The presence of wickedness is what makes the **iterative / incremental** approaches most appealing.

- Methodologies and organizational techniques can help control the degree of wickedness.

Risk Classification

- **Performance risk**: The project might not meet requirements or otherwise be fit for use.
- **Cost risk**: The budget might get overrun.
- **Support risk**: The software might not be adaptable, maintainable, extendable
- **Schedule risk**: The project might be delivered too late.

Ways to Manage Risk

- Risk cannot be eliminated; it must be managed.
  - Do thorough **requirements** analysis before the design.
  - Use **tools** to track requirements, responsibilities, implementations, etc.
  - Build ***small*** **prototypes** to test and demonstrate concepts and assess the approach, prior to building full product.
  - Prototype **integration** as well as components.

Controlled-Iteration Model

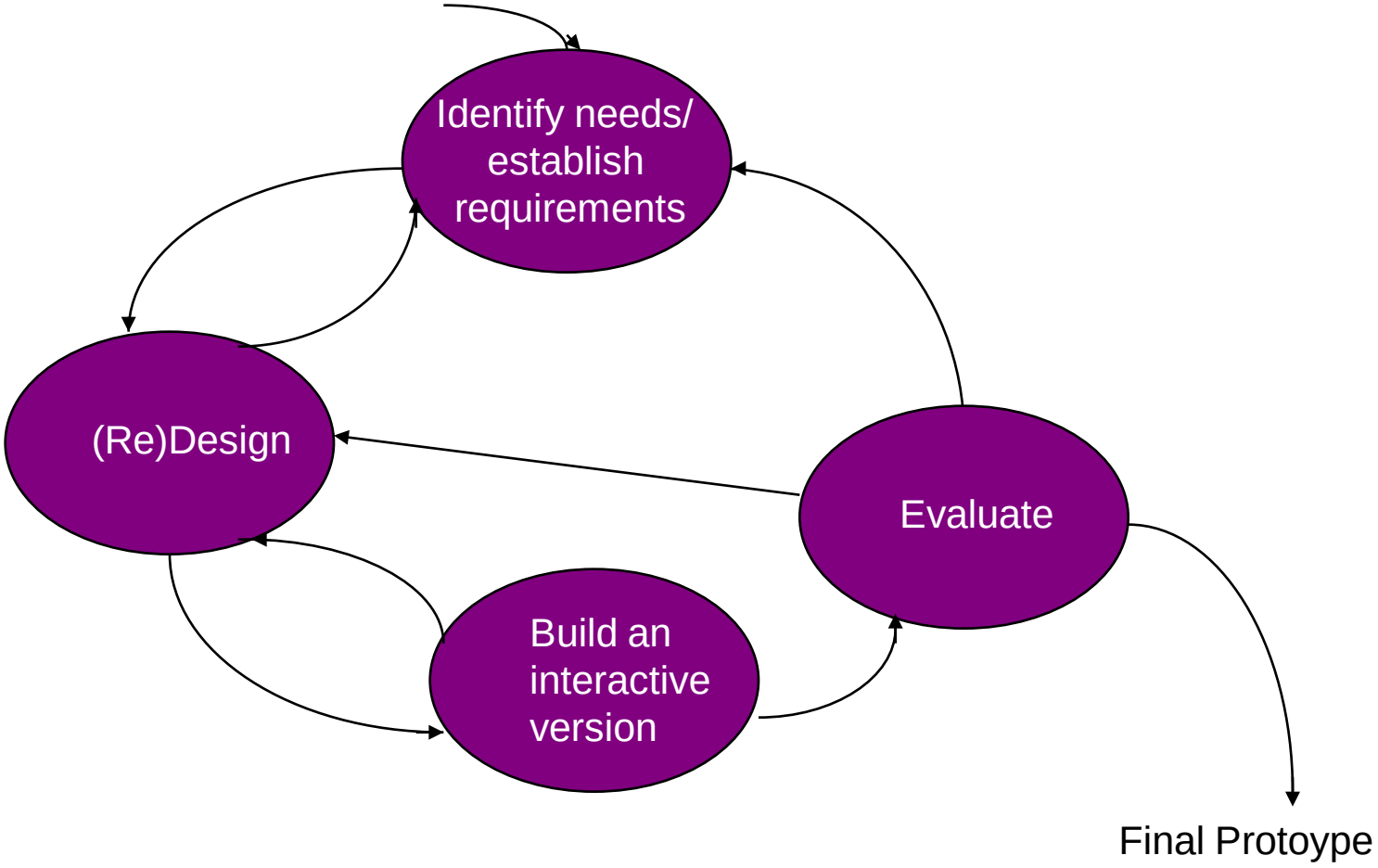
- Four phases per major cycle
  - **Inception**: Negotiate and define product for this iteration
  - **Elaboration**: Design
  - **Construction**: Create fully functional product
  - **Transition**: Deliver product of phase as specified
- The next phase is started **before** the end of the previous phase (say at 80% point).

Valuable TIPS

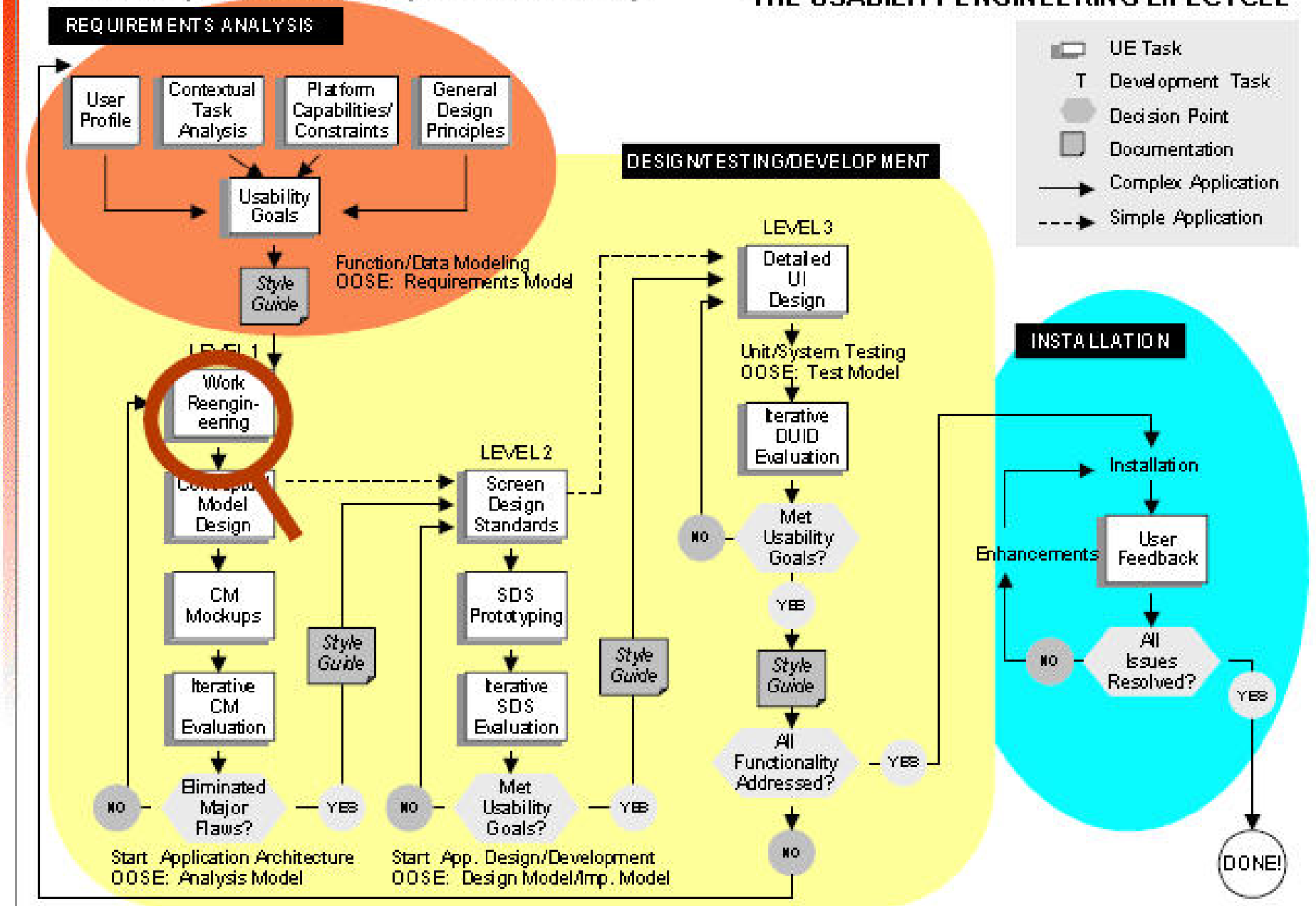
- Tackle the unknown and harder parts earlier rather than later.
- Better to find out about infeasible, intractable, or very hard problems early.
- The easy parts will be worthless if the hard parts are impossible.
- Find out about design flaws early rather than upon completion of a major phase.

The End

A simple interaction design model



THE USABILITY ENGINEERING LIFECYCLE



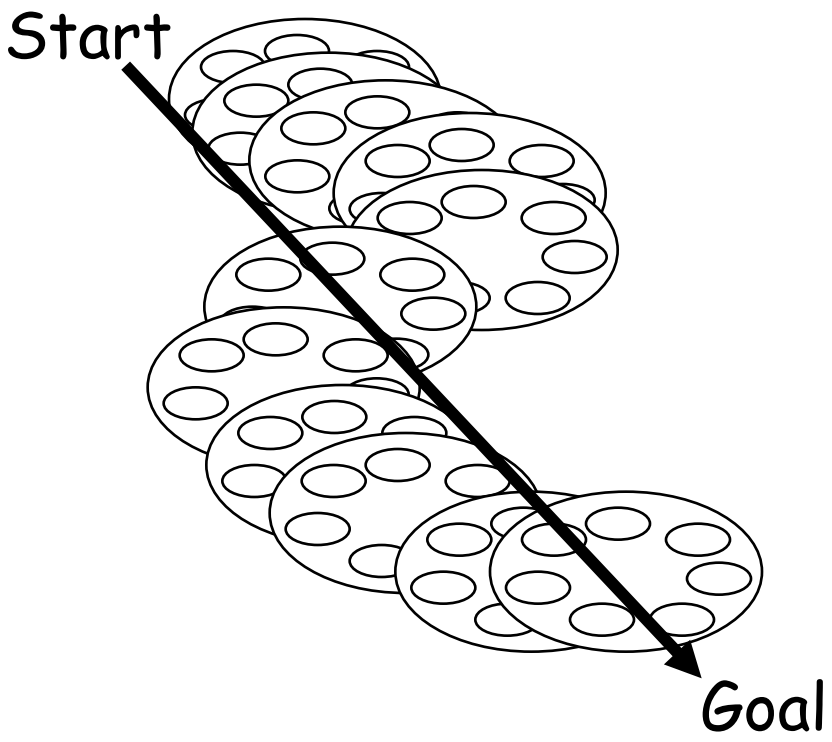
SCRUM model,
A cure for the Wicked?

Scrum first mentioned in
"The New New Product Development Game" (Harvard Business Review 86116:137-146, 1986)

Scrum Model

(incremental model,
includes some aspects of team structure, as well as process)

A **small group** is responsible for **picking up the ball and moving it toward the goal**.



See http://en.wikipedia.org/wiki/Scrum_%28development%29

Argument for the Scrum Model over other iterative models

- A product development project might not be compartmentalizable into nice clean phases as the Spiral models suggest.
- Scrum may be "just the thing" for wicked problems, because the team can quickly react to new information.

Some Principles of Scrum Model

- **Always have a product** that you can theoretically ship: "done" can be declared at any time.
- **Build early, build often**.
- **Continuously test** the product as you build it.
- **Assume requirements may change**; Have ablility to adapt to marketplace/user changes during development.
- **Small teams** work in parallel to maximize communication and minimize overhead.

Concepts Used in Scrum

(from http://www.controlchaos.com/ap.htm)

- **Backlog** - an identification of all **requirements** that should be fulfilled in the completed product. Backlog items are **prioritized**.
- **Objects/Components** - self-contained reusable **modules**
- **Packets** - a group of **objects** within which a backlog item will be implemented. **Coupling** between the objects ***within*** a packet is **high**. **Coupling** ***between*** packets is **low**.
- **Team** - a group of 6 or fewer members that works on a packet.
- **Problem** - what must be solved by a team member to implement a backlog item within an object(s) (includes removing errors)
- **Issues** - Concerns that must be resolved prior to a backlog item being assigned to a packet or a problem being solved by a change to a packet
- **Solution** - the resolution of an issue or problem
- **Changes** - the activities that are performed to resolve a problem
- **Risks** - the risk associated with a problem, issue, or backlog item

Use of Iteration in Scrum

http://www.controlchaos.com/scrumwp.htm

- Each **iteration** consists of all of the standard Waterfall **phases**,
- *but* each iteration only addresses **one set of functionality**.
- Overall project deliverable has been **partitioned** into prioritized subsystems, each with clean interfaces.
- **Test the feasibility** of subsystems and technology in the initial iterations.
- Further iterations can **add resources** to the project while ramping up the speed of delivery.
- **Underlying development processes are still defined** and linear.

The End