Research Methodology for PhDs

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Session 4 Topics

- Elements of research design –
  - -Concept and types of hypotheses
  - -Units of measurement
  - -Hypothesis testing

Research Design

A research design is a strategy for answering your research question using empirical data

Creating a research design means making decisions about:

- Your overall research objectives and approach
- Whether you'll rely on primary research or secondary research
- Your sampling methods or criteria for selecting subjects
- Your data collection methods
- The procedures you'll follow to collect data
- Your data analysis methods

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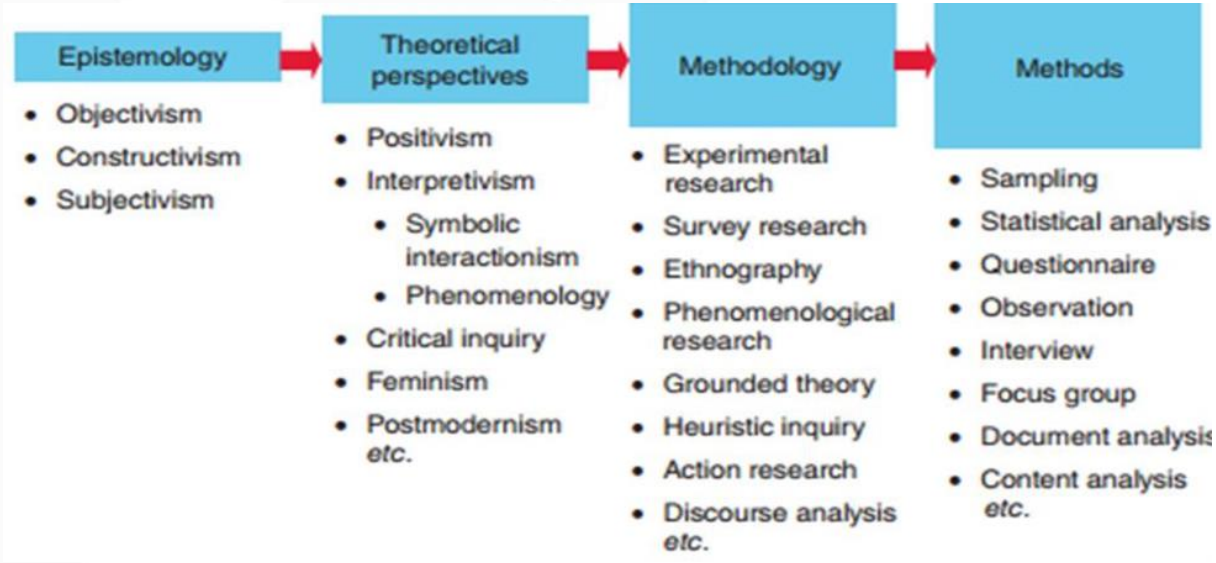
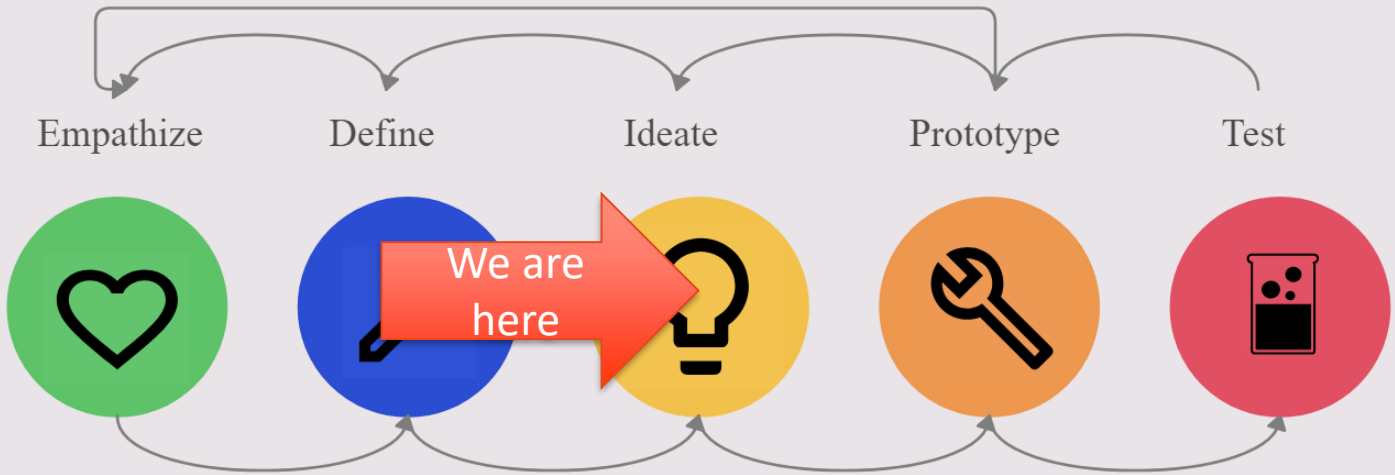
Linking Research Methodology to Scientific Approach



Iterative Approach

Research Design (similar to Design Thinking) is a non-linear, iterative process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. It is most useful to tackle ill-defined or unknown problems

Similarity to Design Thinking Methodology



Empathize with users to gain real insight into their needs	Define the core problems of your users	Brainstorm and generate ideas to solve the problem	Create prototypes in order to test and find the best solution	Test your solutions with users and iterate based on feedback
A Fitness goods manufacturing company empathizes with its users through interviews and by observing their purchase behavior in stores.	Defines the problem that users need to feel like being part of a fitness community, even when they are away from the gym.	Comes up with the idea to design non fitness products (but those which fitness enthusiasts need like Water Bottle, Bags, etc.) with a fitness related design.	Creates prototypes such as water bottles that can be carried similar to a dumbbell in order to create a better experience for the users.	Tests the created prototypes by making it available in limited stores and iterates the product based on user feedback.

Hypothesis

The term hypothesis means “little theory”.

A scientific hypothesis is a foundational element of the scientific method. It’s a testable statement proposing a potential explanation for natural phenomena.

A hypothesis is a short statement that can be tested and gives a possible reason for a phenomenon or a possible link between two or more variables.

In the setting of scientific research, a hypothesis is a tentative explanation or statement that can be proven wrong and is used to guide experiments and empirical research.

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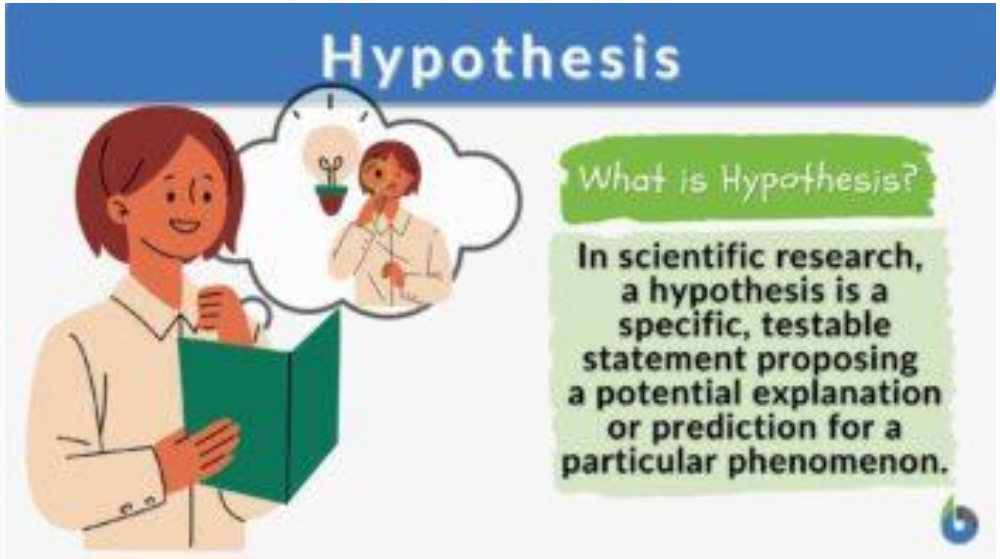
Hypothesis



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Three Types of Useful Hypothesis (Theories) according to Penrose

- Perfect – explains facts, proved predictions for wide area
- Working – explain facts and makes predictions for local area
- Perspective – seems to be helpful in explaining facts and making predictions

A useful hypothesis must have the following qualities

- It should never be written as a question.
- You should be able to test it in the real world to see if it's right or wrong.
- It needs to be clear and exact.
- It should list the factors that will be used to figure out the relationship.
- It should only talk about one thing. You can make a theory in either a descriptive or form of relationship.
- It shouldn't go against any natural rule that everyone knows is true. Verification will be done well with the tools and methods that are available.
- It should be written in as simple a way as possible so that everyone can understand it.
- It must explain what happened to make an answer necessary.
- It should be testable in a fair amount of time.
- It shouldn't say different things.

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Sources of hypothesis are

Patterns of similarity between the phenomenon under investigation and existing hypotheses.

Insights derived from prior research, concurrent observations, and insights from opposing perspectives.

The formulations are derived from accepted scientific theories and proposed by researchers.

In research, it's essential to consider hypothesis as different subject areas may require various hypotheses (plural form of hypothesis). Researchers also establish a significance level to determine the strength of evidence supporting a hypothesis.

Individual cognitive processes also contribute to the formation of hypotheses.

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Types of Hypotheses

Simple Hypothesis	• It illustrates the association between one dependent variable and one independent variable. For instance, if you consume more vegetables, you will lose weight more quickly. Here, increasing vegetable consumption is the independent variable, while weight loss is the dependent variable.
Complex Hypothesis	• It exhibits the relationship between at least two dependent variables and at least two independent variables. Eating more vegetables and fruits results in weight loss, radiant skin, and a decreased risk of numerous diseases, including heart disease.
Directional Hypothesis	• It shows that a researcher wants to reach a certain goal. The way the factors are related can also tell us about their nature. For example, four-year-old children who eat well over a time of five years have a higher IQ than children who don't eat well. This shows what happened and how it happened.
Non-directional Hypothesis	• When there is no theory involved, it is used. It is a statement that there is a connection between two variables, but it doesn't say what that relationship is or which way it goes.
Null Hypothesis	• It says something that goes against the theory. It's a statement that says something is not true, and there is no link between the independent and dependent factors. "H0" represents the null hypothesis.
Associative and Causal Hypothesis	• When a change in one variable causes a change in the other variable, this is called the associative hypothesis. The causal hypothesis, on the other hand, says that there is a cause-and-effect relationship between two or more factors.

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Examples of Useful Hypotheses

Students who experience test anxiety before an examination will get lower scores than students who do not experience test anxiety

Younger people who are routinely exposed to green, outdoor areas have better subjective well-being than older adults who have limited exposure to green spaces

Increasing the frequency of brand advertising on social media will lead to a significant increase in brand awareness among the target audience

There is not a significant relationship between the number of hours spent playing video games and academic performance

There is an association between socioeconomic status and access to quality healthcare services in urban neighborhoods

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Hypotheses Help Us with

A hypothesis gives a study a point of concentration. It enlightens us as to the specific characteristics of a study subject we need to look into.

It instructs us on what data to acquire as well as what data we should not collect, giving the study a focal point.

The development of a hypothesis improves objectivity since it enables the establishment of a focal point.

A hypothesis makes it possible for us to contribute to the development of the theory. Because of this, we are in a position to definitively determine what is true and what is untrue.

Hypotheses Help Us with (Cntd.)

Hypothesis generate specific predictions regarding the expected outcomes of experiments or observations. They elucidate what researchers anticipate observing if the hypothesis is true.

Hypothesis direct the design of experiments and data collection techniques. Researchers can use them to determine which variables to measure or manipulate, which data to obtain, and how to conduct systematic and controlled research.

Following the formulation of a hypothesis and the design of an experiment, researchers collect data through observation, measurement, or experimentation. The collected data is used to verify the hypothesis's predictions.

Hypothesis establish the criteria for evaluating experiment results. The observed data are compared to the predictions generated by the hypothesis. This analysis helps determine whether empirical evidence supports or rejects the hypothesis.

If the data support the predictions, then the hypothesis is supported. If this is not the case, the hypothesis may be revised or rejected, leading to the formulation of new queries and hypothesis.

Hypotheses Measurement Approach

A "Measurable Hypothesis" is a tentative, specific prediction that can be rejected by experimental data.

Measurable Hypotheses typically have a consistent form: Measurable Hypotheses involve a prediction that can be directly compared to an experimental outcome to result in a conclusion.

Hypotheses Testing

Hypothesis testing (or significance testing), is an act whereby an analyst tests an assumption regarding a population parameter.

The methodology employed by the analyst depends on the nature of the data used and the reason for the analysis.

Hypothesis testing is used to assess the plausibility of a hypothesis by using sample data.

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Hypotheses Testing Best Practices & Insights

Hypothesis testing is used to assess the plausibility of a hypothesis by using sample data.

The test provides evidence concerning the plausibility of the hypothesis, given the data.

Statistical analysts test a hypothesis by measuring and examining a random sample of the population being analyzed.

The four steps of hypothesis testing include

- stating the hypotheses,
- formulating an analysis plan,
- analyzing the data,
- analyzing the result.

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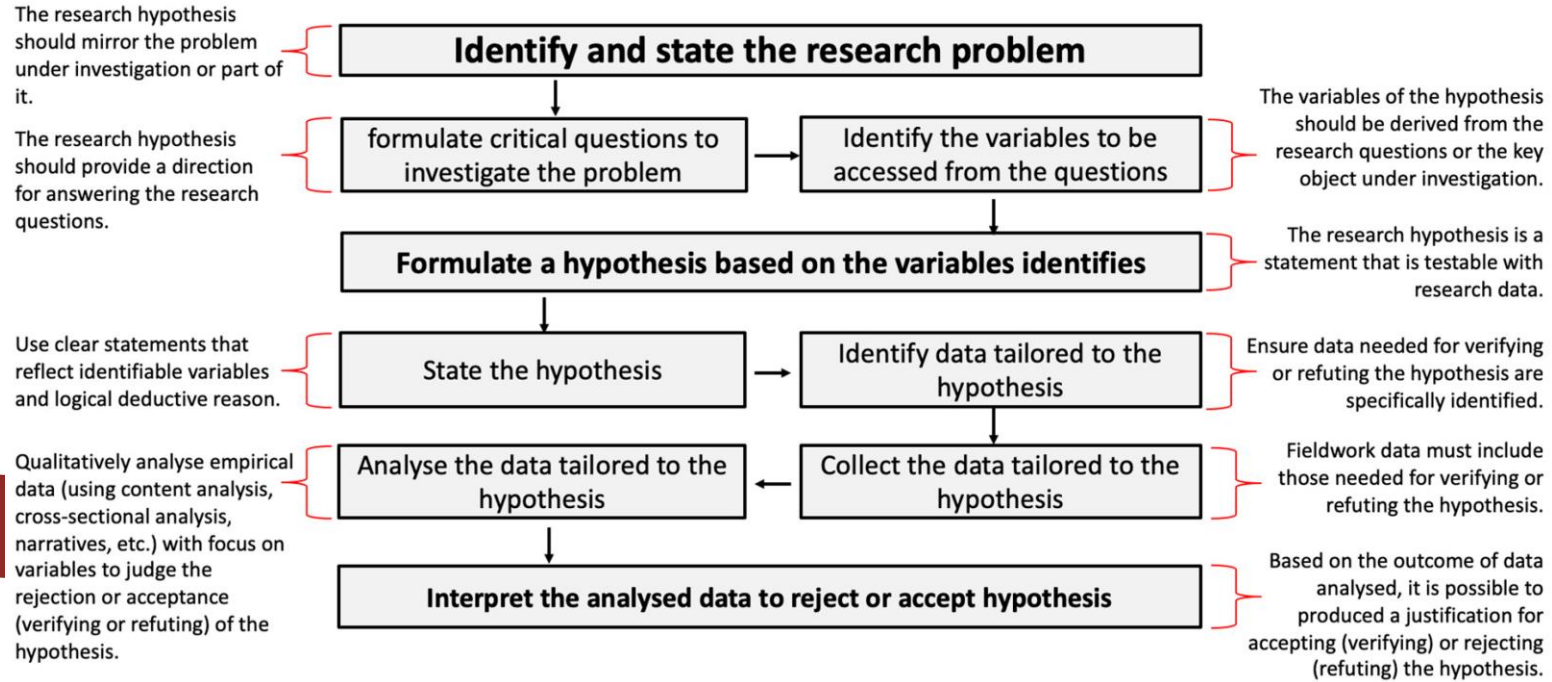
Bringing All Together



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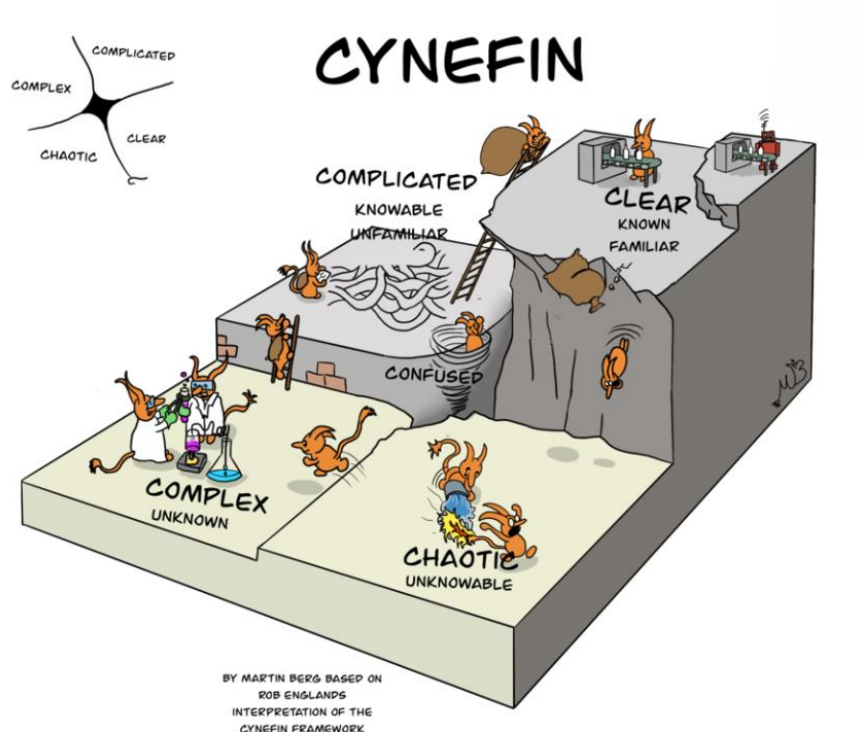
Session 4-2 Topics

- -Elements of research design –
  - -planning a research study
  - -Primary vs secondary research

Planning the Research Project. Why?

- Avoid research disaster
- Time management
- Make your work realistic
- Introduce self-control

Which Type a Research Project Is. How?

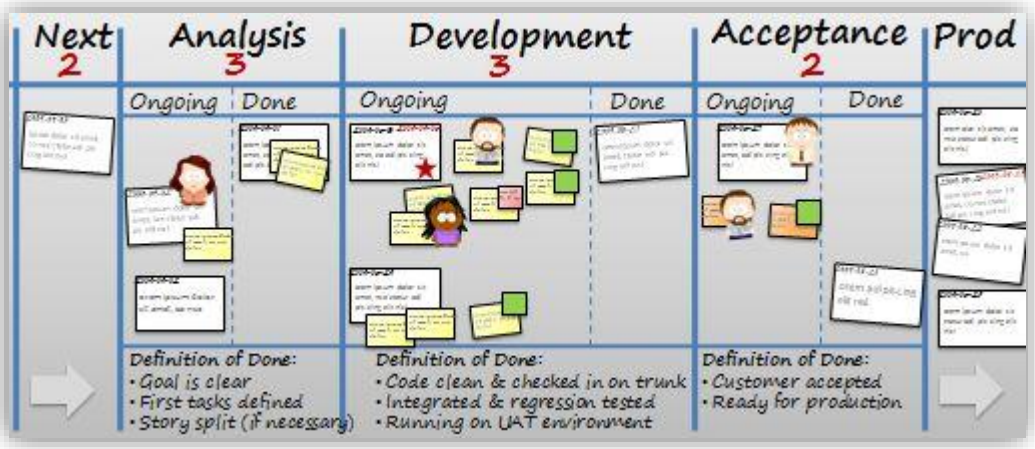


Is It Chaotic. Use Kanban methodology

Definition:

The Kanban Method is a means to design, manage, and improve flow systems for knowledge work. The method also allows organizations to start with their existing workflow and drive evolutionary change. They can do this by visualizing their flow of work, and stop starting and start finishing

A general term for systems using the Kanban Method is flow – reflecting that work flows continuously through the system instead of being organized into distinct timeboxes



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Kanban Principles

Service Delivery Principles

- Understand and focus on your needs and expectations
- Manage the work; self-organize around it
- Evolve policies to improve customer and business outcomes

Change Management Principles

- **Start with what you do now** – Understand current processes as they are actually practiced.
- **Agree to pursue improvement through evolutionary change**
- **Encourage acts of leadership at every level**

Practices

- Visualize
- Manage flow
- Make policies explicit
- Implement feedback loops
- Improve collaboratively
- Evolve experimentally

Kanban starts with the process as it currently exists and applies continuous and incremental improvement instead of trying to reach a predefined finished goal.

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Visualize

Kanban systems use mechanisms such as a kanban board to visualize work and the process it goes through. In order for the visualization to be the most effective, it should show

- where in the process a team working on a service agrees to do a specific work item (commitment point)
- Where the team delivers the work item to a customer (delivery point)
- Policies that determine what work should exist in a particular stage
- WIP Limits
- Limit work in progress

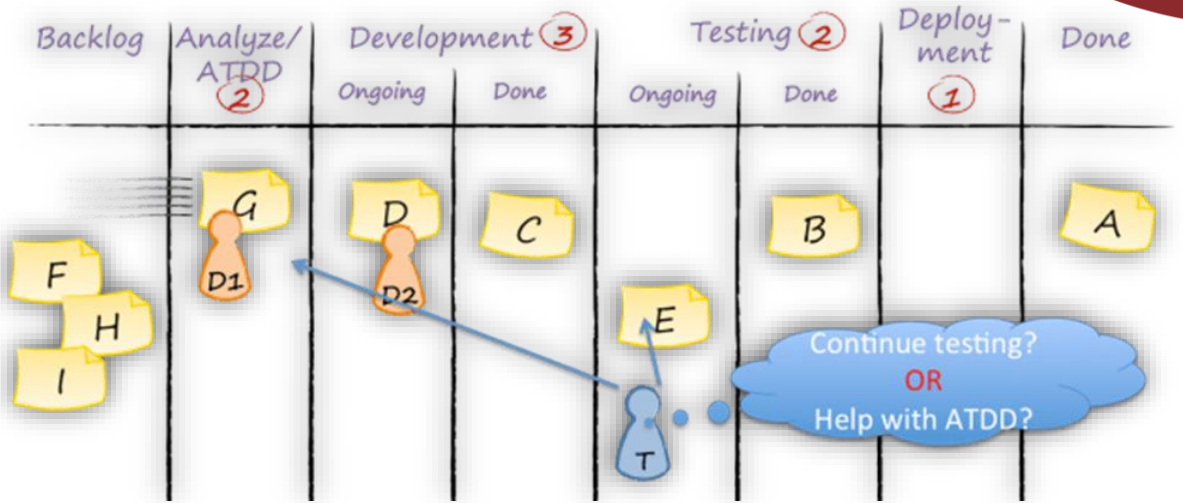
When you establish limits to the amount of work you have in progress in a system and use those limits to guide when to start new items, you can smooth out the flow of work and reduce lead times, improve quality, and deliver more frequently.

Manage Process Flow

The flow of work in a service should maximize value delivery, minimize lead times and be as predictable as possible.

Teams use **empirical control** through transparency, inspection and adaption in order to balance these potentially conflicting goals.

A key aspect of managing flow is **identifying and addressing bottlenecks and blockers**.



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Identify Blockers

Blocker is a task, which blocks further actions. Kanban board helps to identify blockers

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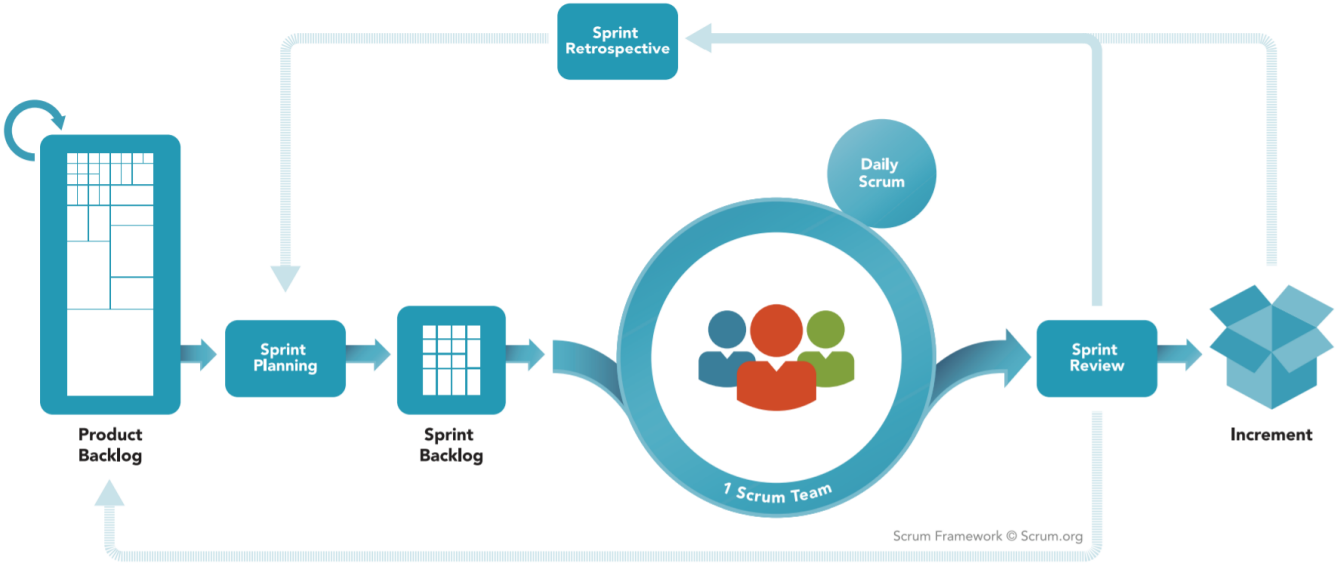
Is It Complex. Use Agile Iterations



Scrum & Kanban

	Scrum	Kanban
Cadence	Regular fixed length sprints (ie, 2 weeks)	Continuous flow
Release methodology	At the end of each sprint	Continuous delivery
Roles	Product owner, scrum master, development team	No required roles
Key metrics	Velocity	Lead time, cycle time, WIP
Change philosophy	Teams should not make changes during the sprint.	Change can happen at any time

Scrum vs Kanban

Action or Artifact	Kanban	Scrum
Minimal planning item	Task	Sprint
Prediction	Based on average task productivity	2-week planning
Implementation Area	Any, for example, a team which works on different products simultaneously	A single product
Level of uncertainty	Chaos	Basic product description

Examples of Software Tools for Planning

- Trello
- Jira
- MS Teams Planner

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Primary & Secondary Research Approaches

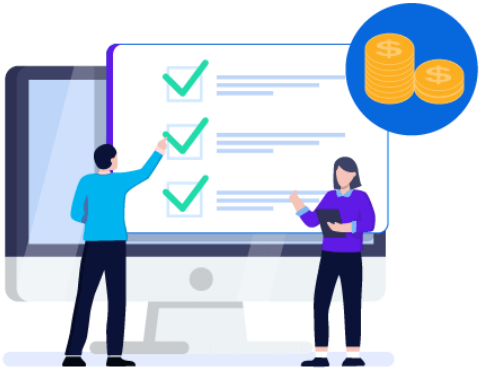
Primary

Provides results specifically about your company

- Focus groups
- Surveys
- Interviews
- Cost of research

Secondary

Involves applying results of previously completed studies to your situation



- Free or low cost
- Results are not specific to your business

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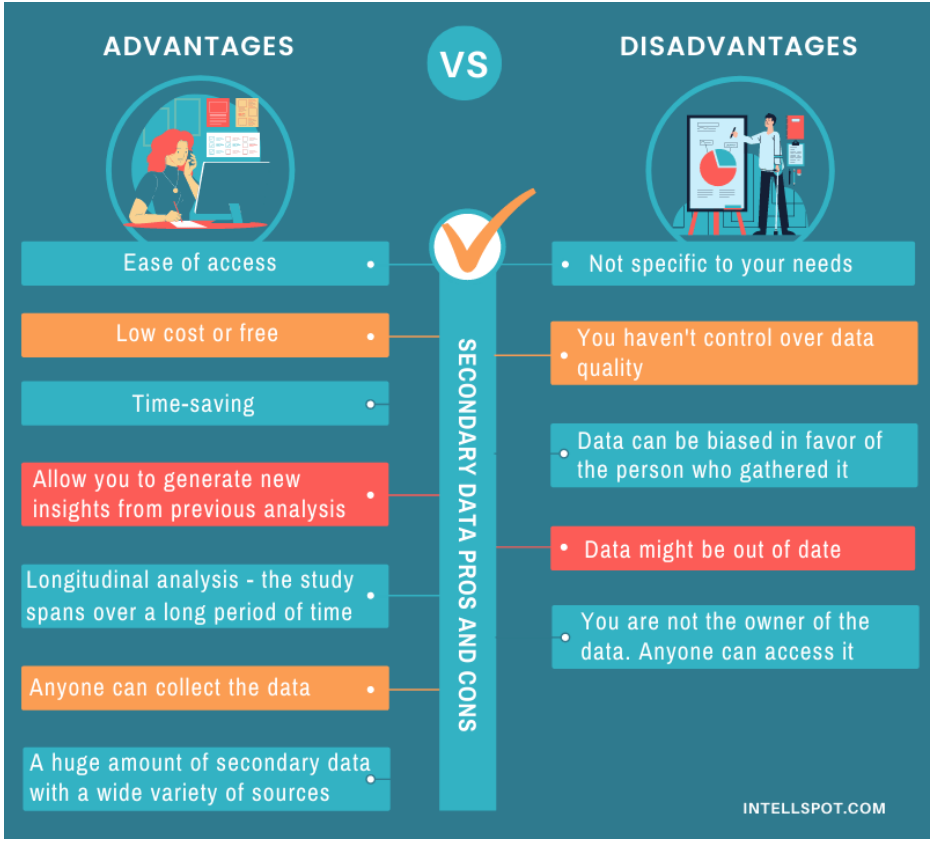
Primary Research Advantages/Disadvantages

* Very fast turnaround	*Sample is still not "representative" of general consumer markets (U.S. or worldwide)
* Very inexpensive	*Response rates are dropping as novelty declines
*Fairly versatile (e.g., can show print ads, beauty shots of products, can play music, video, in addition to survey)	*Respondents may have concerns with privacy
*Survey responses automatically entered into a data file	
*International sample possible	

Secondary Research Advantages/Disadvantages



Here We are – the General List of Research Methods

- Experimental
- Quasi-experimental (i.e. base on existing groups instead of random)
- Phenomenological
- Analitical surveys
- Action research
- Heuristic enquiry

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