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# Introduction to Research in Computer Science

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# The Research Process

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Approaches to Defining The Process


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# Contents

- A Conceptual Model
- A Stage Model
- Comparison of Models
- The Research Process in Practice
- Apportioning Effort


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# Key Reference

- How to get a Ph.D.: a handbook for students and their supervisors.  
Phillips, E.  
Open University Press, UK. 1994


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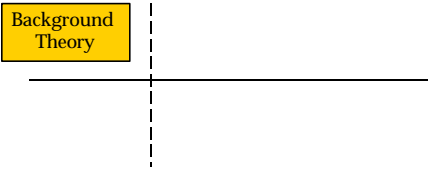
# A Conceptual Process Model

- Background Theory
  - This phase is based upon the need for the researcher to familiarise themselves with the research field
  - note that this may be distinct from existing familiarity with the practitioner field
  - this phase usually involves a literature review
  - The researcher must evaluate the contributions of others and make justified criticisms where appropriate
  - trends in research approach and methodology are also identified here
  - The researcher should also identify areas of theoretical or empirical weakness in the research field

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# Background Theory



After Phillips, 1994

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## Background Theory

A diagram illustrating the 'Background Theory' stage. A horizontal line represents the theory. To the left, two yellow arrows point towards each other, with a yellow question mark above them. A vertical dashed line is positioned to the right of these arrows. A yellow box labeled 'Background Theory' is placed below the line to the left of the dashed line. A black arrow points to the right from the end of the line. Below the line, a blue-outlined box contains the text 'How much effort?'.

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## Focal Theory

- Background Theory
- Focal Theory
  - This is the stage in the research where the researcher establishes and analyses the nature of the problem and details exactly what is going to be researched
  - the research focuses from the general to the specific
  - as the researcher creates hypotheses
  - examines the arguments of others
  - and hypothesises that their new principles, data or artifact will push forward the field

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## Focal Theory

A diagram illustrating the 'Focal Theory' stage. A horizontal line represents the theory. To the left, two white arrows point towards each other. A yellow box labeled 'Focal Theory' is placed above the line to the right of the arrows. A vertical dashed line is positioned to the right of the 'Focal Theory' box. A yellow question mark is placed below the line between the dashed line and the 'Focal Theory' box. A yellow double-headed arrow is placed below the line between the dashed line and the 'Focal Theory' box. A black arrow points to the right from the end of the line. Below the line, a blue-outlined box contains the text 'How much effort?'.

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## Data Theory

- Background Theory
- Focal Theory
- Data Theory
  - During this stage the researcher justifies the relevance and validity of the data that supports the thesis
  - this is always focussed upon the appropriateness of the data
  - but the exact form of the data varies with the nature of the project

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## Qualitative Data Forms

- Background Theory
- Focal Theory
- Data Theory

for example ...

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A flowchart showing 'Qualitative Study' in a box at the top. Three arrows point downwards from this box to three circles labeled 'Case Study', 'Interviews', and 'Action Research'.

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## Quantitative Data Forms

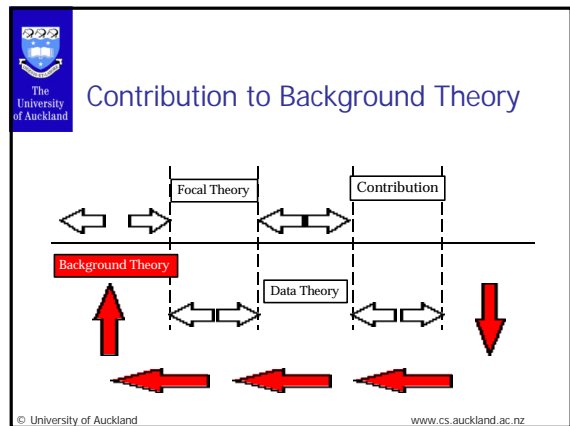
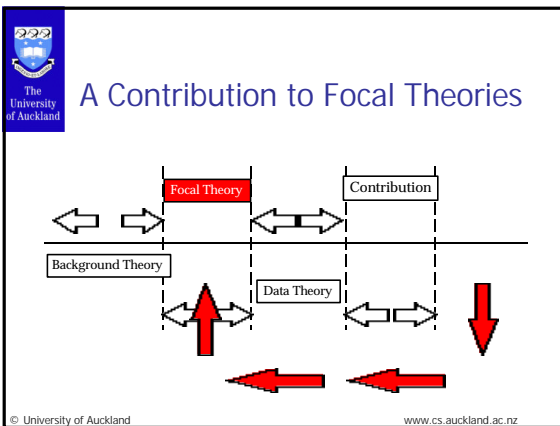
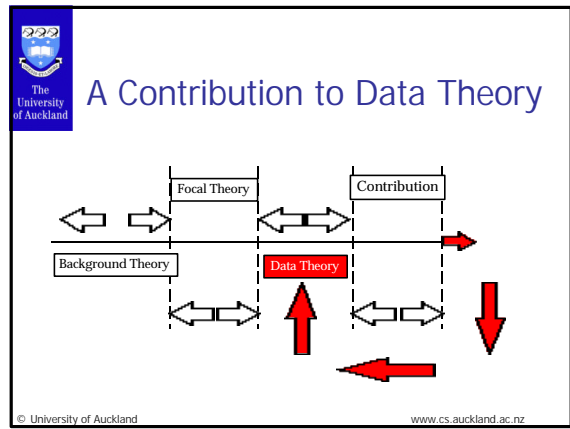
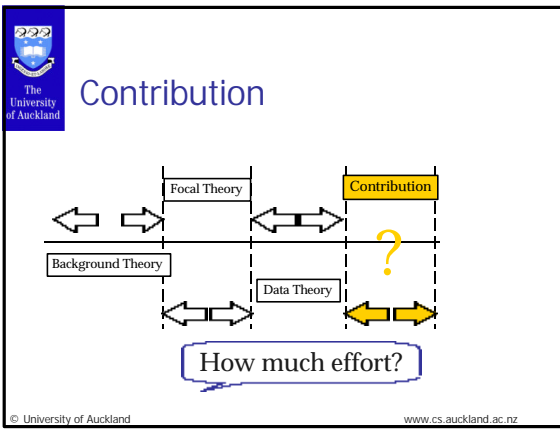
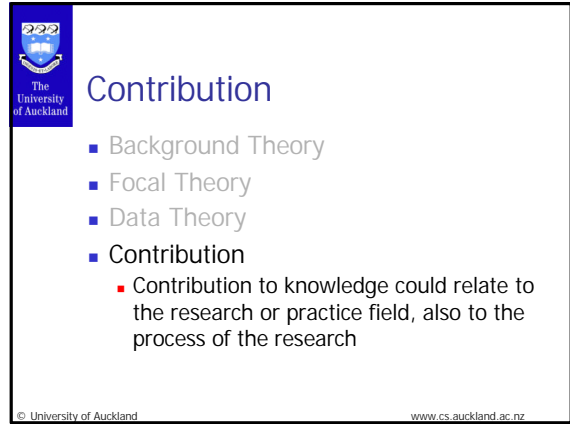
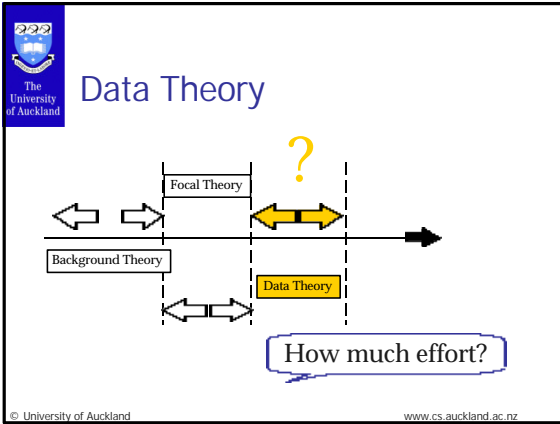
- Background Theory
- Focal Theory
- Data Theory

or for quantitative research...

After Phillips, 1994

A flowchart showing 'Quantitative Study' in a box at the top. Two arrows point downwards from this box to two circles labeled 'Quasi Experiment' and 'Experiment'.

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## An Alternative Stage-Based Model of the Research Process

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## Stages in the Research Process

- Identify Field of Interest

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## Stages in the Research Process

- Identify Field of Interest
- Identify Possible Topics

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## Stages in the Research Process

- Identify Field of Interest
- Identify Possible Topics
- Create a Thesis Proposal

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## Stages in the Research Process

- Identify Field of Interest
- Identify Possible Topics
- Create a Thesis Proposal
- Undertake Pilot Study

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## Stages in the Research Process

- Identify Field of Interest
- Identify Possible Topics
- Create a Thesis Proposal
- Undertake Pilot Study
- Data Collection

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## Stages in the Research Process

- Identify Field of Interest
- Identify Possible Topics
- Create a Thesis Proposal
- Undertake Pilot Study
- Data Collection
- Data Analysis


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## Stages in the Research Process

- Identify Field of Interest
- Identify Possible Topics
- Create a Thesis Proposal
- Undertake Pilot Study
- Data Collection
- Data Analysis
- Writing Up

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## Comparing Research Process Models

Note that the stage model assumes that there is a linear and single route through the research process ...

... whereas the conceptual model allows for the emergence of the thesis. It is still linear, however.


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## The Research Process in Practice

- In reality the process is usually customised to the particular research project
- It is also usually cyclic in nature
- hence you may visit stages out of order,
- and may re-visit stages several times in different contexts
- and you may find that a combination of the two processes emerges as your thesis evolves

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Identify Broad Area  
Review State of Art  
Select Topic  
Literature/Field Familiarisation




Corresponds to the Background Theory ...

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Identify Broad Area  
Review State of Art  
Select Topic  
Literature/Field Familiarisation



... also to the Linear Stages Approach

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Identify Broad Area


Review State of Art

Select Topic

Literature/Field Familiarisation

**BUT** The scope of the Broad Area may be defined and re-defined by the review(s) of the State of the Art ...

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Identify Broad Area


Review State of Art

Select Topic

Literature/Field Familiarisation

**AND** The State of the Art Review may be influenced beforehand or as a consequence of the subsequent selection of research topic(s) ...

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Identify Broad Area


Review State of Art

Select Topic

Literature/Field Familiarisation

Furthermore, the literature review will probably highlight limitations or perspectives on the topic selection (especially where a large amount of ongoing work is uncovered).

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Identify Broad Area


Review State of Art

Select Topic

Literature/Field Familiarisation

A parallel approach is probably what will emerge in practice

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Identify Broad Area

Review State of Art

Select Topic

Literature/Field Familiarisation

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Define Topic/Problem

Define Hypothesis

Corresponds to the Focal Theory ...

... also to the Linear Stages Approach

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Identify Broad Area

Review State of Art

Select Topic

Literature/Field Familiarisation

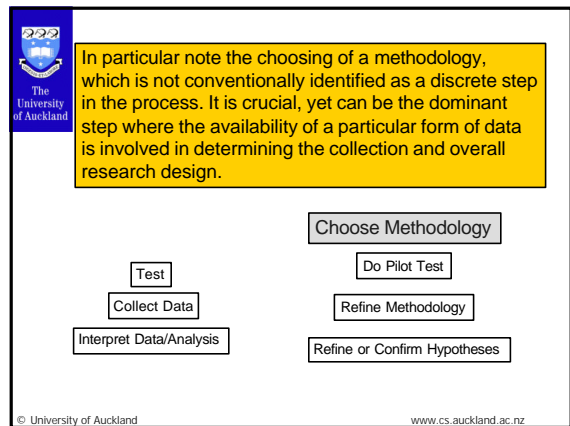
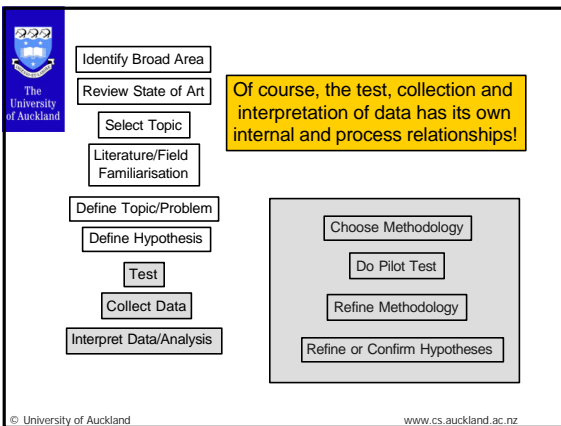
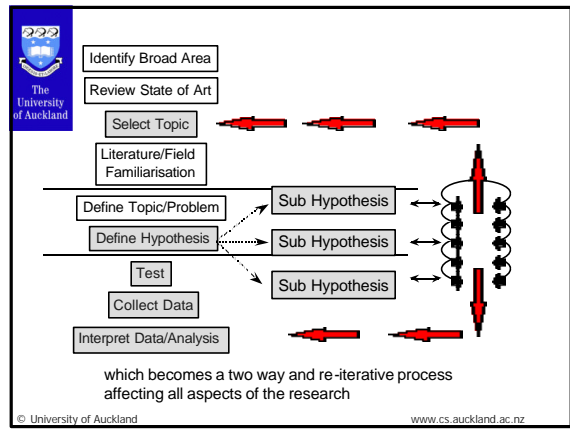
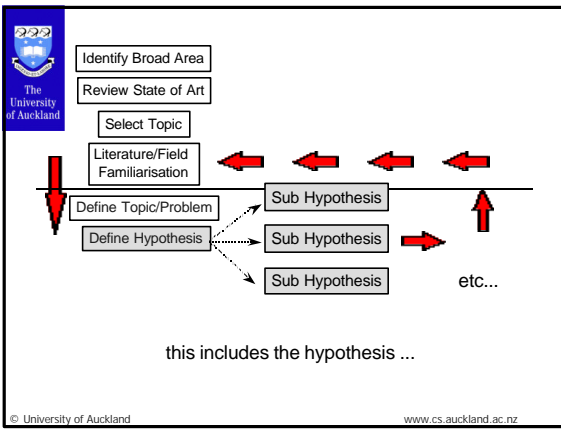
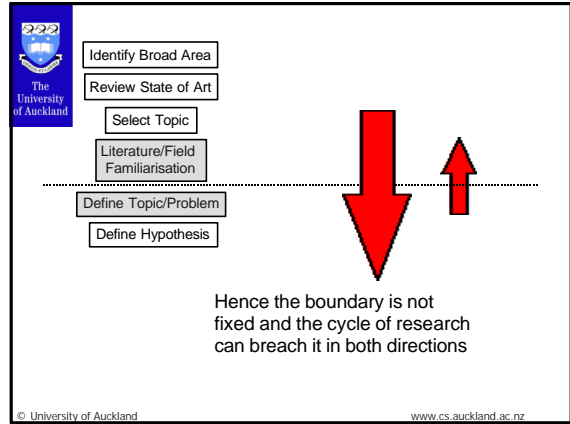
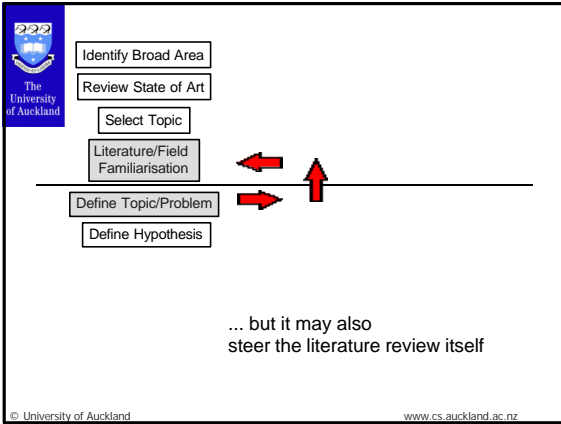
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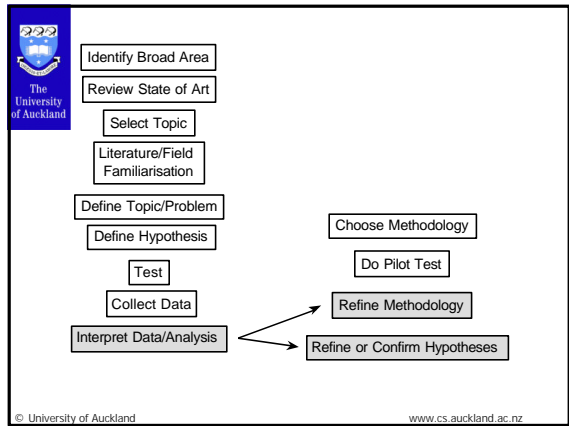
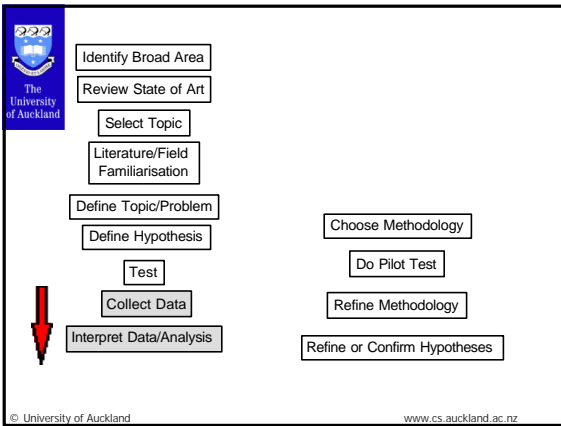
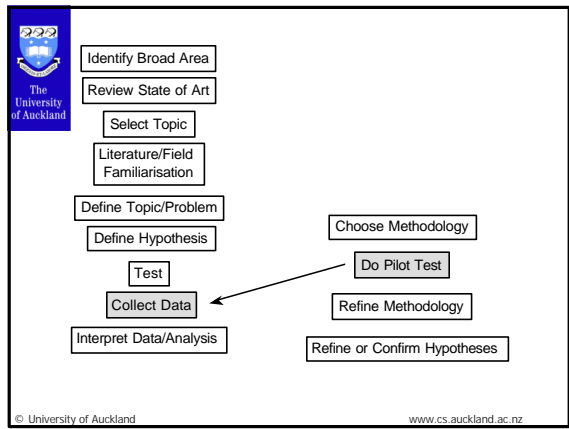
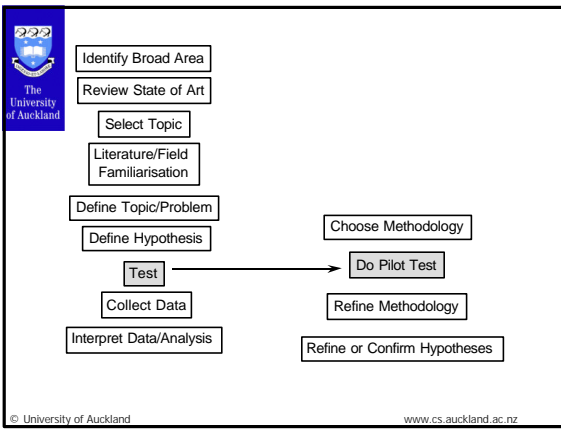
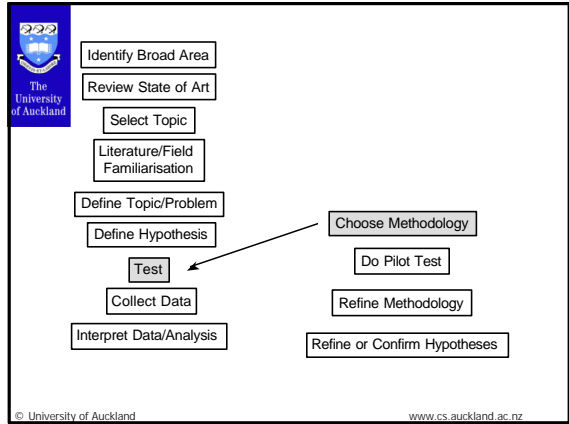
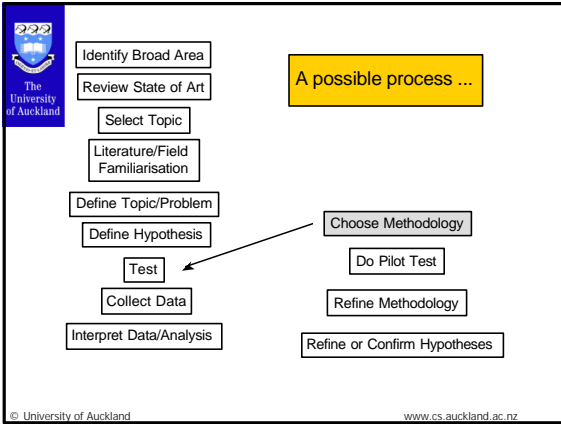
Define Topic/Problem

Define Hypothesis

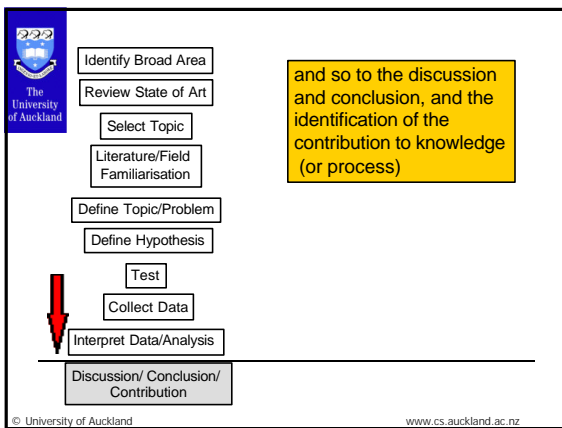
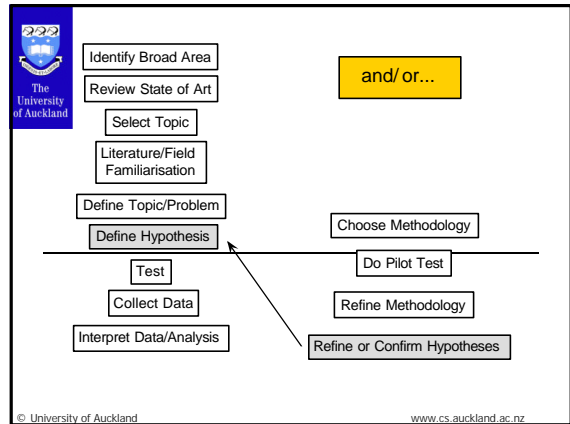
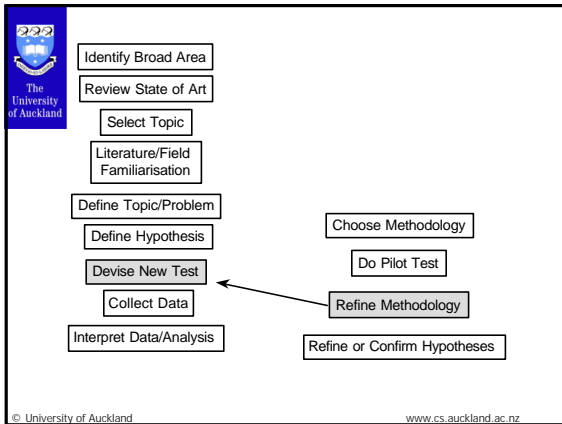
The definition of the problem will be determined by the literature review ...

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### Apportioning Effort

- Clearly this depends on the type of research project
- and it may change throughout a project
- but it is important to have an initial idea of the stages and effort involved
- and to revise it when it becomes necessary to do so

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The message is that the research process is highly fluid and needs to be carefully attuned to your project.

There is no single method which suits all projects and all circumstances ...

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Let them be your guide to an appropriate research process

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... and you need to create and revisit a process programme in a systematic manner.