Research Methodology 2

PROBLEM FORMULATION AND OBJECTIVES

2.0 PROBLEM FORMULATION AND OBJECTIVES

2.1 What is research problem?
2.2 Why need to formulate the research problem?
2.3 Step in formulating research problem
2.4 How to identify the research problem?
2.5 Formulation of Problem Statement
2.6 Formulating research question and/or hypothesis
2.7 Identify research objectives
2.8 Scope of research: Criteria for Masters vs Doctoral Level of research.

2.1 What is research problem?

- A research problem is **a statement** about an area of concern, a condition to be improved, a difficulty to be eliminated, or a **troubling question** that exists in scholarly literature, in theory, or in practice that points to the need for **meaningful understanding and deliberate investigation.**

2.2 Why need to formulate the research problem?

- Formulating your destination before beginning a journey.

- It determines,
  - what you will do,
  - will it withstand scientific scrutiny,
  - how you will do it, and
  - what you may achieve!

2.3 Step in formulating research problem

1. Identify a broad topic
2. Identify a narrow topic within the broad topic
3. Raise questions
4. Formulate objectives
   - **Use action-oriented words - To demonstrate; To evaluate; To measure…**

2.4 How to identify the research problem?

- **Think of the BIG PICTURE**
  - What is the problem you are trying to solve?
  - Think of something you like to learn more about
  - Consult text books, journal or your supervisor

- **Pick one based on:**
  - Interest and relevance
  - Magnitude of work involved
  - Level of expertise
    - yours and your advisors

Examples of Broad Topics

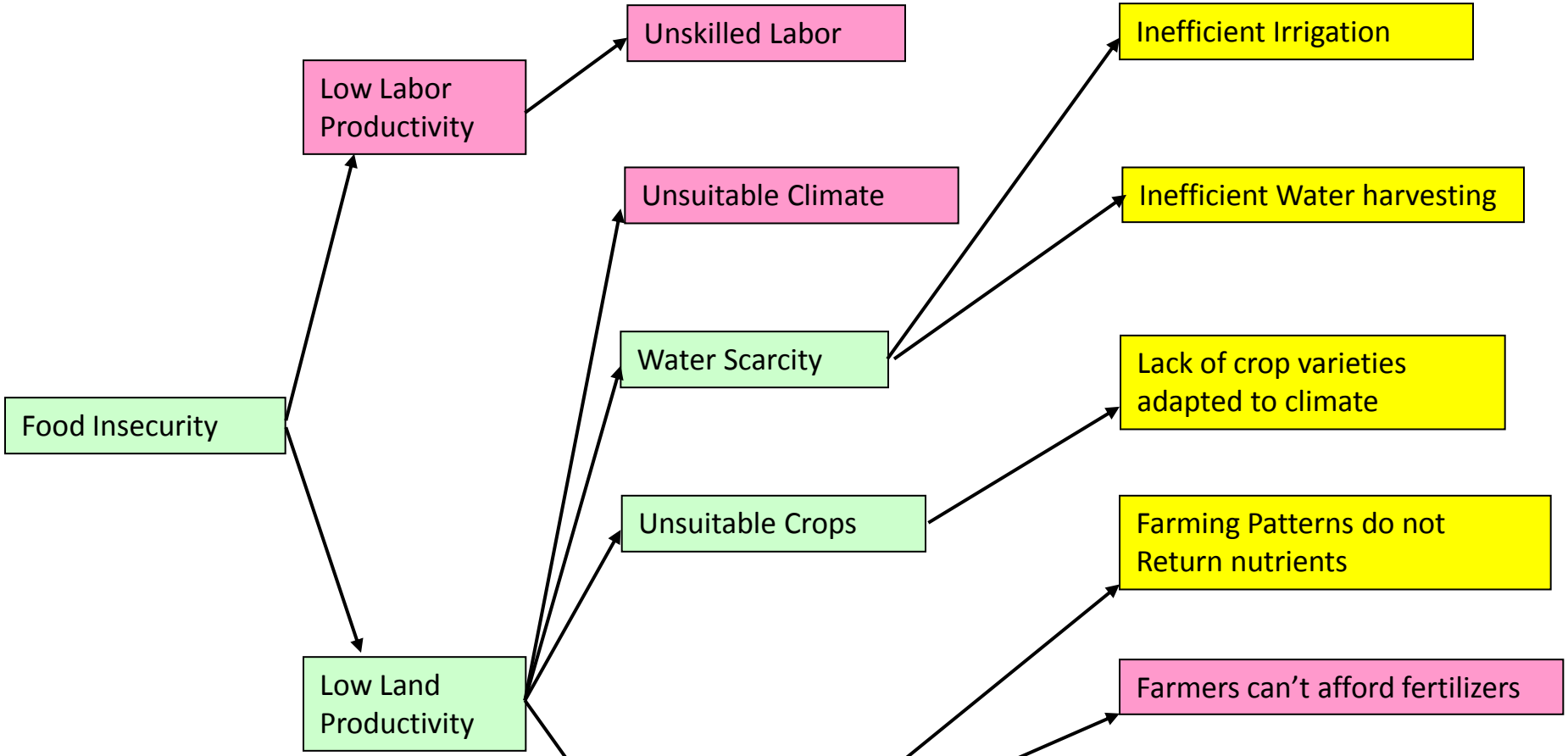
- Optimizing productivity of land and water resources
- Ensuring Food Safety and Security
- Sustaining Agricultural & Marine Environments

From Broad Topic to Narrow Topic

- **Examples of a narrow topic:**
  - Liver disease in Goat
  - Greenhouse Agriculture
  - Milk Quality
  - Greywater reuse potential in Malaysia

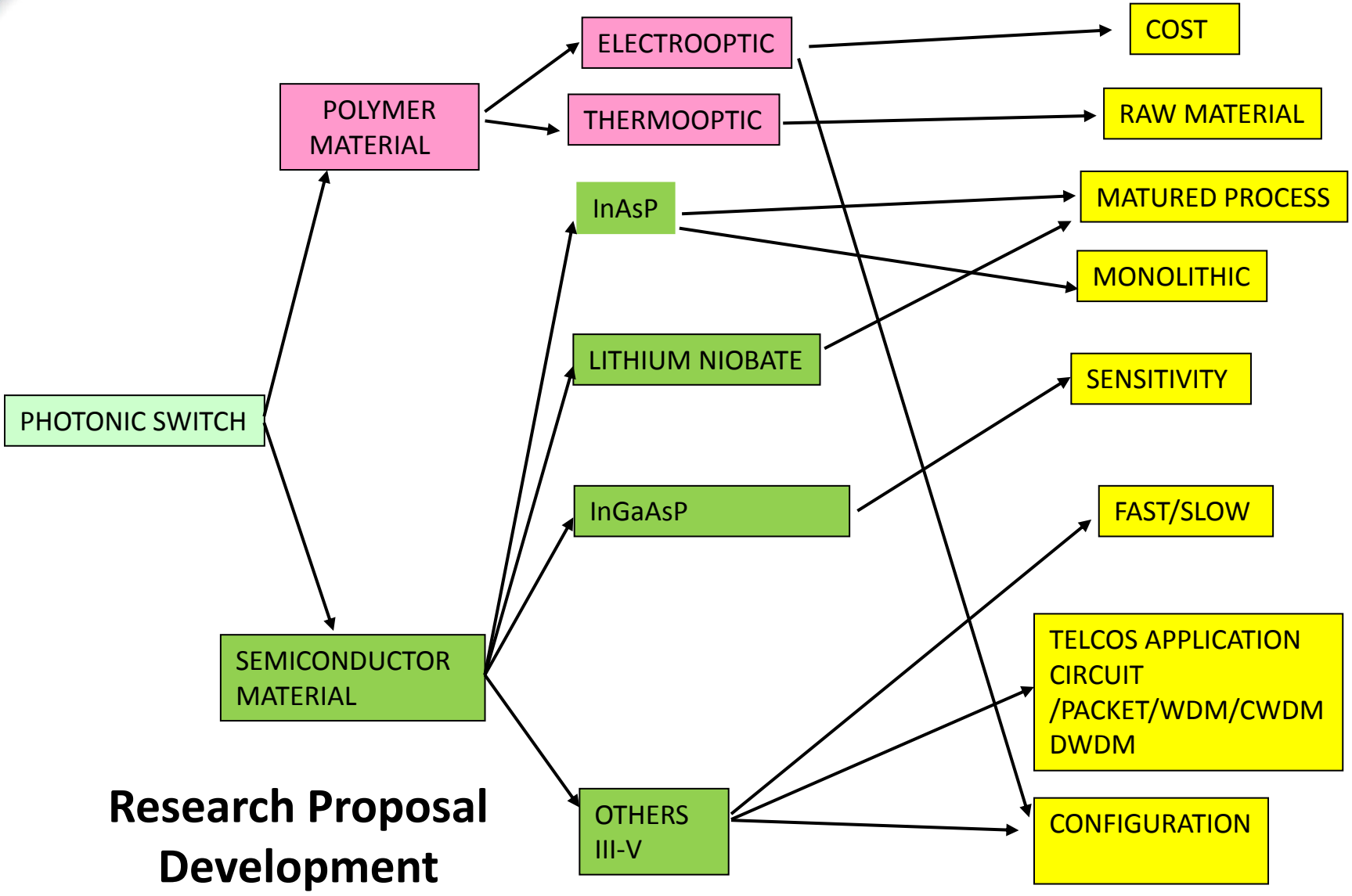
- When selecting a narrow topic think how it can contribute towards solving the BIG PROBLEM!

Problem Tree – Keep asking Why?



Research Proposal Development

Problem Tree – Keep asking Why?



Research Proposal Development

2.4.1 What Are The Criteria For Selecting a Research Problem?

- Interest
- Size/Scope
- Economy/Cost
- Researcher's Capabilities and Limitations
- Uniqueness

Criteria For Selecting a Research Problem

(1) Interest

- By being interested, you are more likely to read widely on the topic and have a more thorough knowledge of the situation.

- On the other hand, the issue does not have to be of concern to everyone, but the results should be communicable and of interest to someone.

Criteria For Selecting a Research Problem

(2) Size

- For example, a researcher wanting to investigate the quality of water in a certain area would be faced of determining the sample of water which is representative.

- However, further analysis, reduces the problem into a smaller and manageable research.

Criteria For Selecting a Research Problem

(3) Economy

- Research are often confronted with practical constraints, not the least of which are time and money.

- Even at the initial planning stages, it is wise to think about the possibility of receiving some support, both financial and non-financial, either from within your institution or from outside sources.

Criteria For Selecting a Research Problem

(4) Researcher's Capabilities and Limitations

- A researcher must recognize his own capabilities and limitations

.

- If inexperienced in educational research, then it is highly likely that you will need some guidance.

- It will be an advantage if you have people willing to support you throughout the research-to suggest alternative approaches, assist in clarification of issues, etc.

Criteria For Selecting a Research Problem

(5)Uniqueness

- That is, you would not want to duplicate a study.
- However, you may want to pursue a study similar to one already in existence but change the methods used, or modify the design, or use a different sample, or choose to perform different statistical analyses.

2.4.2 EVALUATING THE PROBLEM

- Having developed a well-constructed research problem it is important to consider :

  a. whether you think the research problem is FEASIBLE, and

  b. whether you feel the research problem is WORTHWHILE.

Is the Problem Feasible ?

- The primary evaluative source is yourself.
- You should ask yourself a number of questions relating to the feasibility of the study – that is, whether it is possible for the problem to be solved.

You are seeking an answer to the question…

Is the Problem Researchable ?

1. Has the problem been specified ?
2. Is the problem amenable to research ?
3. Is the problem too large ?
4. How available are the data ?
5. Am I capable of solving the problem ?

CONSULTATION WITH OTHERS

- It is wise to consult others (who are either experienced researchers, interested colleagues or experts in the field) for their honest opinions.

Is the Problem Worthwhile ?

Is the Problem Worthwhile ?

- Usefulness of the research findings, or on the interest it holds for the readings or even on its contribution to the existing body of knowledge.

- In order to judge whether you research problem is worthwhile, you should ask yourself the question.

Will the Results be Significant ?

Will the Results be Significant?

- In answering this question you are concerned with what are called social factors (or social considerations).

- To evaluate the worthwhileness of your research problem, you would need to ask questions such as :

1. Will the results advance knowledge ?
2. Will the research have some value ?
3. Will the results be of interest to others ?

2.5 Formulating a Problem Statement

- Reflect on the key issues and formulate a problem statement that incorporates the most important ideas in the issues.

- Guidelines
  - 1 or 2 complete sentences
  - Legible…easy to understand
  - Large enough

Reminders for Formulating a Problem Statement

- Sometimes it is a quick and easy process; other times it is slower and more difficult.
- The conversation to identify a critical problem is important in focusing the improvement work and building team commitment.
- Encourage robust discussion, but do not get bogged down in wordsmithing.

2.6 FUNCTIONS OF A HYPOTHESIS/RESEARCH QUESTION

- Once a problem situation has been located and a problem refined to a researchable form, the researcher's task is to find an answer to the problem.

- If the answer to the question cannot be found from within the body of knowledge already in existence, it is necessary for the researcher to develop a hypothesis.

What is meant by a Hypothesis ?

A hypothesis is an educated guess.

- It is an attempt to explain the nature of the relationship between the variables identified in the problem.

- If you like, a hypothesis is an attempt to suggest a possible answer to the problem based on available facts or information that the researcher already knows.

- Hypothesis are constructed in everyday life, e.g. when items are lost, when an unusual happening occurs or when something does not act in the normal way.

- Hypothesis that direct them to finding the solution to a question, for example:

  Where did I leave the scooter key ?
  What is that rumbling noise ?
  Why didn't the mail arrive ?

- **In order to solve the problem, you attempt to link what is known and what is not known and suggest a possible reason or solution….HYPOTHESING**

Cycles of Research Question Development

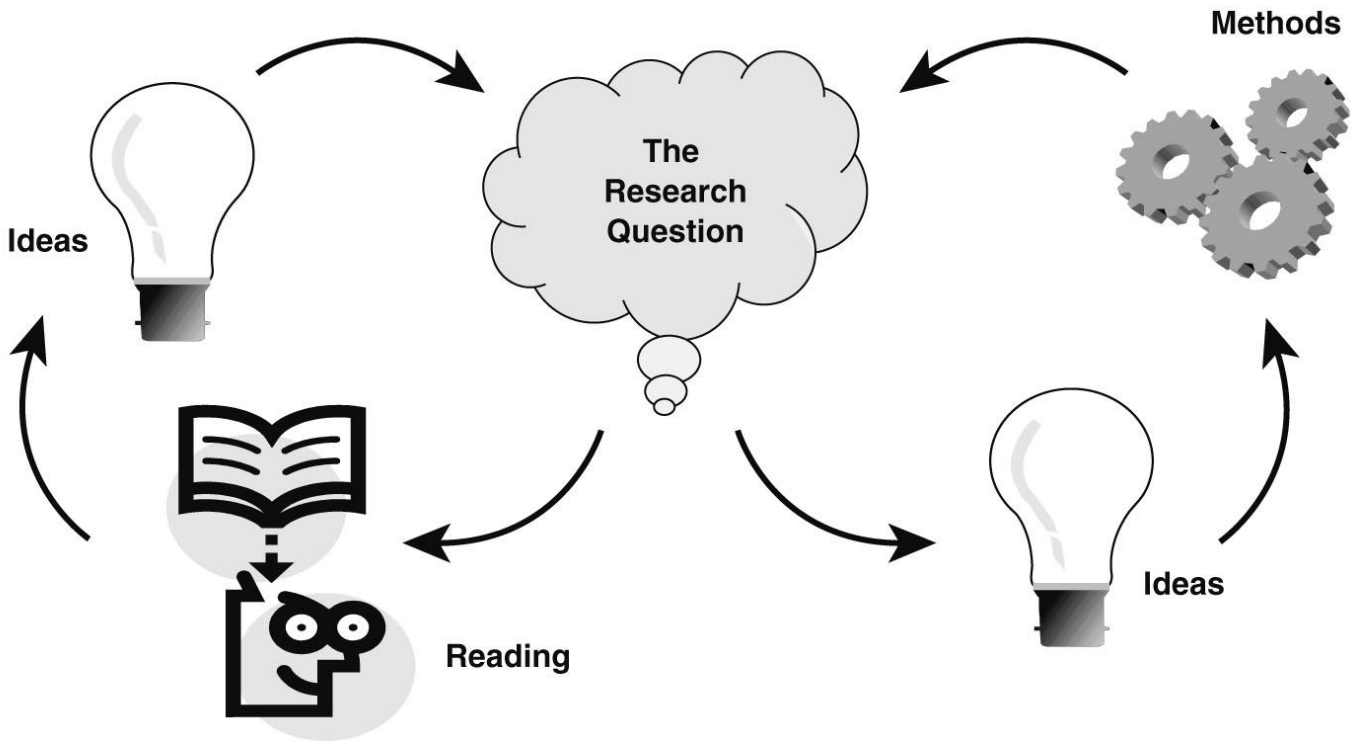


FIGURE 3.4 CYCLES OF RESEARCH QUESTION DEVELOPMENT

Narrowing and Clarifying

- Narrowing, clarifying, and even redefining your questions is essential to the research process.
- Forming the right ‘questions’ should be seen as an iterative process that is informed by reading and doing at all stages.

Good Question Checklist

✓Is the question right for me?

- Will the question hold my interest?
- Can I manage any potential biases/subjectivities I may have?

Good Question Checklist

✓ Is the question right for the field?

- Will the findings be considered significant?
- Will it make a contribution?

O'Leary, Z. (2004) The Essential Guide to Doing Research. London: Sage. Chapter Three

Good Question Checklist

✓Is the question well articulated?

- Are the terms well-defined?
- Are there any unchecked assumptions?

O'Leary, Z. (2004) The Essential Guide to Doing Research. London: Sage. Chapter Three

Good Question Checklist

✓Is the question doable?

- Can information be collected in an attempt to answer the question?
- Do I have the skills and expertise necessary to access this information? If not, can the skills be developed?
- Will I be able to get it all done within my time constraints?
- Are costs likely to exceed my budget?
- Are there any potential ethics problems?

O'Leary, Z. (2004) The Essential Guide to Doing Research. London: Sage. Chapter Three

Good Question Checklist

✓Does the question get the tick of approval from those in the know?

- Does my supervisor think I am on the right track?
- Do 'experts' in the field think my question is relevant/important/doable?

O'Leary, Z. (2004) The Essential Guide to Doing Research. London: Sage. Chapter Three

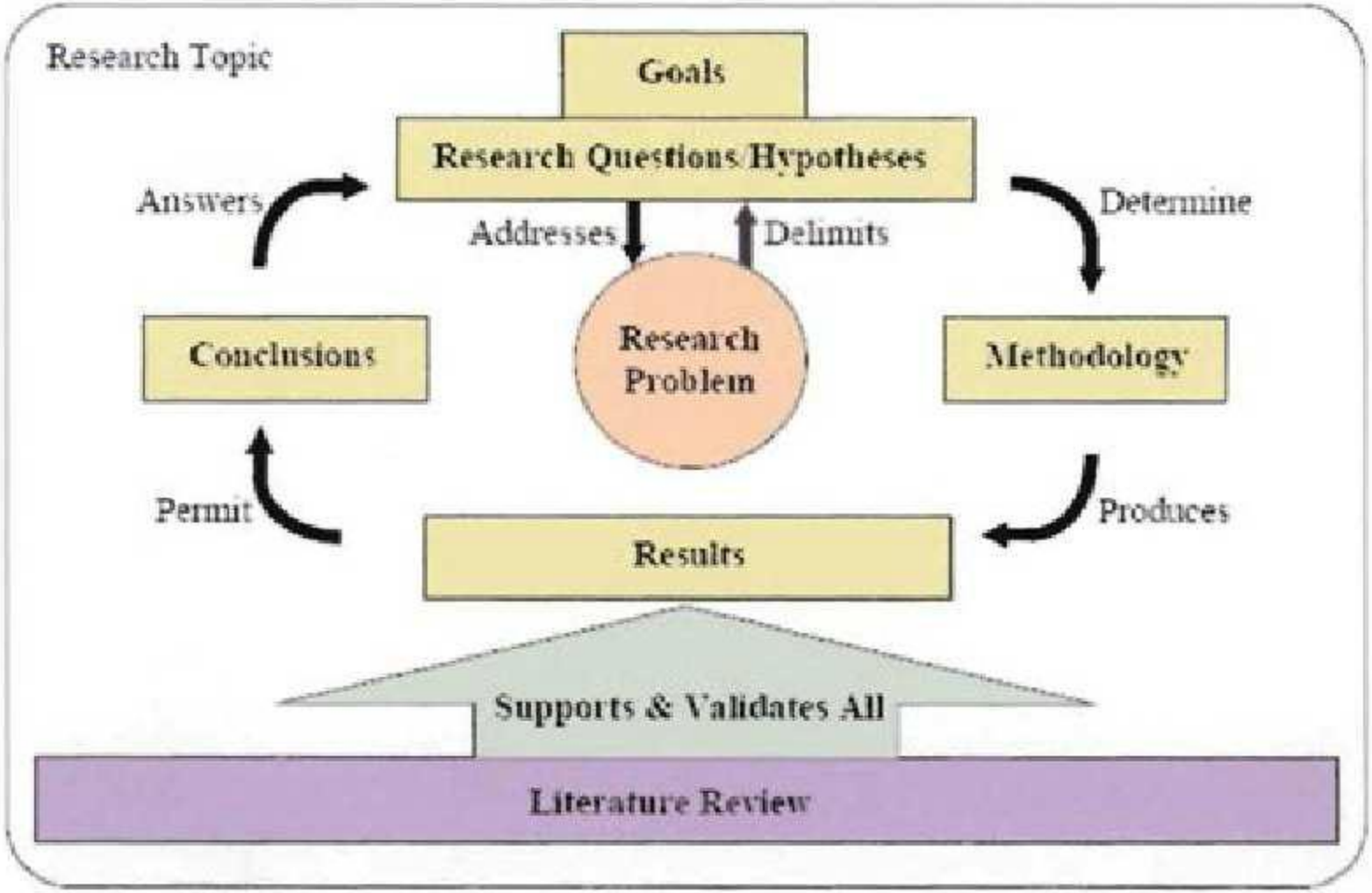


Figure 1: Conceptual Map of the Problem-Based Research Cycle

2.7 How to identify the research objectives?

SMART Objectives

- **S**pecific: Be precise about what you are going to achieve
- **M**easurable: Quantify the objectives
- **A**ppropriate: Align with the needs of the target audience
- **R**ealistic: Do you have the resources to make the objective happen?
- **T**ime-Specific: State when you will achieve the objective

SMART Objectives

Specific: Be precise about what you are going to achieve

- Specify target
- Specify intended outcome
- One outcome per objective
- Avoid vague verbs (e.g. know, understand)
- Make sure the objective is linked to the goal
- *Sample: By January 2010, at least 3% of the engineering majors at the institution will be female*

SMART Objectives

Measurable: Quantify the objectives

- Use measures as indicators of program success
- If possible, establish a baseline *(e.g. In January 2009, 2% of the engineering majors at the institution were female)*
- *Sample: By January 2010, at least **3%** of the engineering majors at the institution will be female*

SMART Objectives

Appropriate: Align with the needs of the target audience

- Meeting the objective will advance the goal
- Identify a specific target audience
- Are inclusive of diversity within your group
- *Sample: By January 2010, at least 3% of the engineering majors at the institution will be **female***
- ***Note: The "A" is sometimes called "Attainable" or "Achievable" in the literature.***

SMART Objectives

Realistic : Do you have the resources to make the objective happen?

- Are important to stakeholders
- Are adequately resourced
- Can be achieved
- *Sample: By January 2010, at least 3% of the engineering majors at the institution will be female*

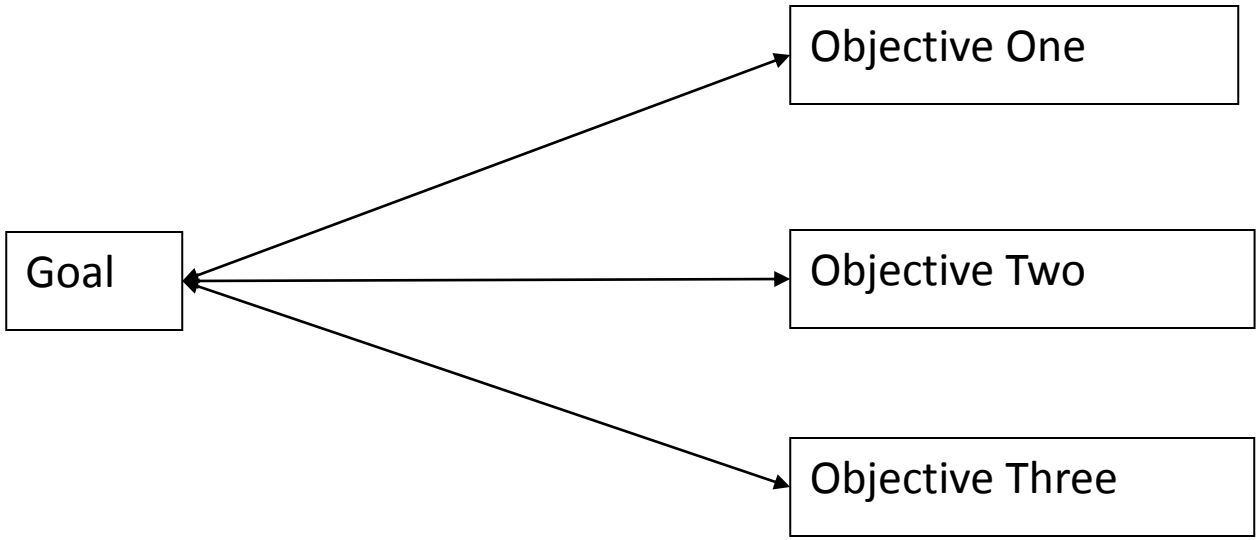
Take care on what you say you can do! The January 2009 baseline was 2%. Is a 1% increase in one year realistic?

SMART Objectives

Time-Specific: State when you will achieve the objective

- Provide timeframe indicating when objective will be met
- *Sample: By **January 2010**, at least 3% of the engineering majors at the institution will be female*

Goals and Objectives



*Maintain a clear connection between your goals and objectives. By maintaining this connection, you are articulating your **theory** of goal attainment.*

2.8 Scope of research: Criteria for Masters vs Doctoral Level of research.

Our Focus:

ENGINEERING

Engineering Disciplines:

- Electrical and Electronics
- Civil
- Chemical
- Mechanical

Activities in Engineering Research [1]

- Involve in the development of new algorithms/techniques/methodologies.
- Involve in the confirmation of newly proposed algorithms (applications to benchmark problems or laboratory equipment).
- Involve in the design of new products/circuits.
- Involve in comparing a number of different methodologies.
- Stability analysis on newly proposed algorithms.

Activities in Engineering Research [2]

- Involve in the application of some proposed algorithms in novel applications.

- Involve in the study of certain aspects of dynamics (behavior) of plants/systems.

- Involve in surveys of some engineering aspects.
- Involve in market study of certain engineering products.

- Involve in the study on the effects of environmental factors on a particular product/design.

Activities in Engineering Research [3]

- Involve in improving the design of existing products.
- Involve in extending the algorithms developed by others to a wider variety of applications/systems.
- Involve in the testing of new techniques extensively on benchmark problems in which earlier research has not done.

Differences between Research Activities in the Engineering Discipline and Others? [1]

- Engineering research are more formulative in nature.
- A lot is based on mathematics.
- Experiments are conducted on machines, rather than humans or animals.
- Data to be collected differ significantly.
- Hypotheses arrived at are largely based on mathematical proofs, rather than just an educated guess.

Differences between Research Activities in the Engineering Discipline and Others? [2]

- Experiments can be done within a shorter period of time.
- Outputs in engineering research are more tangible such as a software, a new machine or component, or even mathematical equations, etc.
- Engineering research do not differ much in different regions of the world.

Differences in Postgraduate and Undergraduate Research

Postgraduate Research

- Time (Longer)
- More algorithmic /mathematical
- Applications should be novel
- More detailed analysis

Undergraduate Research

- Time (Shorter)
- Emphasis is not on developing of new algorithms
- Applications not necessarily novel
- Analysis need not necessarily be substantial

Research Program at the University (Time frame)

- PhD: 3-4 years
- Masters by Research: 1.5-2 years
- Masters by Instruction (Course): 3-6 months
- Bachelors: 3-4 months

Research Program at the University (Differences in levels)

- PhD: More algorithmic, development of new techniques, extension of existing new techniques, and/or novel applications.
- Masters by Research: Mainly novel applications, applications of relatively new techniques or algorithms, comparisons of techniques.
- Masters by Instruction (Course): Case studies, mostly similar to Bachelor projects with more analysis.
- Bachelors: Application of existing techniques, case studies, software or circuit design to implement existing techniques.

Summary of Module

In this module, we have studied the following:

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THANK YOU