

Engineers & Society

CHAPTER 6 (Part 1) ENGINEERS AND RESEARCH

by

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R&D - What?

- *Search* means to look for something whereas
- *Re* means do something again and again.

Research simply means

- To look in detail or to search intensively
- **Other definitions**
 - ‘The careful, systematic, patient study and investigation in some field of knowledge, undertaken to discover or establish facts or principles’
(Webster's New World Dictionary)

“Creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications”

(Organization for Economic Cooperation and Development (OECD) and adopted by MOSTI)

R&D - What?

OECD breaks Research into three parts:

1. Basic/Pure Research
2. Applied research
3. Experimental Development

Types of Research (OECD)

Basic (Pure) Research:

- Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundations of phenomena and observable facts without any particular application or use in view.
- Intended to expand the boundaries of knowledge and conducted to verify the acceptability of a given theory.

Types of Research (OECD)

Applied research:

- Research conducted to answer specific problems or to make accurate decision for a particular business decisions, policies and strategies.
- Original investigation undertaken in order to acquire new knowledge directed primarily towards a specific practical area of objective


Types of Research (OECD)

Experimental Development:

- Systematic work drawing on existing knowledge gained from research or practical experience directed towards producing new materials, products and devices, to installing new processes, systems and services and towards substantially improving those already produced and installed

RND - Why?

Theory



Research that makes a
difference . . . in theory
and practice

Research

Practice

R&D

What Research Is Not

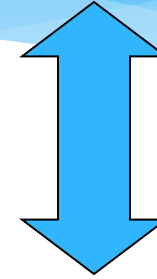
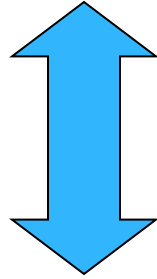
- * Research isn't information gathering:
 - * Gathering information from resources such books or magazines isn't research.
 - * No contribution to new knowledge.
- * Research isn't the transportation of facts:
 - * Merely transporting facts from one resource to another doesn't constitute research.
 - * No contribution to new knowledge although this might make existing knowledge more accessible.

R&D - What

- * Research is:

“...the systematic process of collecting and analyzing information (data) in order to increase our understanding of the phenomenon about which we are concerned or interested.”

R&D – How?



Stages of Research

- Finding a topic and supervisor
- Developing the hypothesis
- Literature review
- Collection of Data / Experiments
- Data analysis
- Writing up
- Viva



Requires

- Good time management
- Effective Supervisory relationship
- Effective management information
- Good Scheduling and organisation
- Hard work!!

Introduction: Research Characteristics

1. Originates with a question or problem.
2. Requires clear articulation of a goal.
3. Follows a specific plan or procedure.
4. Often divides main problem into subproblems.
5. Guided by specific problem, question, or hypothesis.
6. Accepts certain critical assumptions.
7. Requires collection and interpretation of data.
8. Cyclical (helical) in nature.

Getting Start: Steps

- * Find a topic → What, When
- * Formulate questions → What, Why
- * Define population → Who, When
- * Select design & measurement → How
- * Gather evidence → How
- * Interpret evidence → Why
- * Tell about what you did and found out

Getting Start: Research Projects

- * Think of a topic that interest you
- * Make sure that the issue is **researchable** and have **literature base** academically
- * Be prepared to spend several hours in an academic library to help you search out good sources on your intended topic and not totally depend on Internet
- * It is probably better to think of the whole of your project as essentially **answering a question** rather than researching a field

Getting Start: Research Projects

- * Research begins with a problem.
 - * This problem need not be Earth-shaking.
- * Identifying this problem can actually be the hardest part of research.
- * In general, good research projects should:
 - * Address an important question.
 - * Advance knowledge.

Getting Start: Research Projects Pitfalls

- * The following kinds of projects usually don't make for good research:
 - * Self-enlightenment.
 - * Comparing data sets.
 - * Correlating data sets.
 - * Problems with yes / no answers.

Getting Start: Quality Research (1)

- * Good research requires:
 - * The scope and limitations of the work to be clearly defined.
 - * The process to be clearly explained so that it can be reproduced and verified by other researchers.
 - * A thoroughly planned design that is as objective as possible.

Getting Start: Quality Research (2)

- * Good research requires:
 - * Highly ethical standards be applied.
 - * All limitations be documented.
 - * Data be adequately analyzed and explained.
 - * All findings be presented unambiguously and all conclusions be justified by sufficient evidence.

Getting Start:

Sources of Research Problems

- * Observation.
- * Literature reviews.
- * Professional conferences.
- * Experts.

Getting Start:

Stating the Research Problems

- * Once you've identified a research problem:
 - * State that problem clearly and completely.
 - * Determine the feasibility of the research.
- * Identify subproblems:
 - * Completely researchable units.
 - * Small in number.
 - * Add up to the total problem.
 - * Must be clearly tied to the interpretation of the data.

Getting Start: Hypotheses

- * Hypotheses are tentative, intelligent guesses as to the solution of the problem.
 - * There is often a 1-1 correspondence between a subproblem and a hypothesis.
 - * Hypotheses can direct later research activities since they can help determine the nature of the research and methods applied.

Getting Start: Delimitations

- * All research has limitations and thus certain work that **will not** be performed.
- * The work that will not be undertaken is described as the ***delimitations*** of the research.

Getting Start: Definitions

- * Define each technical term as it is used in relation to your research project.
 - * This helps remove significant ambiguity from the research itself by ensuring that reviewers, while they may not agree with your definitions, at least know what you're talking about.

Getting Start: Assumptions

- * Assumptions are those things that the researcher is taking for granted.
 - * For example: a given test instrument accurately and consistently measures the phenomenon in question.
- * As a general rule you're better off documenting an assumption than ignoring it.
 - * Overlooked assumptions provide a prime source of debate about a research project's results.

Getting Start: Importance of the Study

- * Many research problems have a kind of theoretical feel about them. Such projects often need to be justified:
 - * What is the research project's practical value?
- * Without this justification, it will prove difficult to convince others that the problem in question is worth study.

Research Proposal Contents

- * Research proposals are documents that describe the intended research including:
 - * Title
 - * Proposed Supervisor
 - * Problem and subproblems (Motivation)
 - * Hypotheses.
 - * Delimitations.
 - * Definitions.
 - * Assumptions.
 - * Importance.
 - * Literature review.
 - * Objectives
 - * Methodology
 - * Expected Output
 - * References

References

1. Leedy P. D. and Ormrod J. E., Practical Research: Planning and Design, 7th Edition. 2001.
2. <http://www.mosti.gov.my/>



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