Session One:
Research Concepts

Agenda

◆ Research Basics
- What research is and is not
- Where research comes from
- Research deliverables

◆ Methodologies
- Research process
- Quantitative versus qualitative research

◆ Questions

Research Basics

- ◈ What research is and isn't
- ◈ Research characteristics
- ◈ Research projects and pitfalls
- ◈ Sources of research projects
- ◈ Elements of research proposals
- ◈ Literature reviews

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.

What Research Is

◆ 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."[1]

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.

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.

Research Project 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.

High-Quality Research
(1 of 2)

◆ 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.

High-Quality Research
(2 of 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.

Sources of Research Problems

◆ Observation.
◆ Literature reviews.
◆ Professional conferences.
◆ Experts.

Stating the Research Problem

◆ 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.

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.

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.

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.

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.

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 Proposals

◆ Research proposals are documents that describe the intended research including:

- Problem and subproblems.
- Hypotheses.
- Delimitations.
- Definitions.
- Assumptions.
- Importance.
- Literature review.

Literature Review

◆ A literature review is a necessity.
  - Without this step, you won't know if your problem has been solved or what related research is already underway.

◆ When performing the review:
  - Start searching professional journals.
  - Begin with the most recent articles you can find.
  - Keep track of relevant articles in a bibliography.
  - Don't be discouraged if work on the topic is already underway.

Literature Review Pitfalls
(1 of 2)

◆ Be very careful to check your sources when doing your literature review.

◆ Many trade magazines are not peer reviewed.
  - Professional conferences and journals often have each article reviewed by multiple people before it is even recommended for publication.

  - The IEEE and ACM digital libraries are good places to start looking for legitimate research.

Literature Review Pitfalls

- ◆ The Internet can be a good source of information. It is also full of pseudo-science and poor research.

- ◆ Make sure you verify the claims of any documentation that has not been peer reviewed by other professionals in the computing industry.

Processes & Methodologies

- ◆ Research Process.

- ◆ Common Methodologies.

- ◆ Methodology Comparison.

Research Process

◆ Research is an extremely cyclic process.
  - Later stages might necessitate a review of earlier work.

◆ This isn't a weakness of the process but is part of the built-in error correction machinery.

◆ Because of the cyclic nature of research, it can be difficult to determine where to start and when to stop.

Step 1: A Question Is Raised

◆ A question occurs to or is posed to the researcher for which that researcher has no answer.
  - This doesn't mean that someone else doesn't already have an answer.

◆ The question needs to be converted to an appropriate problem statement like that documented in a research proposal.

Step 2: Suggest Hypotheses

◆ The researcher generates intermediate hypotheses to describe a solution to the problem.
  - This is at best a temporary solution since there is as yet no evidence to support either the acceptance or rejection of these hypotheses.

Step 3: Literature Review

◆ The available literature is reviewed to determine if there is already a solution to the problem.
  - Existing solutions do not always explain new observations.
  - The existing solution might require some revision or even be discarded.

Step 4: Literature Evaluation

◈ It's possible that the literature review has yielded a solution to the proposed problem.

- This means that you haven't really done research.

◈ On the other hand, if the literature review turns up nothing, then additional research activities are justified.

Step 5: Acquire Data

◈ The researcher now begins to gather data relating to the research problem.

- The means of data acquisition will often change based on the type of the research problem.

- This might entail only data gathering, but it could also require the creation of new measurement instruments.

Step 6: Data Analysis

◆ The data that were gathered in the previous step are analyzed as a first step in ascertaining their meaning.

◆ As before, the analysis of the data does not constitute research.
- This is basic number crunching.

Step 7: Data Interpretation

◆ The researcher interprets the newly analyzed data and suggests a conclusion.
- This can be difficult.
- Keep in mind that data analysis that suggests a correlation between two variables can't automatically be interpreted as suggesting causality between those variables.

Step 8: Hypothesis Support

◆ The data will either support the hypotheses or they won't.
- This may lead the researcher to cycle back to an earlier step in the process and begin again with a new hypothesis.
- This is one of the self-correcting mechanisms associated with the scientific method.

Common Methodologies

◆ Methodologies are high-level approaches to conducting research.
- The individual steps within the methodology might vary based on the research being performed.

◆ Two commonly used research methodologies:
- Quantitative.
- Qualitative.

Methodology Comparison

Quantitative	Qualitative
◆ Explanation, prediction	◆ Explanation, description
◆ Test theories	◆ Build theories
◆ Known variables	◆ Unknown variables
◆ Large sample	◆ Small sample
◆ Standardized instruments	◆ Observations, interviews
◆ Deductive	◆ Inductive

References

1. Leedy P. D. and Ormrod J. E., <u>Practical Research: Planning and Design, 7th Edition</u>. 2001.

Useful Websites

- http://computer.org
- http://www.acm.org

Questions?