SOFTWARE ENGINEERING RESEARCH

DEFINITIONS

RESEARCH:

Diligent search or inquiry; scientific investigation and study to discover facts.

SCIENCE:

Systematic knowledge of natural or physical phenomena;

Facts ascertained by observation, experiment, and introduction;

Ordered arrangement of facts known under classes or heads;

Theoretical knowledge as distinguished from practical;

Knowledge of principle and rules of invention, construction, mechanism, etc.,

As distinguished from art.

THEORY/MODEL:

A system for explaining a set of phenomena by specifying constructs and the
laws that relate these constructs to each other.

WHAT ARE THE AVAILABLE RESEARCH PARADIGMS?

Fact: information obtained through direct observation
Hypothesis: educated guess, precedes an experiment
Experiment: operation carried out (sometimes under controlled conditions) to discover unknown effect/law, test/establish hypothesis, illustrate a known law
Theory: possible explanation based upon many facts/reason
Law: description/observation of behavior used for prediction based upon facts and reason
Model: simplified representation of a system/phenomenon
                  ➡ can be a theory or a law
Paradigm: conceptual filter, how we perceive/interpret
Truth: what really is

RESEARCH APPROACHES

ESTABLISHED FIELD:

Easier to answer questions

Areas better defined

More consensus on the importance of an area

Standard methods of study

METHODOLOGICAL APPROACHES:

ANALYSIS:

Build a theory

Derive properties

Show boundary conditions and limits

EXPERIMENTATION:

Formulate hypotheses

Deduce empirical consequences

Test the hypotheses by collecting data

QUESTIONS FROM EVALUATING RESEARCH

IS THERE NEW KNOWLEDGE?
   Were the methods used to obtain the knowledge scientifically sound?

ARE THE RESULTS SIGNIFICANT?
   Do they improve our ability to describe, predict, control or explain?

PICKING A TOPIC:
   Build on prior theories
   Fill in gaps in theories
   Create new theories that explain better than old
   Disprove a commonly held "proven" theory

CHARACTERISTICS:
   Can be neatly packaged
   Focused
   Consistent methodology

QUESTIONS FROM EVALUATING RESEARCH

Develops new knowledge
- which can be applied to the improvement of the field
- e.g., software process or product

If in medicine:
- doctors were to lose their base of medical knowledge -- they would have to stop working, e.g., surgeons couldn't perform surgery without research-based knowledge about heart functions, anesthesia, meaning of symptoms, or the likely risk of a particular course of action.

What part of computer sciences is like this?

How about software engineering?

What would make the following dissertation research?
- Building a descriptive model/theory
- Building a predictive model/theory
- Improving an existing model/theory
- Verifying properties of a model/theory
- Implementing/automating a model/theory

THINKING ABOUT THE RESEARCH PROCESS
THEORY AND RESEARCH PERSPECTIVES

PROBLEM STATEMENT/ QUESTIONS	WHAT IS KNOWN	GAP IN KNOWLEDGE	RATIONALE/ FUNDAMENTAL REASONS	SIGNIFICANCE/ ASSUMPTIONS	IMPLICATIONS

THINKING ABOUT THE RESEARCH PROCESS
PROCEDURAL PERSEPECTIVE

SEARCH QUESTIONS	POPULATION	DATA NEEDED/ VARIABLES	DATA SOURCE/ INSTRUMENT	DATA COLLECTION PROCEDURE	ANALYSIS

SAMPLE EXPERIEMTNAL DISSERTATION

CHAPTER 1:   Introduction:
    A.   General statement of the problem
    B.   Statement of the hypotheses, objectives, or questions
    C.   Definitions of terms (assumptions/limitations/significance)

CHAPTER 2:   Review of the Literature:
    A.   Review of previous research
    B.   Pertinent opinion
    C.   Summary of the state-of-the-art (tie it all together)

CHAPTER 3:   Method:
    A.   Description of the subjects (how chosen)
    B.   Research design and procedures
          (overview of statistical procedures)
    C.   Description of measures employed

SAMPLE EXPERIMENTAL DISSERTATION

CHAPTER 4:   Findings:
    A.   Description of finding pertinent to each hypothesis, objective, or question
    B.   Other findings

CHAPTER 5:   Summary and Discussion:
    A.   Summary of research problem, method, and finding
    B.   Conclusions
    C.   Implications
    D.   Suggestions for further research