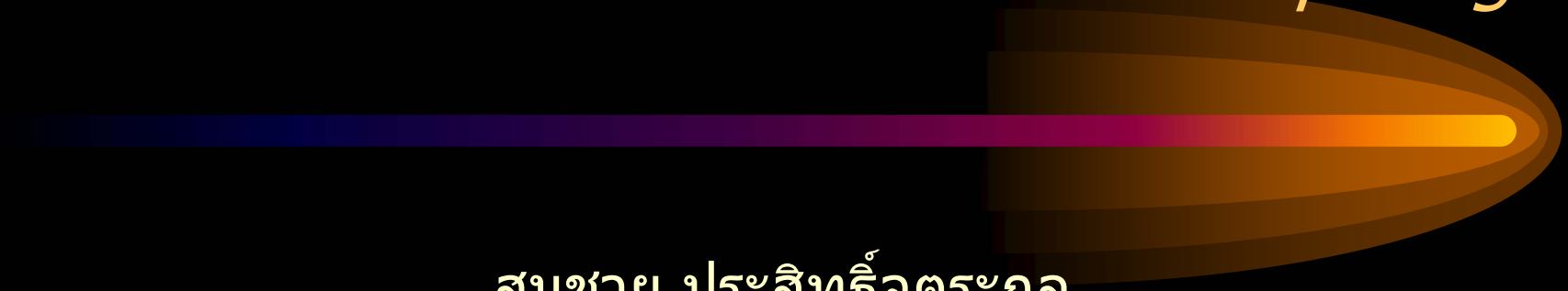
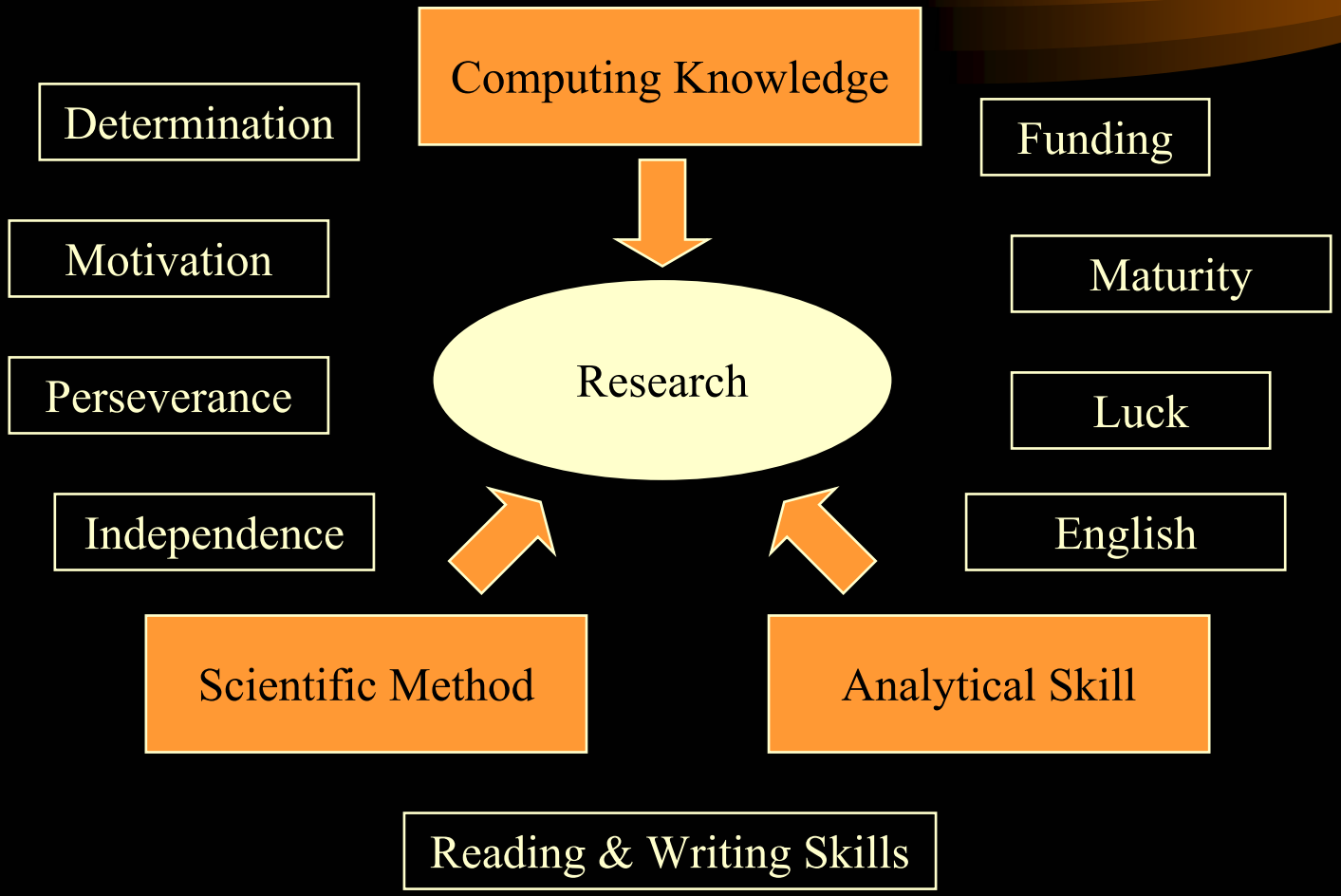
Research in Computing



สมชาย ประสิทธิ์จูตระกูล

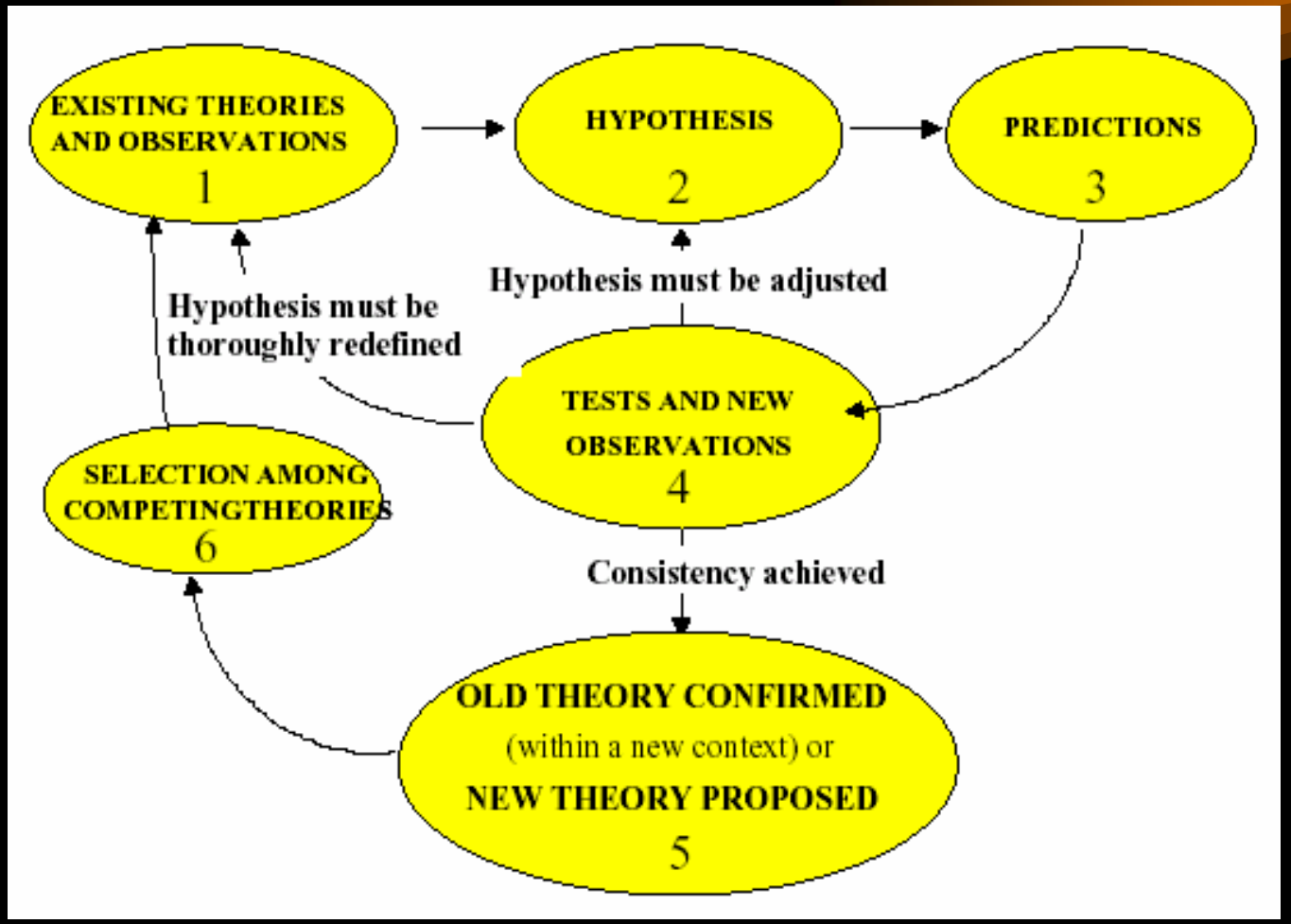
Success Factors in Computing Research



Discipline in Computing

Artificial intelligence
Bioinformatics
Cognitive science
Computational science
Computer science
Database engineering
Digital library science
Graphics
Human-computer interaction
Information science
Information systems
Instructional design
Knowledge engineering
Learning theory
Management information systems
Multimedia design
Network engineering
Performance analysis
Scientific computing
Software architecture
Software engineering
System administration
System security and privacy
Web service design

Scientific Method



Engineering

- Construction of (useful) products
- Solving problems
  - understand the problem
  - analyse the problem
- Find solutions
  - Constructing the solution from parts that address the problem's various aspects - do a synthesis
- Engineers
  - apply theories, methods and tools from different disciplines
  - Search for solutions even when there is not theory or methods

Distinctions between S & T

- Unchangeable vs. Changeable
- Inherent vs. Imposed
- General vs. Specific
- End in Itself vs. End in Something Else
- Abstracting vs. Modeling Complex Systems
- Conceptualizing vs. Optimizing
- Discovery vs. Invention
- Long-term vs. Short-term

Research

- Careful or diligent search
- Studious inquiry or examination; *especially* : investigation or experimentation aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws
- The collecting of information about a particular subject

Building Blocks for Research

Questions	Result	Validation
Feasibility	Qualitative model	Persuasion
Characterization	Technique	Implementation
Method / Means	System	Evaluation
Generalization	Empirical model	Analysis
Discriminization	Analytic model	Experience

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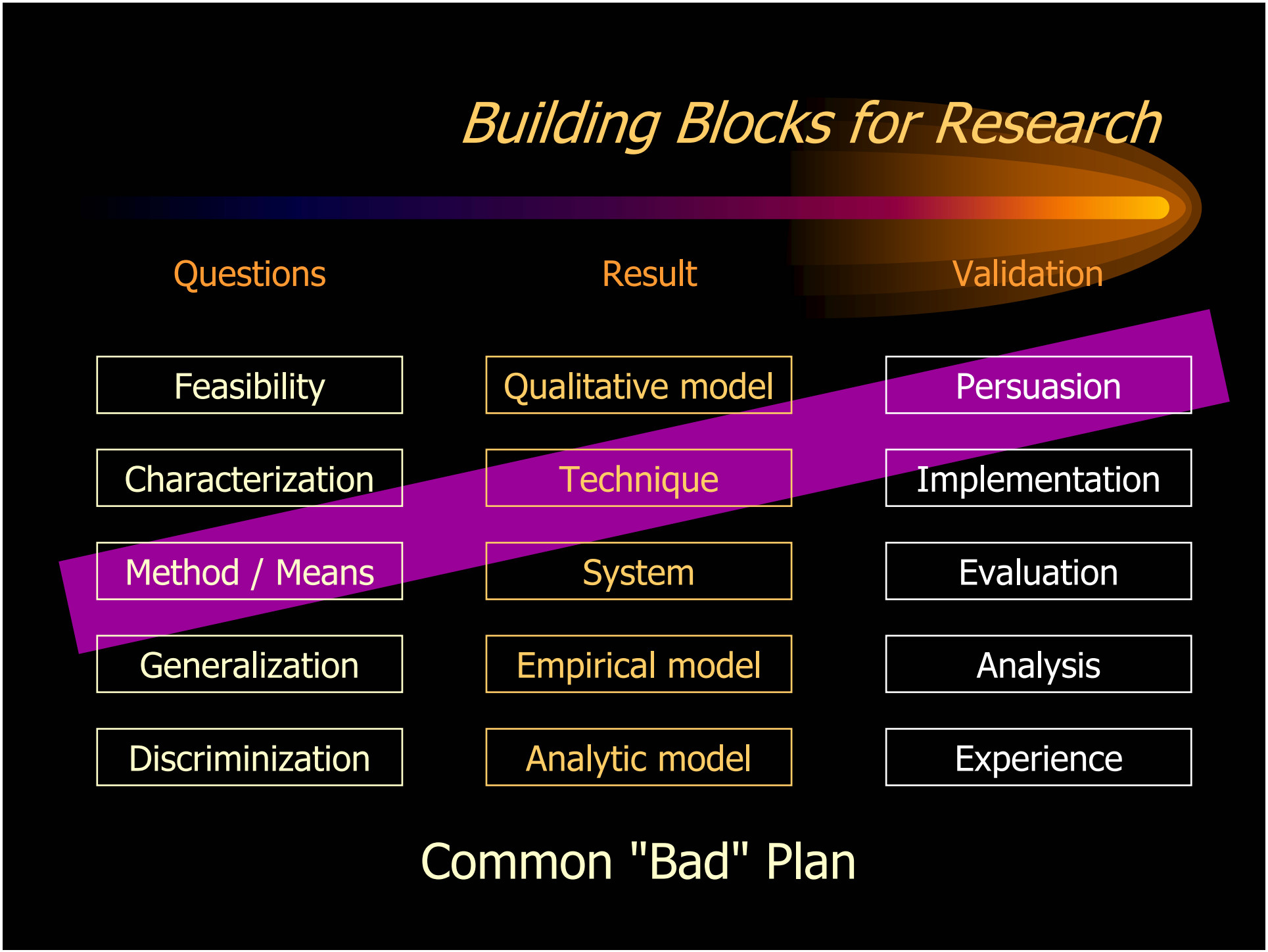
A "Good" Plan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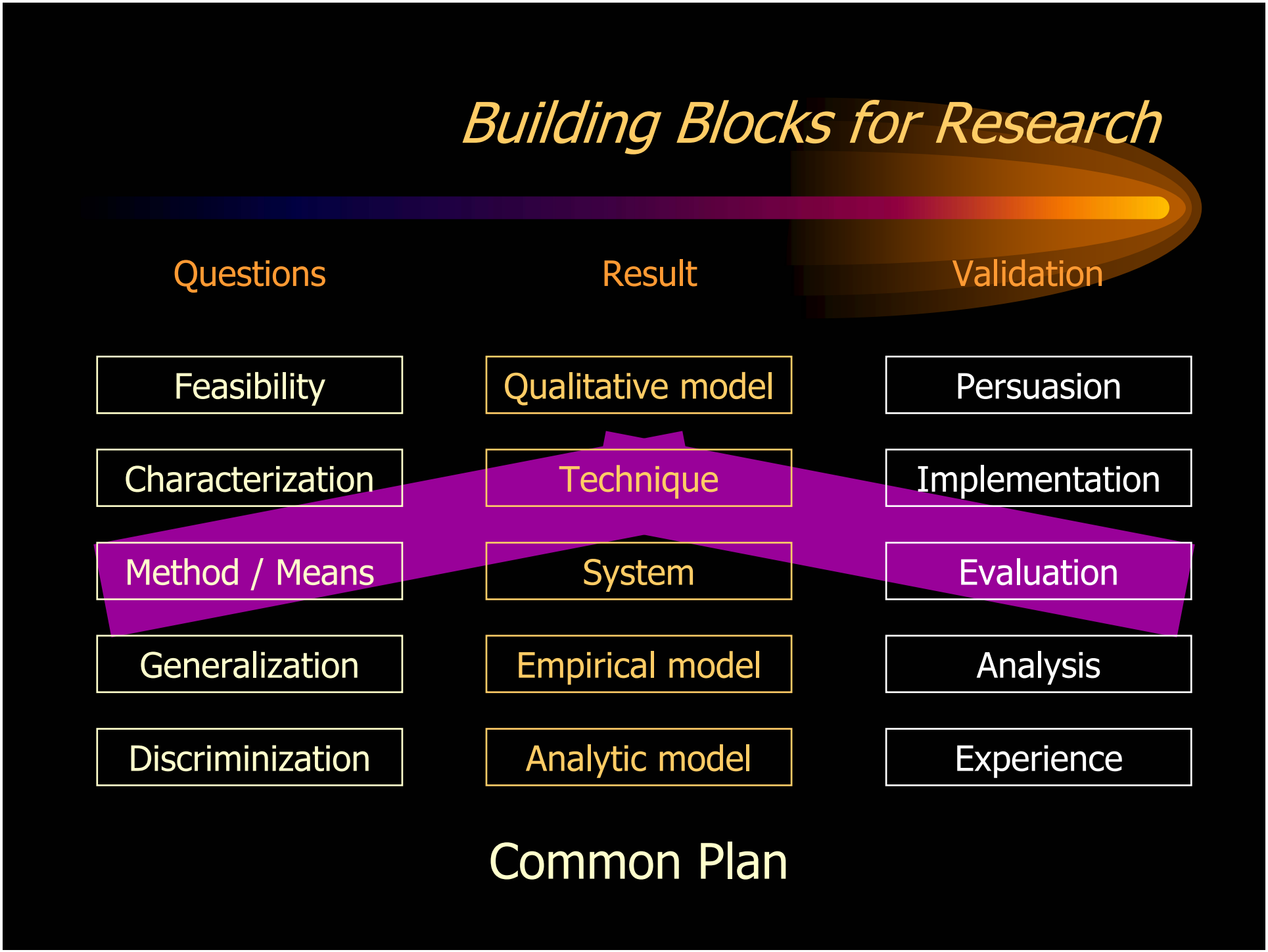
Experience
Common "Bad" Plan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Experience
Common Plan

Validation of CS Papers

- CS published relatively few papers with experimentally validated results.
- Sampling CS articles from ACM
  - 40% have no experimental validation
  - only 30% devote 1/5 space to experimental validation
- Sampling articles from IEEE Trans. on SE
  - 50% have no experimental validation
  - only 20% devote 1/5 space to experimental validation

- Paul Lukowicz and et.al., "Experimental Evaluation in Computer Science: A Quantitative Study", Journal of Systems and Software, January 1995

Validation in NN Papers

- Only 22% of the top NN journal articles use more than one real world problem data and compare the results to at least one alternative algorithm.

- Lutz Prechelt, "A Quantitative Study of Experimental Evaluations of Neural Network Learning Algorithms: Current Research Practice", Neural Networks Vol. 9, 1996

Reading is Fundamental

- Finding and reading related work is the foundation of good research
  - ACM Guide to Computing Literature
  - Computing Reviews
- Developing a bibliography of related works
- Background reading + Important reading
  - Journal + Proceeding

Reading with care

- Abstract, introduction, conclusion
- Get important points
- If relevant, read the whole thing
- Take note during reading
  (make your thought organized)

Reading with Care

- Ask questions when reading
  - what is the motivation ?
  - what is the contribution ?
  - How does this contribution realte to work previously encountered ?
  - What are the important references cited ?
  - What questions are left unanswered ?
  - Can the results be generalized ?
  - Can the specific result be improved ?

Writing is Fundamental

- Good writing is the only lasting medium of the scientific process.
- Mathematics or code are not substitutes for English
- Document your work regularly

Working with Others

- Success comes from work with others
- Share ideas and let them develop in group atmosphere
- Carefully consider criticism, use it as a guideline

Programming

- A programming project is not research
- It is a mechanism for performing experiment
- Experiment
  - Establish goals
  - Think simple (develope manageble project)
  - build prototype (not a complete product)
  - use tools (perl, MathLab, Mathematica, Excel, SPSS, ...)
  - Collaborate
  - Document results

David Patterson's Six Steps

- Selecting a problem
- Picking a solution
- Running a project
- Finishing a project
- Quantitative evaluation
- Transferrring technology

Recommendation

- Grad school is unstructured environment
  - reading papers
  - discussing ideas with colleagues
  - writing and revising papers
  - staring blankly in space
  - having brillant idea and implementing them
- Spend your time wisely