

# Writing Research Papers

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## 3 Components (3 Roles)

1. *(Have an idea)* You have an idea that *you think* is good (Innovator 發明家)
2. *(Verify the idea)* You do all the work (analysis, simulation, etc.) to convince yourself that the idea is *indeed* good (Engineer 工程師)
3. *(Sell the idea)* You package the idea and the supporting results in a form (i.e., research papers) that can convince people that the idea is good and *worth publishing* (Salesperson 推銷員)

# Gap Between 3 Components

- (Gap between 1 and 2) An initial idea may prove useless/wrong after simulation/analysis
- (Gap between 2 and 3) Good ideas and good results may be tarnished if they are not well-presented in a research paper
- You need *all* 3 components to publish a research paper
- Filling the gap is the focus of Ph.D. education

# Component 1

- A creative mind is somewhat a personal trait
- However, it can be cultivated through:
  - Deepened understanding of an area of study
  - Proactive reading
  - Keen observation
  - Peer discussion
  - Interdisciplinary leverage

# Component 2

- An idea is of little use if not investigated, explored, expanded, tinkered, etc., because
  - Its use in practical context is unclear
  - Its “performance” is unjustified or unexamined
  - It can turn out to be a bad idea after detailed study
  - It’s simply not exciting to know
- Therefore, you do lots of “dirty work”: coding, simulation, comparison with previous work, analysis, proof, etc.

## Component 2 (Cont.)

- Simulation results are needed in *all* research papers (except highly theoretic work)
- Analytical results are generally needed in *journal* papers
- Simulation shows *superior performance*
- Analysis tells *why* and forms the theoretic basis for further research and development

# Component 3

- Good ideas and beautiful results are of little use if not well-presented, because
  - The only way people get to know your work is through your writing, not through conversation with you
  - A poorly-written paper can be confusing and hard to read, even causing misunderstanding
  - In short, people do not know what your idea was
- A research work is *incomplete* until it's written up in a paper form and criticized by peers and experts
- *Nobody* can write the paper for you

# Component 3 (Cont.)

- Some useful tips for writing papers:
  - Make an outline (Sec. II: xxx, Sec. II-A: xxx, etc.)
  - Focus on what you want to say first, and just write (don't worry about grammar, sentence structure, etc.)
  - Then edit the raw writing (tend to grammatical errors, reorder sentences, enhance clarity and fluidity, etc.)
  - Edit many times – even the most proficient writers do so
  - Keep this in mind: clarity, conciseness, logic, fluidity



# Component 3 (Cont.)

- Introduction (Sec. I)
  - Write “from big to small”
  - The general area (e.g., MIMO communication) -> A key problem in this area (i.e., the topic of this work) -> Previous work on this problem -> Our proposed solution -> Highlights of our contributions
- Results and Discussions (Sec. IV or V)
  - Write “from small to big”
  - Interpretation of specific simulation figures -> Implication and generalization of the observation made from these figures