

Research Problem Identification

IETYMS CHENNAI

**Workshop on Research Methodologies at
Hotel Chennai Deluxe**



Speaker : Dr. Subir Kumar Sarkar
Professor,
Department of Electronics & Telecommunication Engg.
Jadavpur University
Kolkata-32



Subir Kumar Sarkar received the B. Tech and M. Tech. Degree from the Institute of Radio Physics and Electronics, University of Calcutta in 1981 and 1983, respectively and PhD (Tech) degree in Microelectronics from University of Calcutta. He served Oil and Natural Gas Commission (ONGC) as an Executive Engineer for about 10 years(1982 to 1992) before coming to teaching profession. In ONGC he was involved in the repair , maintenance, planning, import substitution for sophisticated electronic equipments including computers used for control & monitoring of oil exploration and satellite based wireless communication for communication between on shore -- offshore & between remote work sites ---base office communication and software development for oil field related work . He joined as a faculty member in the Dept. of Electronics and Telecommunication Engineering, Bengal Engineering and Science University, Shibpur in April 1992 (from 1992 to 1999). In 1999 he joined in Jadavpur University in the same dept. where he is presently a Professor. He has developed several short courses for the needs of the Engineers.



He has published three Engineering text books and more than 250 technical research papers in archival journals and peer – reviewed conferences. He was a coauthor of a young Scientist awarded paper. Ten scholars have been awarded PhD (Engg) degree under his guidance. He was on the Technical/ organizing/advisory committee of several major international/ national conferences/ symposiums and was the organizing Secretary of International conferences on communications, devices and intelligent systems (CODIS2004) . As Principal Investigator he has successfully completed four R&D projects and three more are running. He has visited several countries like USA, France, UK, Switzerland and Japan for Technical reasons like training, presenting papers or visiting sophisticated laboratories. In 2005 he was invited as a post doctoral Research scholar in the Dept. of Electrical and Computer Engineering , Virginia Commonwealth University to work on quantum computing, spintronics, quantum dot memory and electronic transport in Nanostructures and published two journal papers from the work. His most recent research focus is in the areas of simulations of nanodevice models ,transport phenomenon, single electron & spintronics devices and their applications in VLSI circuits , ad hoc wireless networks, wireless mobile communication and watermarking . He is a life Fellow of the Institution of Engineers, life member of Indian Association for the cultivation of Science.



What is Research

- **Research is about formulating problems or questions, whose answers the research or practitioner community wants to know, and whose answers are not known.**
- **Research is a means of providing some answer to these questions.**





Aspectsof doingPhD

So, the key aspects of doing a PhD are (a) formulating a question or a problem that is of interest and that can be solved, and (b) providing a useful/interesting solution to the stated problem. The results obtained are presented in national/international conferences, and/or submitted to scientific journals.

The problems that are addressed by a PhD scholar can range from very difficult open problems to evolutionary technology issues. In Electronics and Telecommunication Engineering, the problem areas can range from being highly theoretical or mathematical to modeling and experimentation or building new technologies. For example, there are a lot of open issues regarding the complexity of solving some problems algorithmically (like checking whether a number is a prime).



Prospect in Future

Software companies have emerged major employers of engineering graduates in the country. Though regular software jobs continue to increase, area of research and development is rapidly expanding in the IT sector. In a recent issue of Science, the cover article was whether India is becoming a Research and Development (R&D) hub or not. The article states that over 100 labs will be set up within a few years, of which many will be in IT. The recent trend shows how rapidly R&D is increasing. Till a few years ago, most companies typically had large development, but no research centers. The situation, however, has changed in the last few years. Many multinationals, which include Microsoft, Motorola, Lucent, Google, Philips, Sony, Erickson, HP, and Intel have already opened their R&D centers in the country. These centers are over and above their regular development centers.



There are at least 10 R&D centers operating today, and many more are likely to open in the next few years. It is fair to assume that in the next five years, there will be over 25 R&D centers in India, each employing 50 to 150 people, mostly Ph Ds. That is, a R&D centre will typically recruit about five to 10 Ph Ds per year . This translates to at least 200 research positions opening up each year in industry for Ph D graduates. In addition, there are the traditional opportunities in teaching and research labs. In India, there are probably no more than 50 Ph Ds graduating in ETCE each year. That is, there is an acute shortage of research manpower.



Qualities of a Good Researcher

- **What is important is to learn to properly formulate a problem and apply suitable techniques to produce results that further the state of understanding about that problem.**
- **The ability to conduct research in an area requires deep knowledge in that area, knowledge about related areas, and the experience of working on research problems, i.e. problems whose outcomes are not known.**
- **To develop these critical abilities, most PhD programs have three components in them – some course work to provide the breadth of knowledge, some methods to develop the depth of knowledge in the chosen area of study, and a thesis that provides the experience of working on research problems.**



CONTD

- **Through these components a PhD candidate should expect to develop the following abilities, which form the foundation of a career in research:**
 - **Breadth in the discipline – can be provided through courses.**
 - **Expertise in a vertical area in which the PhD candidate can say “I am an expert in this”. I.e. an area in which he has full knowledge of what is known, what is missing, etc. Developing this expertise requires ability to search for relevant work done in an area, as well as the ability to critically read and understand research papers, reports, and monographs and appreciate the subtle or complex issues that may be involved.**
 - **Ability to identify research problems. This is one of the most important abilities for a researcher. This ability requires a good knowledge of the recent developments in the area, and the ability to create a bigger picture and see how the different work fit and what might be missing. Formulating a problem properly is half the research done. In fact, most PhD candidates spend much of their time in defining the problem.**



This skill is strengthened as the person develops the subjective ability of judging results and problems. This skill is also needed by a PhD person as a member of the research community where one is called upon to review other peoples work.

- **Ability to actually do the research. Behind every research there is some new idea, some hypothesis, which forms the foundation of the research work. But doing research is much more than getting an idea. The idea has to be developed using the established paradigms of scientific research, through which the researcher shows the value of the idea. Spending time grappling with research issues, actually doing research, and studying research work of others can help in developing this ability. That is the main reason why doing independent research is always a part of a PhD program.**



- **Ability to write and present the results. This is very important and very difficult. Not only are issues of communication involved, but one has to convince a group of peers (who review it and later read it, if published) that the work is worthy of their time, the results have been put in context, the value is clearly articulated, etc. Publishing the results of research has been the time honored tradition and benchmark, and perhaps the only reliable method to subject a research work to scrutiny as well as use by others. Characteristics of successful scientists is having courage . One you get charged up and believe that you can do important problems, then you can. If you think you can't , almost surely you are not going to.**



Steps for Successful Research

- A. Choose and define a topic**
- B. Gather background information**
- C. Focus the topic**
- D. Write a thesis statement**
- E. Example**
- F. Assignment**

Most academic research papers are written for a specific class assignment and topics relate to the subject area of the class. Within this framework, it is wise to select a topic of personal interest to help sustain enthusiasm for the project.



Howto Generatea Research Topic

To generatetopic ideas,try some or all of the following:

- browse class textbooks and handouts;**
- review lecture notes;**
- discuss options with the professor;**
- discuss ideas with a reference librarian;**
- identify and browse recent journals in the subject area.**



Select a Research Topic

- **Your professor is often the best guide in helping you select an appropriate academic research topic, especially one which will satisfy the requirements of the course.**
- **Instructors often suggest topics in class or in the course syllabus.**
- **Remember that these ideas are typically broad suggestions. They may need to be narrowed in order to make them feasible term paper topics.**
- **If your professor has provided no topic guidance, you may wish to discuss possible topic choices with him or her during office hours.**
- **All professors are required to keep open office hours. Students are invited to drop by during these open hours to talk about classroom lectures, discussions, and assignments.**
- **If you decide to discuss your term paper topic selection with your professor, be sure to show up prepared with a number of possible topics, and for each have at least one clearly formulated research question.**
- **Your professor will not be pleased if you merely show up asking him/her to do this work for you!**



Probing Questions to Ask Yourself



- As you think of possible topics on which
- you'd like to do research and writing,
- pose the following questions to yourself. There's not necessarily a right or wrong answer to the questions, but they will allow you to explore whether the topic is the best choice or not.
- Am I seriously interested in this topic, or do I just have mild curiosity?
- Why? Why is it important to me personally (or to others)?
- What benefit is there for me to learn more about this topic through reading, research, thinking and writing?
- Does it connect to my academic, professional or personal interests?
- Do I already know or feel anything about this topic?
- Do I have significant information and data beyond the common knowledge that most people would have from TV or basic schooling?





- Beyond information that I may have, do I have strong views on the subject?
 - To what extent are these views based on analysis and to what extent on emotion and opinion?
 - Where did I get my information and views?
 - What more would I like to learn about?
 - What specific angles, dimensions, reasons, implications, etc. are not clear to me?
 - Why might these matter to me or to others?
 - Do I feel open-minded with regard to my topic?
 - If I do research, am I prepared to reconsider and interrogate my initial views and beliefs -- my sense of which group of people is at fault for a problem, my notions of right or wrong, my convictions about what should be done, and other fundamental beliefs and assumptions that I may hold with regard to the topic.



What information, data, and resources are available with regard to my topic?

- **Have I done a preliminary review of available resources to determine that there will be enough for me to proceed?**
- **Will I be able to find *scholarly sources* (e.g., academic journal articles) relating to my topic and research question?**
- **Can I imagine a modest and viable original research study using the options from the Research Methods webpage?**
- **Am I excited about doing this research?**
- **Does the topic and the prospect of doing an original research study have the potential to motivate me to become creative, diligent and unrelenting?**



-After reviewing the Required Sources section of the Research Project Guidelines webpage, am I confident that I can find an adequate range of sources, including the required interview with an expert?

The "So What?" question:

You are going to gather, examine and generate data and evidence, but this will not be enough. You will also have to interpret what you find and tell us why it's significant, how it changes our thinking about something, perhaps how what you find allows or invites us to see or do something differently as a result. In choosing your topic and research question, do you think you'll be able to respond to the "So What?" question?



A Specific Example:

Once you have selected a topic, you must clearly define the research question. It helps if you actually state your topic idea as a question. For example:

If you are interested in finding out about use of alcoholic beverages by college students, you might pose the question,

RESEARCH QUESTION: "What effect does use of alcoholic beverages have on the health of college students?"

Identify the main concepts or keywords in your question. In this case they are:

- alcoholic beverages
- health
- college students





Finally, examine your keywords and think of alternative ways that you might approach the same concepts. Make a list of synonyms, include alternative (narrower and broader) terms which may help focus or define the topic.

alcoholic beverages -- OTHER TERMS: alcohol, drugs, alcoholism, beer

health -- OTHER TERMS: physiological effects

college students -- OTHER TERMS: university students, undergraduate students, fraternity and sorority students

Use these keywords and alternative terms as you search for research material in the Library's electronic databases, or in Internet search engines which you choose.