

Air navigation

Assignment: First steps of a research project

1 Introduction

Generally, research is understood as systematic, controlled, empiric and critical investigation of hypothetic statements on supposed relationships among phenomenon. It is a process in which thinking is dominant. Characteristic features of research are:

- Systematic solving of scientific problems
- using scientific methods
- System of interconnecting phases and steps

The research process should be understood as one of ongoing planning, searching, discovery, reflection, synthesis, revision, and learning, as shown in Figure 1:



Figure 1: The research process

As showed above research is composed of a certain phases and steps. Step order may vary depending on the subject matter and researcher (Wikipedia, 2009). Taking into account different guidelines one can distinguishes different number of phases/steps in research process.

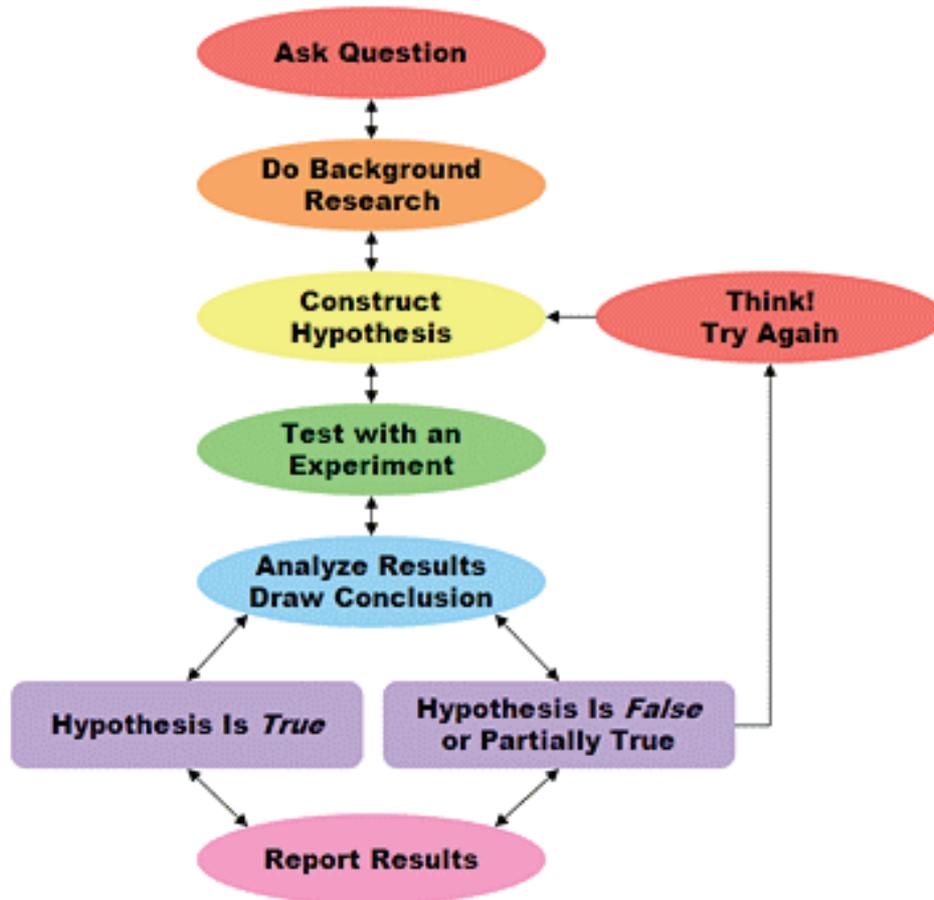


Figure 2: Research phases

The following five phases outline a simple and effective strategy for conducting effective research:

1. The conceptual phase
2. Phase of construction of research design
3. Empiric phase
4. Analytic phase
5. Disseminative phase

A sketch is given in Figure 2.

1.1 Phase of conception

This phase of research involves activities with a strong conceptual element. Conceptualisation refers to the process of developing refining abstract ideas. During this phase, the researcher categorises and labels his/her impressions. Thus, the activities include **thinking, rethinking, theorising, making decision, and reviewing ideas with colleagues, research partners or mentors/supervisors**. The researcher also needs to draw on the skills and abilities of creativity, analysis and insight, as well as on the firm grounding of existing research on the topic of interest. Phase of conception is the first phase of original research. In this phase are created content and structure of the planned research. Creation of conception of new research project is structured process. It can be divided into 4 steps as follows:

1. Formulation of research problem or research questions, set bounds of them, determine the purpose of the study
2. Searching and review the literature relating to the regarding research problem and develop a framework
3. Development of the theoretical construction of the future research
4. Creation of hypothesis which should be verified/phalsified in future research

1.1.1 Formulation of research problem and set bounds of it

The first step of the research work is to state the scientific problem. It is important to clearly state what your problem is to avoid any confusion later. Formulation of scientific problem is frequently recognized as **the most difficult and the most important part of research project**. Precisely it was expressed by A. Einstein (paraphrase):

If I have one hour for solving the problem on which my life depends, than I will devote 40 minutes to study the problem, 15 minutes to analyze the ways how to solve it, and only 5 minutes to solve it.

Scientific problem is frequently stated in form of a question.

If formulation of scientific problem is so difficult and important who than is qualified to do this job?

There is consent that it should be a person(s): **with large and high quality of knowledge in the respective field, with high creativity, able to think independently, large knowledge in culture and history, with ability to persist in research despite of serious problems, with non-conventional thinking, able to doubt on recent valid truth (dogmas), able to formulate and publicly present**

his/her own doubts, with appropriate dose of curiosity, able to resist to fashionable hypotheses and theories, able to preserve independent thinking in the sphere of strong scientific and/or political personalities, with high grade of perseverance in looking for scientific problem and its definition, able to look at scientific problem from different points of view, possessing excellent memory and appropriate dose of emotionality.

How the really important scientific problem can be discovered and defined? According to the definition the problem is something you'd like to know more about, a question you'd like to answer. Such questions can come from many different sources: **from lectures or textbooks, from an experiment you have just made (that raised another questions), from articles you've read in scientific journals or even newspapers and magazines.** To identify a scientific problem, then, you can find sources that relate to your topic and look to see what problems are raised in your search. Write down the problems that you find. Choose one that would be interesting to solve and that is feasible for you to solve. **Discovery of good scientific problem can't be planned. It will emerge or not! It can emerge at any time of day and night, at any situations (sometimes very peculiar)** without any identifiable dependence to previous study or research work. Despite of the mentioned uncertainties some situations and activities are more frequently recognized as the source of new ideas, new scientific problems. These are: sometimes it can be mere chance or it can be a result of observation an accidentally recorded phenomenon during research, it can be discovered by systematic study of the subject, and the problem emerge as a gap it can be identified during study of different sources of technical literature as controversies related to some facts, functions, and so on.

At the beginning the scientific problem is usually not well defined. There are not clear limit, its bounds are not set well. So, you may need to narrow it, to identify a more specific topic within the broader one (refinement of research question/problem). This can make it easier to work with. To set up the boundaries of scientific problem is very important step in preparation of future research. To fulfil this aim one have to: think about possible causes of observed new, up to now unknown phenomenon, create of hypothesis, think on whether defined scientific problem is solvable, think about methods suitable for solving the defined scientific problem.

How the research problem is formulated? At the beginning there is e.g. accidental observation of phenomenon which we are not able to explain. Thank to our curiosity we will start with looking for explanation. We formulate questions-why and how the phenomenon originated. There is a lot of uncertainties and only small amount of certainties at the beginning. The consideration on possible cause(s) of the phenomenon is formulated. These

considerations we discussed with co-workers, we are looking for answers in literature, and we consider personal experience of other researcher. If we are not able to find convincing explanation than we formulate primary research problem. Subsequently, we consider its solubility. If it seems soluble than what we are thinking on possible kinds of method which can be used for this purpose. If it seem not soluble than it is necessary to go back and start to think about the research problem once again. Looking for, to define, to set the boundaries of scientific problem are the steps which are essential for quality of created scientific problem. On the above mentioned steps depends also the importance of the results which will be obtained by solving the problem, and how these results will influence branches of science, the science as whole and whole society. From this point of view we can distinguish so called serious research problems solving which brink a very new knowledge in the field.

1.2 Searching and review the literature relating to the regarding research problem and development a framework

It is regular rule that **research projects begins with conducting literature, which means to identify related research, to set the current research project within a conceptual and theoretical context.** When conducting the literature review its important to concentrate on the scientific literature, start with the most valuable research journals in your topical area, use a blind or juried review system on the research journals and do the review early in the research process. In the literature review you might be able to find a study that is quite similar to the one you are thinking of doing and the literature review will help you to find and select appropriate measurement instruments and it will also help you to anticipate common problems in your research context and will help you to avoid common traps. The aims of literature review are to get an insight and to get a view work of others, and there are some requirements needed to be fulfilled to be an effective review analyser. One of the requirements is to compare different authors views on an issue and in the same time put those with similar conclusions in groups, note the disagreement areas and conclude by summarising what the literature says. The best way to do a literature review is to use library resources. And **to write a good literature review you have to have an ability to show why your research should be carried out, and why you did choose certain theories to work with. And how your work already adds to research carried out.** When reading you need to decide which ideas or information are important so you could emphasis them, and you should look at conclusions, theories, arguments that underline the work and look for similarities and differences with closely related work. And when writing you should compare and show relationships between the work already done by for example another researcher and compare it with another

research, and see differences and decide who is most convincing. So, using other words, the aim of this step is to find the current information related to the recognized research problem. Not to be confused with a book review, a literature review surveys scholarly articles, books and other sources (e.g. dissertations, conference proceedings) relevant to a particular issue, area of research, or theory, providing a description, summary, and critical evaluation of each work. **The purpose of a literature review is than to offer an overview of significant literature published on a topic.**

By study of literature we would like to find the answers to following questions: did anybody else formulate the same research problem in the past? did anybody else solve the same or similar problem in the past? are the results of the previous solving acceptable for us or not?

Result of the searching literature is than more precisely defined research problem or the recent research problem is rejected because it was successfully solved in the past. More details on the topic you will find in the specific chapter devoted to searching for literal information.

1.3 Development of the theoretical construction of the future research

Before the real research will start it is necessary to create its theoretical construction (abstract construction, virtual model). The main aim of this step is thinking on the content of presumed research, on its timing (date of beginning, duration of individual stages, duration whole research, date of supposed finish), on its structure (division to stages, phases), on conditions which should be created for successful run of research (persons, money, material, place). This step give a chance to researcher to think about each detail related to presumed research, to find out very early weak links of chain in the planned research, to think on alternative ways in research protocol if some non assumed condition will influence the research process. Creation of good virtual model of the future research will save the time, money and decrease probability of stressful situations during running research.

For creation theoretical construction of presumed research are necessary some conditions: the research problem should be clearly defined the technical, financial and personal conditions are potentially available the social, legal and ethical views are known and are consistent with current state (institutional) law and ethical rules and regulations the main aims of research are well defined The important result of this step is clear framework of the way by which the research problem will be solved.

1.4 Formulation of hypothesis

A stable step in research is formulation of a research question. A research question is a statement that identifies the phenomenon to be studied. **A well-thought-out and focused research question leads directly into your hypotheses.** What predictions would you make about the phenomenon you are examining? This will be the foundation of your application. Hypotheses are more specific predictions about the nature and direction of the relationship between two variables. For example, Those researchers who utilize an online grant writing tutorial will have higher priority scores on their next grant application than those who do not.

Such hypothesis can be then verified or falsified. It is desirable to create strong hypothesis. What are the characteristic features of such hypothesis? It should: give insight into a research question, be testable and measurable by the proposed experiments, spring logically from the experience of the staff Normally, no more than three primary hypotheses should be proposed for a research study. A proposal that is hypothesis-driven is more likely to be funded than a *fishing expedition* or a primarily descriptive study. Hypothesis is the result of researcher's creativity. It is a rational assumption on the possible cause(s) of the observed phenomenon. **Hypothesis is a source of questions focused to the core of the research problem. Answers to the questions may support (verify) or reject (falsify) formulated hypothesis.** But we have to realize that research process can never completely verify or falsify the studied hypothesis, it can be done with certain probability, only. Researcher who has not any doubts on his own research results is not real researcher.

2 Goals and competences

Throughout the project the alumni will:

- Acquire ability to read scientific documents.
- Acquire abilities to work in teams, discuss and synthesize the information.
- Acquire abilities to write scientific documents.
- Understanding the main research lines in air navigation.
- Understanding how to conduct research.

3 Working method

- There will be four research groups with 5-6 people each.
- We will dedicate 50 minutes a week to work during lecture hours (Wednesday 12.00-13.00 approx.).
- We will organize via-a-vis 30 minutes briefings every week. (To be agreed with every group).
- Each group will write a report (using latex) on the first steps of a air navigation related research project, including:
 - Introduction with the main ideas and the research question/s. (D1)
 - Review of the literature (state of the art). (D1)
 - Out of the box thinking with a research idea. (D2)
- Each group will give a presentation on the project.

4 Evaluation

The evaluator will consider:

- Individual work and implication during the lectures (only the 50 min/week).
- Individual work and implication during the briefings.
- Quality of the report (group evaluation).
- Quality of the presentation (both group and individual evaluation)