ACADEMIC

GUIDEBOOK

FOR

YOUNG

RESEARCHERS

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Chief editor: Dragana Cvetković Ilić

Publisher: University of Niš, Univerzitetski trg 2, 18000 Niš

Technical processing: Slavica Miladinović

Printing: 2700 copies

FOREWORD

This work is part of the project “Enhancement of HE Research Potential Contributing to Further Growth of the WB Region Re@WBC” with project number 561586-EPP-1-2015-1-RS-EPPKA2-CBHE-JP.

This book has been published with the support of the Erasmus + programme KA 2 Capacity Building in Higher Education.

This project has been funded with support from the European Commission. This publication reflects the views of the author(s) and the Commission cannot be held responsible for any use which might be made of the information herein contained.

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PREFACE

This book is a practical guide for young researchers at an early stage of their careers, which aims at providing them with answers primarily related to research methodology, ethics in research, writing a PhD thesis or a research proposal, getting first papers published, participating in conferences, career development and other related issues and would like to develop their skills. Written in the framework of the Re@WBC project, the book is another contribution to enhancing management of human research potential at WB universities in line with national and EU strategies for researchers. The range of topics included here is so wide as to increase the understanding of this field. Scholars from WB Universities were involved in the process of preparing the various chapters of this book bearing in mind to identify the most appropriate way to inform the reader about how they can further develop on things they have observed, what issues are involved in a specific field of research and what different methods they can use in order to conduct their research.

This guidebook introduces a wide range of concepts, methods and necessary tools through which research is conducted, interpreted and evaluated. It helps readers to understand the necessary concepts and vocabulary of scientific research, the relation between theory and research methods as well as to develop the skills needed to complete the whole research process. This guidebook is divided into eight chapters each of which focuses on a specific issue related to research.

Chapter one discusses the nature of science and of the scientific method, with special emphasis on research philosophies and the various types of scientific methodology. It focuses mainly on the stages of the research process and provides a detailed account of basic, applied and evaluation research along with a description of interdisciplinary, cross-disciplinary, multidisciplinary and interdisciplinary approaches.

Chapter two examines processing, analyzing and interpreting research results focusing mainly on independent and dependent variables used to define the scope of study and explaining the interconnected steps in a survey which include: defining the objectives, selecting a survey frame, determining the sample design, designing a questionnaire, collecting and processing data, analyzing and disseminating data and documenting the survey.

Chapter three explores the main principles of research ethics. It tries to provide a classification of and typology for the different types of scientific misconduct and to inform the reader about the best effort to formally define them. This chapter also draws special attention to some of the tools for

ethical research norms, including recent proposals with innovative approaches.

Chapter four looks at types and elements of scientific and technical communication taking into consideration communicating to colleagues, decision-makers and public audience. It also covers letters, memos and email. It places importance on reports, presentations and proposals which are an important part of research per se.

Chapter five discusses specific areas of career development focusing on the pre-employment phase, the desired outcomes and the timeline forecasted for completing defined goals. Defining this documentation set is a prerequisite for rewarding employment seeking and making a notable performance at a job interview.

Chapter six explores some of the stages or steps that any researcher should take when it comes to writing a PhD thesis. It outlines the different types of research and the various approaches employed when analyzing data and reporting results. The chapter provides an overview of the organization of a PhD thesis and of the composition of each specific part.

Chapter seven investigates the importance of academic teaching. It focuses particularly on teaching and learning processes especially in a university environment, on aspects of teaching and learning with an emphasis on curriculum design and development and, more importantly, on intended learning outcomes. A greater part of this chapter is devoted to research steps by focusing particularly on aspects of supervising research students and dealing with all of them from this perspective.

Chapter eight provides detailed information on research projects planning and managing. After a brief introduction of project life cycle, the following section deals with project formulation and project proposal preparation. A part of this section is dedicated to project management and monitoring.

Finally, we would like to thank all our contributors for their time, commitment and dedication to the preparation of this book, which we hope will be of great use to young researchers in the WBC and not only.

CHAPTER 1: Scientific methodology and the research process

Marko ŠKORIĆ[1], Aleksej KIŠJUHAS[2], Pavle SEKERUŠ[3]

ABSTRACT: We discuss the nature of science and the scientific method, with special emphasis on research philosophies and the types and varieties of scientific methodology. In this manner, we discern quantitative/qualitative and positivist/phenomenological methodologies, while describing and analyzing different research methods and techniques. Furthermore, we focus on the (stages of the) research process, such as defining the research problem, questions and hypotheses, using sources, reviewing literature etc. Finally, we provide a detailed account of basic, applied and evaluation research, together with describing intradisciplinary, cross-disciplinary, multidisciplinary, interdisciplinary and transdisciplinary approaches.

KEYWORDS: science, scientific method, quantitative methodology, qualitative methodology, reseach process, research types.

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Contents

1.1 What is science and the scientific method?

Defining anything in a way which would be generally accepted is quite difficult, and this also refers to science. However, that does not mean that it is impossible to understand what science is, what it consists of, what it deals with and in what ways, what makes it different from other human enterprises, etc. It can be said that science is an activity aimed at broadening and deepening our comprehension of nature, and this is achieved by applying the scientific method. Put simply, the scientific method includes three processes − the first one is observing nature, the second is speculating as to the explanations of certain occurrences which are puzzling, and the third process is finding a way to test those speculations.

Science is also a social institution, however, religion, law, art, etc., are among social institutions as well, therefore stating this as its main characteristic is simply not enough. Furthermore, there are many conceptions about science which, nowadays, we know to be rather erroneous. For instance, science is not a social activity and institution for itself, being that it is based on facts which are assumed to be statements about the world that can be established by means of one's senses. A layman's conception or the usual conception of science views facts as directly accessible and presentable to unbiased individuals who observe them with their senses, as preceding and not depending on theory, as well as constituting the firm foundation of scientific knowledge. All of the three given ideas are, at the very best, problematic.

In simple terms, science is a set of methods used to collect information on particular phenomena in specific areas, and to gain sound knowledge of those phenomena. That knowledge is acquired by means of research − a process during which a scientist identifies the phenomenon they are going to study, establishes hypotheses, gathers data, analyzes it, and then presents the results. Science also implies the development of theories that help describe, explain and organize the scientific information that has been collected. Besides being instrumental in gaining knowledge, science is also a specific manner of thinking and observing the world. Therefore, the essence of any science is the information acquired by observing and measuring phenomena.

For these reasons, before attempting to provide an explanation, it is necessary for us to ensure that we understand the facts related to the phenomenon we are researching. An explanation implies the introduction of the factors that explain how or why an occurrence we study takes place, and in case we do not understand something well enough, it is quite likely

that our explanation, too, will be unclear. Finally, in order to determine whether a specific explanation is right, we need to conduct an experiment that would allow us to determine if the expected result will occur under given conditions. Consequently, we can say that, at a most basic level, the scientific method consists of the following three steps:

- Careful observation of a particular segment of nature;
- Proposal of possible explanations for what is being observed; and
- Testing those explanations.

Generally speaking, science consists of methods (studied by the philosophy of science), organization (studied by the sociology of science), events (discussed within the history of science) and funding (belonging to the domain of the politics of science). Scientific research contains all these elements, but here we are mostly interested in the scientific method as an access to knowledge which allows us to discover what exists in nature and to understand how nature functions. It involves theory construction and research (empirical) techniques through which the reality of things is discovered.

In that sense, it is of immense importance to differentiate science from protoscience, nonscience and pseudoscience, precisely on the basis of the methods used during collecting information and drawing conclusions. Science relies on research methods so as to get the necessary information, and follows specific rules when it comes to the validity of the collected information. Protoscience refers to attempts bordering current scientific knowledge and understanding, and is also known under the term "fringe science". Protoscience usually employs the scientific method to test ideas, and it has the potential to develop into science if the phenomena it studies attain legitimate scientific support, which is what happened with computer science and epigenetics.

However, more frequently it happens that protoscience turns into pseudoscience, upon establishing that certain statements cannot be empirically confirmed, and it is also possible that there is simply not enough proof for something to become science. For example, that is what happened with alchemy and astrology. Nonscience can be a legitimate academic discipline, like in the case of philosophy or literary criticism, whereas pseudoscience literally implies "false science". Pseudoscience is a set of ideas founded upon theories presented as scientific, though they are actually not, and one should bear in mind that it often differs from genuine science in the degree as well, not the type, so at times, the boundaries between the two are quite blurred. Therefore, what science and pseudoscience have in common is their goal of providing support to specific ideas, but the methods employed in pseudoscience are not of such

rigorous standards as those required in genuine science. The most famous examples in history are phrenology, iridology, homeopathy, ufology, and so on.

Science is, therefore, a process of exploring nature which asks questions about what things exists in nature and how they are related. When asking questions about what the universe consists of, that is, what exists in nature, science is in fact asking about ontology. When interested in how we can apprehend nature, it deals with questions about epistemology and formulates methodology as a set of research methods. When it opts for particular methods of researching nature, or rather, formulates the methodological approach and organizational resources necessary for scientific research, it is concerned with research. Finally, when it provides the scientific basis for technological innovations, that is called technology, that is, the application of scientific knowledge. This is the micro-level of scientific activities, but there is the macro-level as well, which also contains four categories – the funding of science, the performance of scientific institutions, peer review, and technological progress (that is, innovation).

Science therefore differs from the everyday or layman's conceptions about the world, in that in everyday life explanations are typically founded on little information and are filled with subjectivity and partiality. Explanations of everyday events do not possess the rigorousness that science demands, they are not tested like scientific ideas, and rarely do we search for explanations which are better than those we have already accepted. There is a lot of secondhand information, coming from anecdotes, hearsay, speculations and the like, hardly any of which is ever tested. That is why it can be said that there is an omnipresent human tendency to search for such information that would confirm what is already believed, that is, a confirmation bias. It is precisely the scientific method that aims to avoid as much as possible all the aforementioned flaws of the kind of explanations used in everyday life. Lastly, one should never forget that in science nothing is taken as absolute truth, or rather, that scientific observations, conclusions, and theories are always open for modifications, even dismissal, in case new proof is found.

1.2 Scientific methodology

Research methodology is a philosophy or a general principle which directs and guides scientific research itself, and lies within the very foundation of science and scientific endeavors. In other words, it is a comprehensive principle or a perspective of studying or researching a

specific topic, and which also implies a variety of questions related to the challenges, dilemmas, limitations, and ethical problems of particular research. For these reasons, choosing an adequate research methodology presents the first and, frequently, the most crucial step for every researcher.

Put simply, methodology is a manner in which a researcher conducts their research, that is, the choice of a manner in which they will approach a specific problem. This often results in defining a given problem, and before that, it is concerned with resolving the dilemma of whether to choose the qualitative or quantitative approach, whether to collect data through participant observation or from archives, through direct observation or interviewing, and the like. The choice of methods mostly depends on the nature of a given research question and one's conception (whether it be implicit or explicit) of what makes "good research". That mixture of (scientific) reflections and the previously mentioned contextual conditions is also shaped by personal preferences. In that case, we can also say that methodology, too, includes four levels:

- Research paradigm (how a researcher sees reality);
- Research methodologies (the way a researcher conducts research, which is in accordance with a given research paradigm);
- Research methods (specific steps which must be taken in a pre-established order and stem from the methodology);
- Research techniques (practical instruments or tools used for collecting and analyzing data, which are in accordance with the methods).

Usually the goal of research is to find out something new and it is highly important to understand given research questions and the nature of proofs, after which it is necessary to choose an adequate paradigm, methodology, methods and techniques. In that sense, research implies providing answers to questions, but a researcher must know which questions it is possible to answer in the first place, they should understand what an answer could look like, or rather, which proofs are adequate and are able to provide us with an answer in a given context, etc. In regard to that, choosing an adequate research methodology can start with asking the following five main questions:

- What?
- Why?
- Who?
- Where?
- When?

Namely, every potential researcher must first answer the question of **what** their research represents, that is, how to define their research project as precisely as possible (it is considered helpful to do that in one or just a few sentences). Furthermore, a researcher must also ask themselves) **why** they are conducting or engaging in the specific research, what the purpose of that research is (science project, doctoral dissertation, discovery of a specific law or recurrence, etc.). A researcher must also answer the question of **who** participates in their research, or rather, what type of people or social group that research will cover, but also **where** the research will be organized spatially or geographically speaking. All the above mentioned are variables that affect the budget, time, and other research resources. Finally, there is also the important question of **when** specific research will be organized, that is, how long it will last, when research participants or subjects will be contacted, etc.

In addition, it is highly important for a researcher not to attempt to find only such proofs that would support their idea, or thesis, which means that they should search for proofs that will answer a given question, regardless of whether that answer will prove or disprove their thesis. A good research strategy for a researcher is to find the answer to a given question and further on to ask themselves what can be done with that answer. However, it is a severe problem that for many facts there are many explanations which are consistent with those facts, although that does not imply that all explanations are equally valid.

Ultimately, in social sciences there has been an ongoing debate for decades about research methodologies and about whether it is the qualitative or quantitative methodology that is more suitable for social research, or more precisely, about which of the two is "scientific" to a lesser or greater extent. Moreover, there have also been high points and low points in the popularity of these methodologies in different social, political, historical, and cultural periods. That is why it is necessary to provide a brief overview or history of research philosophies, that is, of the discussions on scientific methodology and the scientific method.

1.3 Research philosophies

Even when individual scientists' methodological ideas are not clear from text, there are always certain methodological standards of a specific epoch that affect scientific practices and that cannot be proclaimed irrelevant. For this reason, previous theories on the scientific method are also significant, since we could, for example, learn about the criteria for acceptable scientific explanations at a particular period of time. The

scientific method must be differentiated from the theories of the scientific method, because the scientific method refers to techniques and procedures that scientists use when conducting experiments or constructing theories, whereas the theories of the scientific method include a scientist's metascientific conceptions upon discussing about drawing scientific conclusions.

Nowadays we know that throughout history methodological problems were not the same to all scientists, philosophers or in all epochs. The problems which, for example, Auguste Comte or Isaac Newton were interested in, were not the same as those of modern-day scientists. However, it is justifiable to assume that their problems gradually led to the current ones, as the three main questions that they struggled with were about: the goals of science, the certitude of scientific knowledge, and the existence of the logic of scientific discovery.

Since it is typically said that science and philosophy were born during classical Antiquity, it is not surprising that the Greeks were the first ones to theorize about the scientific method, as well as that Aristotle was the one who made the biggest contribution, though one should not forget Plato, Ptolemy, Galen, or the Stoics, or medieval authors Roger Bacon and William of Ockham, Robert Grosseteste, Albertus Magnus and Thomas Aquinas. During the renaissance, the problem of the scientific method was also dealt with by Averroes, al-Bitruji, Nicholas of Cusa, Copernicus, Galileo, and the modern scientific method is generally considered to have originated in Europe in the seventeenth century.

The most significant change that its modern version brought was a different conception of nature. With the application of the scientific method, people altered the multi-centennial conceptions about the world around them. Probably the most important change is the one regarding the apprehension of the natural and the supernatural, as in science the basic assumption is that only the natural exists, and only the natural can be studied, described and explained through experiments and theory. Even nowadays the methodological ideas of Francis Bacon, Descartes, Robert Boyle, Robert Hooke and Isaac Newton are still discussed. The most well-known persons from the eighteenth century certainly are David Hume, Condillac, Condorcet, Diredot and D'Alembert, and Immanuel Kant, while in the nineteenth century the most influential people were Comte, Whewell, John Herschel, John Stuart Mill, Claude Bernard and Charles Darwin.

However, the truly modern history of the study of methodological problems begins with the theoreticians who were greatly influenced by Ernst Mach and who are commonly called logical positivists. His main followers were Philipp Frank, Hans Hahn, Otto Neurath, Rudolf Carnap,

Herbert Feigl and others. They thought that there is a clear-cut difference between theory and observation, that nothing has meaning unless it can be empirically tested, that the history of science is cumulative and revolutions do not exist, that science only organizes our experience and predicts what we will observe, but it does not attempt to offer "deeper" causal explanations.

Furthermore, the logical positivists claimed that science aims to develop empirically adequate theories, not "truthful" ones, and that there is a difference between discoveries (coming up with new ideas) and justifications (testing new ideas objectively). To put it concisely, they stressed that experiment is the foundation of knowledge, that the regularities in the world must be discovered without any previous metaphysical speculations, and that theory is constructed directly from experiment. That means that the only source of knowledge is experience and that logical analysis is the only way of solving philosophical problems. It was under their influence that the simplified image of the scientific method was created – hypotheses are formulated and then confirmed or rejected by means of experiment. After them come Karl Popper, Thomas Kuhn, Imre Lakatos and Paul Feyerabend, whose ideas are discussed to this day, and numerous variations and improvements are suggested.

Surely the most well-known opponent of logical positivism was Karl Popper (1902-1994), who developed his theory by polemicizing with the logical positivists. He thought of science as a process of bold conjectures and refutations, that there is no logic of scientific discovery and no method which could provide good ideas, and he was convinced that a single counterexample is enough to disprove a theory. As the criterion separating science from nonscience he used falsifiability, which means that a theory that cannot be disproved is not actually scientific (he thought that based on this criterion one can differentiate between science and pseudoscience). Popper viewed the inductive method as a lost cause, because positive proofs that support theory are nothing but an illusion, and he stated that science is characterized by a critical spirit. In the sixties, he introduced the term "verisimilitude", so the corroboration of theories became an indicator of verisimilitude – since we can never know if we have reached the truth, we can only speak of theories that are more verisimilar than others.

Thomas Kuhn (1922-1996) wrote what is undoubtedly the most famous and influential book on science – The Structure of Scientific Revolutions (1962/1970). For him, most of the science is normal science – the kind of science in which scientists agree on all the main postulates because they take them for granted. At that stage the fundamental theoretical framework remains outside the domain of criticism. The most well-known term in the entire philosophy of science is "paradigm", which to Kuhn represents a

sort of disciplinary matrix. Science is a puzzle-solving activity, during which everything fits into a pattern set by the paradigm, and in a normal period, science is cumulative. Certain puzzles are, like anomalies, particularly resistant, therefore, if they remain unsolved for too long, a crisis arises which begins questioning the paradigm itself, that is, the main precedents.

After that comes the period of revolutionary science, when schools of scientific thought are born, which criticize one another and create new paradigms, until eventually one of them predominates. This period is called scientific revolution, followed by the resolution of revolutions, which does not occur just because of the validity of empirical proofs or arguments, but because of "indoctrination" – students learn about a new theory from textbooks acting as exemplars that illustrate a given theory as if they are independent proofs for it, which means that a given paradigm is presented as something reasonable, and existing rival hypotheses as something old and outdated.

Imre Lakatos (1922-1974) wanted to improve Popper's falsificationism, which was envisioned as an improvement of inductivism, and under Kuhn's influence he came to the realization that all theories have anomalies, which would mean that refutability is an unsatisfactory criterion. It was obvious to him that theories are not to be rejected in the simple way that Popper wrote about, but that the main constituents of a research program are a hard core and a protective belt. The hard core is a set of fundamental principles which to a greater or lesser extent define a program, and the protective belt is what is constantly modified and receives criticism, being that it consists of auxiliary hypotheses which can be adjusted in accordance with criticism. Therefore, the scientists' goal is not to disprove a prevalent theory just because there are reasons to do so, but precisely to preserve its core. That is why a research program can be progressive or degenerative. When predicting new phenomena, it is progressive, and that is where Lakatos agrees with Popper – that at this phase, a program is growing into an ever-better approximation to the truth. When constantly modified just to be kept away from becoming outdated, it is degenerative.

Paul Feyerabend (1924-1994) was the last among classical theoreticians of research methodology; he is most famous for his formulation of the anarchistic understanding of science and the rejection of the existence of universal methodological rules. He thought that the scientific method inhibits scientific activities, thereby also inhibiting scientific progress, so it is good for science to contain a certain dose of theoretical anarchism. This opposed all preceding rationalist understanding of science. Feyerabend's most famous book reveals much even with its title − Against Method (1975). Sci-

ence does not always follow methodological rules, the choice of theory is not always rational, but is often aesthetically based as well; in certain episodes great scientists broke the prescriptive rules of science, rules in specific historical circumstances only prevent the scientific revolution, etc. All this points to the thesis that new theories get accepted, not because of their accordance with the scientific method, but because their supporters use various "tricks" (rational, rhetorical, esthetic) in order to defend or promote those theories. That is why the only approach that does not hinder progress in science is: "Anything goes."

As has been said, after these theoreticians, discussions on methodology mostly looked back on them, but over time, new questions, new problems, solutions, etc., occurred. The point is that there is still no consensus about what science is, that is, about everything that it includes, how discoveries are made, as well as whether science can be so strictly differentiated from pseudoscience, whether and to what extent it is progressive, and so on, but it does not mean that nothing can be said about these problems or that the whole field is chaotic.

1.4 Quantitative/qualitative and positivist/ phenomenological methodology

Probably the most significant, most influential and practically fundamental division of research methodology is the one into:

- Quantitative; and
- Qualitative methodology.

With respect to that, the question or the problem of an adequate choice of either quantitative or qualitative methodology is usually the first step in all research. Thus, after and on the basis of answering the aforementioned five questions (what, why, who, where, and when), a researcher should choose either a quantitative or qualitative methodology, more precisely, adjust their research thesis to a specific methodology. What do they represent and what is the difference between these two types of research methodology?

Quantitative methodology usually generates statistical and mathematical regularities with the use of questionnaires or extensive surveys. In other words, with quantitative methodology the stress is on objective measuring and statistical, mathematical or numeric analysis of the data obtained based on a comparatively large number of questionnaires distributed among a certain population or based on researching public opinion. Quantitative research focuses on collecting numeric data which is then generalized according to specific variables in order to explain a particular phenomenon. The goal of research conducted in this way is to determine or

discover a correlation and/or a causal relationship between a specific phenomenon (independent variable) and another phenomenon (dependent variable) within a certain population.

So, within the framework of quantitative methodology, data is mostly gathered by using structured research instruments (questionnaires, tests or "test batteries"), and research results are based on samples representative of a certain population. For those reasons, research can usually be repeated or replicated, which increases the reliability of collected data. Unlike with the qualitative approach, a researcher working within the framework of quantitative methodology usually has a clear and precisely defined research question to which they are looking for objective answers and which does not change throughout the research process. With regard to that, quantitative research actually tests objective theories by examining the relationships between different variables, which are at a later point measured with various instruments. Research results often have a strictly structured form (introduction, description of methods, results, discussion and overview of references).

Quantitative methodology can be descriptive (subjects or participants are typically examined once) or experimental (subjects or participants are examined both before and after a specific experimental intervention). While descriptive research usually only discovers relationships or correlations between variables, experimental studies typically discover existing causal relationships between them as well. With that in mind, data gathered on the basis of quantitative research is presented numerically or statistically, that is, through tables and graphs, not in narrative form. Finally, quantitative research uses numbers and data, and it is therefore characterized by a unique objective, convergent, rational and logical attitude of distance toward the subject of research or the research problem. Consequently, based on quantitative methodology in most cases it is possible to generalize concepts and conclusions, anticipate ensuing results and research causal relationships.

On the other hand, qualitative methodology usually studies attitudes, behaviors, opinions, feelings and experiences of a smaller number of individuals, using methods and techniques such as interviews or focus groups, for example. The word "qualitative" itself indicates the reference to the qualities of specific entities or processes, that is, to the meanings, the implication being that they cannot be measured numerically or experimentally. In that sense, this type of methodology aims to gain a relatively more detailed or a deeper insight into the thoughts and behaviors of research participants, as opposed to quantitative approaches. Since subjects' views, experiences and feelings are the focus of this type of methodology, comparatively fewer people participate in research itself, but

on the other hand, the actual contact with subjects usually lasts a lot longer. Closer attention is paid to specific details, not just to quantitative generalizations and regularities.

Qualitatively oriented researchers often stress the socially constructed nature of social reality, as well as the close relationships between researchers and their research topics, that is, the situational limitations which determine research. That is why values, meanings and concrete experiences of participants matter more than sheer measuring of causal relationships between particular variables and why qualitative methodology focuses on naturalistic research – on "real world" situations, instead of on controlled, experimental situations, and the research process also implies the incorporation of new questions which arise during research itself.

These researchers are therefore more "open" to the reality taking place or shifting right before their eyes. Concrete cases (people, groups, organizations, events, cultures) which are chosen as the subject of qualitative analysis are most frequently cases which are "rich" in information as specific and useful manifestations of a particular phenomenon, regardless of empirical generalizations. Finally, qualitative researchers are usually in direct, close or immediate contact with their subject of research, just like with subjects themselves, while the research is often colored with their personal experiences and insights as well, that is, researchers themselves often participate in the interpretation of the meaning of collected data. Results are presented in a lot more flexible form than they are with quantitative research.

It is important to point out that many researchers walk into a trap, thinking that quantitative methodology is in certain ways "better" than qualitative (or vice versa). Neither of the two is necessarily "better" than the other one – they simply differ from one another, and both have their own advantages and flaws. Quantitative methodologies are usually seen as "more traditional" research modes, because of which they also have carefully chosen procedures and systematic rules. On the other hand, qualitative methodologies typically allow for somewhat more innovative and creative approaches. At the same time, these methodologies should not be viewed as overly rigid or distinctive categories, polar opposites or strict dichotomies. In most cases they are points or poles located on a continuum, and specific research is simply relatively closer to either one pole or the other. Put differently, a lot of research skillfully incorporates the elements of both quantitative and qualitative methodologies.

The division of methodology into quantitative and qualitative is not the only one, so one can also talk about the distinction between positivist (objectivist, scientific, experimentalist, traditional, etc.) and phenomeno-

logical (subjectivist, humanistic, interpretive, etc.) methodology. Positivist methodology in research is usually based on approaches which are typically used in (natural) sciences, including also the search for the laws, causes and explanations behind various social phenomena. In other words, it insists that the study of human (social) behavior ought to be founded and organized in the same way in which it is founded and organized in natural sciences.

In that sense, positivist methodologies aim to identify, measure and assess various phenomena on the basis of the rationality, causality and predictability of causes and effects. Therefore, a positivist explanation strives to discover causal links and relationships between different variables it explores, and thus this perspective usually insists that people react to external stimuli and norms in a relatively organized, regular and predictable way, which it is possible to discover, identify and explain by using rational, deductive reasoning processes.

On the other hand, phenomenological methodology approaches its research stating that human behavior cannot be measured in the way the phenomena belonging to the domain of natural science can. These methodologies stress that human motives are also controlled by certain factors that cannot be observed objectively (for example, the internal processes of thinking), which is why it is difficult to generalize research conclusions. A particularly significant variable of phenomenological approaches are the individual meanings and interpretations that people themselves assign to events and phenomena. Phenomenological methodologies imply that people (or actors in general) affect the events around them, as well as that they act in relatively unpredictable ways. That is why here the stress is placed on understanding behavior on the basis of studying the personal or subjective perspectives of subjects, that is, research participants. In that sense, various events are also described or interpreted on the basis of those subjective perspectives, and not of objective, numeric indicators.

In addition, an adequate choice between qualitative and quantitative, and/or positivist and phenomenological methodology depends to a significant extent on the knowledge, skills and experiences of a given researcher. With respect to that, it is recommendable for researchers to also listen carefully to their own inclinations, intuition or hunches, that is, to research a specific phenomenon in a way that will make them feel confident and relatively comfortable during their own work. It is for those reasons that every researcher should also ask themselves whether they, as an individual or person, prefer written communication or face-to-face interaction, how they handle relations with other people, and how successfully they handle numbers, statistics and mathematics.

What can be helpful in this case as well are the answers to the aforementioned “five questions” (what, why, who, where and when). Namely, if those answers include the words such as “how much”, “testing”, “confirm”, “prove”, it would be more reasonable to choose a quantitative/positivist methodological approach. If, on the other hand, they contain words such as “experience”, “opinion”, “discovery”, “motivation” etc., it is probably more adequate to opt for qualitative/phenomenological methodology. In other words, researchers’ education and inclinations also affect the choice of methodology. If a researcher is well-educated with respect to the domain of technical and scientific writing, statistics, and statistical software, it is quite likely that they will choose quantitative approaches. On the other hand, individuals who prefer writing in a more creative or literary way, deep and long conversations, or detailed, meticulous observations, usually turn to qualitative approaches.

1.5 Quantitative research methods and techniques

The next important step in conducting research is choosing adequate research methods, or rather, techniques. As has been said, it is highly important not to confuse research methodology with research methods, or with research techniques. Methodology presents the general philosophy, principle or approach of certain research, methods refer to specific steps emanating from methodology, whereas techniques imply specific tools or practical instruments which a researcher uses in order to collect data, and which are in accordance with given methods. In that sense, typical research methods, that is, techniques include: questionnaires, interviews, observation, etc., and the rest of the section will elaborate on some of the most frequently used quantitative methods. That methods are:

- Surveys or survey research;
- Experiment;
- Quasi-experiments;
- Longitudinal studies; and
- Cross-sectional and cross-cultural studies.

Surveys also imply choosing a representative and unbiased sample of subjects, that is, a sample based on a group, community, or an entire society being the subject of research. During **survey research**, data is mostly gathered on the basis of questionnaires, which are a typical research technique related to this method. Questionnaires are commonly distributed to subjects from a given sample to fill them in (including questionnaires distributed through the post and via the internet), but during survey research, data can also be collected by using the conversation or

interview technique (which can be done face-to-face, over telephone, but also over the internet, etc.). Within quantitative methodology, interviews are usually structured, whereas in qualitative methodology they are unstructured (there are also semi-structured interviews). Collected data is then processed and analyzed, using different statistical methods. In that sense, survey research is done in order to reach certain statistical conclusions about the views or behaviors of a particular population, which is why it (also) depends greatly on the questions asked in a given questionnaire. The public is commonly surveyed in order to reach conclusions about public opinion, public health, consumer behavior, but also about many other questions that require both more detailed and more sophisticated answers in the domain of psychology, political science, sociology and the like. The success of particular survey research depends on the representativeness of a sample chosen within a targeted population, but also on the characteristics of the questions asked. Surveys are generally divided into descriptive and analytical. With descriptive surveys, the focus is on sheer identification and measuring of the frequency of a specific reaction (or response) within a sample (for example, for which candidates and in what number the subjects within a certain sample will vote in elections). When it comes to analytical surveying, the relationship is analyzed between certain elements or variables (for example, sex, age, income) and the frequency of a specific reaction (for example, preferences for a particular candidate in elections), that is, the responses within a given sample. Therefore, a survey or survey research allows for quantitative or numeric descriptions, or rather, for the analyses of trends, attitudes, or opinions of a certain population or group by studying its sample.

The next significant quantitative method is the **experiment**, that is, experimental research/experimental studies. This kind of method implies research conducted in carefully controlled and structured environments, which enable the discovery, identification and analysis of causal relationships between different phenomena. In certain ways, an experiment is some kind of exemplar of the scientific method, as it allows researchers to identify and demonstrate causal relationships. When conducting experiments, researchers define key variables and formulate hypotheses, then manipulate the variables and collect data on the results. Moreover, external variables are minimized and controlled so as to avoid their effect on the outcome of the experiment. In other words, during experiments, researchers change one or more than one variable to establish whether that change also causes changes in other variables or among the subjects of a specific experiment. In order to make that possible, typically there is a control group and an experimental group, and within control groups changes in variables are purposefully omitted. For example, it is possible

to manipulate the amount of light in an office and then observe the effects on employees' performance. Therefore, experimental research primarily attempts to determine if a specific treatment influences an outcome, by parallelly observing a control group and an experimental group. Studies conducted in laboratories are the best opportunity to have strict control over variables, although the superficiality of such a situation can influence the outcome of a given experiment. However, experiments can also be conducted in natural surroundings, despite the fact that in that case a researcher has the least control over a given situation. Finally, when subjects are human beings, the experimental method can start conflicting certain ethical principles.

For those reasons, much research (in social sciences) actually takes the form of **quasi-experiments**, that is, it applies the quasi-experimental method. In quasi-experiments, research subjects are not chosen randomly, and researchers do not have absolute control over an experimental situation. Quasi-experiments mostly serve to measure the influence of a specific intervention within a given population, and they too make the distinction between a quasi-experimental and a quasi-control group. In this way, specific (and not random) groups are chosen, such as, for example, parents who inflict corporal punishment on their children and parents who do not, then children's behavior and success in school is analyzed and conclusions are drawn on the causal relationship between corporal punishment and children's behavior. Quasi-experiments are characteristic of social sciences, but also of the fields of research like public health, education and policy analysis. Among the subtypes of quasi-experiments is the so-called natural experiment, where there is actually no intervention on behalf of researchers, not even in the choice of (quasi) control and (quasi) experimental groups. In a natural experiment, a researcher observes and analyzes a situation which "naturally" has an experimental character and then they offer conclusions on the causal relationships between different variables. Undoubtedly, both quasi-experiments and natural experiments are frequently influenced by many other (external) variables, which is why their validity is sometimes questionable.

Quantitative methods also include **longitudinal studies**, which also have a quasi-experimental character. They imply research which is conducted throughout an extended period of time, in order to become familiar with the consequences of the flow of time on certain individuals and groups, on their behavior or a given situation. This kind of research typically lasts for several years or even decades, with the observation or analysis of the same subjects or data within that period. It is frequently used in psychology and sociology, for studying the causal effect of certain phenomena on individuals and groups during their lifetimes or generations,

or rather, it is applied in medicine for the purposes of studying the predictors of specific illnesses. Longitudinal studies allow (social) scientists to differentiate between the effect of short-term and long-term phenomena, such as, for example, between the effect of specific advertising campaigns as opposed to the effect of social class or poverty. So, although the technique characteristic of longitudinal research is observation, this type of research can surely detect the causal relationships between variables, which is why it is an integral part of quantitative or positivist methodologies. At the same time, this kind of research can be retrospective (looking back in time, using existing medical or historical data) or prospective (requiring the collection of new data).

Finally, quantitative methods also include **cross-sectional and cross-cultural studies**. Cross-sectional studies are a kind of research which usually involves different organizations and groups of people, and then analyzes in detail all the similarities and differences between organizations and groups of people being the subjects of research. For example, these studies can be concerned with the knowledge and skills of sociologists across various organizations (different universities, institutes, companies, etc.). Therefore, this is a kind of research which implies a detailed analysis of a specific situation or state, by comparing different individuals, groups and situations. The point lies in the analysis and comparison of the data gathered from a certain (representative) population at a specific moment in time. The technique typical of this method is observation, but with the inclusion of complex statistical tools used to single out the causal effects of different variables that researchers are interested in. Similarly, cross-cultural studies, also called comparative studies, use field data in studying human behavior, but also test hypotheses on human behavior and culture within the domain of quantitative methodology. They are common in social sciences, especially in anthropology, sociology and psychology. However, unlike qualitative methods, which are focused on the interpretive comparison of different case studies or ethnographic data, which will be further explained later, they use a sufficiently big sample so as to point out the causal relationships between different cultural variables by using various statistical tools. Therefore, within the framework of this method, researchers analytically and statistically compare series of data about a certain cultural trait (or relationships between traits) across a sample of societies and/or cultures. In this way, researchers draw quantitatively oriented conclusions about causal relationships between cultural characteristics, as well as about individuals' and groups' behaviors.

1.6 Qualitative research methods and techniques

Qualitative research methods and techniques include:

- Ethnographic study;
- Case study;
- The biographical method;
- Grounded theory;
- Action research; and
- Feminist research.

Very important qualitative research method is **ethnographic study**. Ethnography has its roots in anthropology and was a very popular research method at the turn of the 19th into the 20th century, when anthropologists traveled the world in search of isolated tribes, or "natives". The focus of ethnographic research at the time, as well as now, was the description and interpretation of a certain group, or population's, cultural and social behavior. Thus, in most cases, the researcher becomes an integral part of the group or situation he or she is observing, and the goal is to understand the situation "from the inside", i.e. from the perspective of the people in that situation. The researcher shares the experience of his/her subjects, or participants in the research. This method is especially efficient in the study of small social groups or communities. The ethnographic approach implies getting immersed in the everyday life and culture of the studied group, and this is why ethnographers often live in it for months or even years. So, the researcher takes an active role in the group's activities, observing their behavior, taking notes, conducting interviews, analyzing, reflecting and writing reports. This type of research is referred to as field work, and its characteristic technique is so-called observation with participation (although this does not exclude interviews and questionnaires). In addition, ethnography takes into special consideration the group's written documents (if there are any), since they are perceived as adequately reflecting the culture under study. Finally, this research can be overt (everyone involved knows it is conducted) or covert (the participants do not know they are being studied).

Another typical qualitative method is the **case study**. This method facilitates an in-depth exploration of a concrete subject ("case"), such as, for example, an organization, or a group of people, and it usually comprises both an extensive, or comprehensive, collection of data on that case and their analysis. In case studies, the researcher develops an in-depth analysis of a particular program, event, activity, process, organization, group, or even of a "case" involving one or several individuals. These cases are mostly limited by time and space, and the researcher gathers a substantial

amount of information using a range of particular, usually qualitative, techniques, such as, for example, focus group, also known as discussion group. Using this technique, the researcher talks to a group of people in a relaxed and semi-structured manner, recording the entire conversation (with a tape-recorder, camera etc.), encouraging free discussion about a particular case among the participants. Case studies are commonly presented in the form of a report on a person, group, or situation under study, describing the participants' behavior, or through the use of more or less formal research techniques. This method is widely used in sociology, psychology, anthropology, political sciences and social work, that is, in the domain of education, health, politics, etc. For example, in medical sciences, concrete "cases" are described in order to explain a medical phenomenon more accurately. Also, a "case" can be presented in an abstract way, as a claim, a view or an argument. Case studies are often used to formulate new and inventive theories, or they can be descriptive (when a certain practice or phenomenon is given a detailed description), illustrative (exemplifying new practices or behaviors), experimental (exploring the difficulties in adopting new practices or procedures) or explanatory (providing theoretical basis for understanding and explaining practices or procedures). However, the fundamental methodological problem with case studies is the (im) possibility of extending their findings and drawing wider generalizations regarding larger categories of the phenomenon.

One of the qualitative methods is also **the biographical method**. It involves the collection of information about the life (or a segment of it) of certain individuals or groups, or more precisely, the systematic use of personal information for exploring the relations among various factors, events, and outcomes in a society. This method was developed by the sociologist William Thomas, while he studied Polish immigrants in Chicago at the beginning of the 20th century, using their letters and diaries to draw conclusions about their social status and experience. A characteristic technique of the biographical method used most commonly nowadays is the unstructured interview. Even today, researchers often use biographies and autobiographies as the sources of information about the "life story" of individuals and small groups. This is where they search for characteristic patterns, issues, and representative life problems of a certain group of people. The biographical method can be used, for example, to reveal the influence of different variables (class, sex, education etc.) on one's career, etc. On the basis of a historical description of one's life, the biographical method helps to identify the relations between concrete events and their outcomes. It is a very demanding method too, which presupposes a relation of trust between the researchers and the subject(s) of their research.

Another typical qualitative method **grounded theory**. Grounded theory refers to the set of specific methods applied in the research process, as well as to its product – a theoretical analysis of an empirical problem. The term "grounded" itself comes from the fundamental premise that scientists should (and must) base or ground their theory on a strict analysis of empirical data. The founders of this approach are the sociologists Strauss and Glaser, and it is quite popular, especially in the fields of education and health. The essence of this relatively flexible method is the generation of a theory from the data, which distinguishes it from other methods that in most cases involve the testing of a given hypothesis formed by the researcher. Grounded theory's common techniques are focus groups and interviews, but also a detailed analysis of the literature, which is conducted during the entire data collection process. The idea behind this method is that theory development is an emergent process of discovering facts about the external empirical world, which is achieved through a systematic communication with the empirical data. Both the collection and the analysis of the data are conducted simultaneously, and from the very beginning of the research process, the researcher is required to analyze them and identify the analytic "traces" and so-called provisional categories, developing them during further data collection. Therefore, the analytical stages of the grounded theory are the following:

- Codes – identifying anchors for the key data collection;
- Concepts – grouping the concepts with similar content, which allows the grouping of the data;
- Categories – sets or large groups of similar concepts used in the creation of a theory;
- Theory – a set of explanations about the research subject.

Thus, after collecting the data using various qualitative techniques, the researcher marks the key formulations with a set of codes, which are extracted from the text, for example. Then the codes are grouped into similar concepts, so that they can be handled more easily, and the concepts are grouped into categories, which make the basis for a theory, or a "reverse-engineered" hypothesis. As already mentioned, this is in opposition to the traditional research model, where the researcher first chooses a theoretical framework, and then applies it to a phenomenon in question.

Among the qualitative methods, there is also **action research**. For some theoreticians, action research comprises different methods, while others consider it a separate methodology. Namely, in this type of research, a scientist collaborates closely with a specific group of people to improve the situation in some social context. In other words, the researcher does not

work “on” people, but “with” them, being a facilitator of a certain action, policy or qualitative change. In that sense, the knowledge of group management, or the understanding of group dynamics are important skills for conducting action research. The domains in which action research is particularly popular are: organizational management, community development, education, agriculture etc., and the applied research techniques involve questionnaires and interviews, focus groups and the like. The researcher’s intervention is therefore required in order to bring about a social change in a given situation, but also in order to follow and evaluate the results of such change. Hence, the researcher, in collaboration with the subjects of his/her research, or the “clients”, identifies a certain goal (for example how to induce a quicker response to a fire alarm) and looks for ways to achieve that goal. He/she participates in a given situation, introduces new techniques and solutions, keeps adjusting them, and monitors the results, constantly co-operating with the participants. This is why action research starts with a process of communication and an agreement among the people who want to change something, for example, in an organization or community. For the same reason, most often this research is conducted by small groups of devoted individuals, who are open to new ideas and are willing to change their behavior. The researcher and the group plan, work, and observe together, until all participants are equally satisfied with the result and the implementation of a certain change.

Many theoreticians include also **feminist research** among typical qualitative methods, although there are debates about whether it is a research methodology, or if it represents a separate epistemology, and not just a method. This kind of research usually starts from the premise that the lives and social experiences of women have been ignored, marginalized and misrepresented for centuries, which is why they should be made visible. The claim is that in the past research has been conducted mainly on male “subjects”, and the results have been inadequately generalized to the whole population. In other words, women and their contribution to social and cultural life have been sidelined, which is reflected in the dominant research practice. It is pointed out that men, male perspectives and male norms have dominated previous research, but also that, unlike some other categories (race, ethnicity, class etc.), sex and gender have been missing from our understanding and interpretations of social phenomena. Feminist research criticizes dominant research topics and their methods, especially the quantitative ones, which claim to reveal the objective, scientific “truth”. Therefore, it insists on the need for a different, participative, qualitative inquiry, and thus offers a relatively high-quality or inspiring alternative research framework to those scientists who are not comfortable treating people as research objects, which is typical of

quantitative methods. The research rooted in the feminist perspective focuses on knowledge that stems from the "female" experience, which, in practice, is useful for everyone (especially women). For example, in a business context, feminist research focuses on the role of women in a business organization, their attitudes and world views, but also on the limitations they encounter. Finally, they pose the question of why certain forms of knowledge are perceived as more valuable than others.

1.7 The research process

Conducting scientific research is often the result of our desire to gain new knowledge, and as such, it represents a specific kind of goal-oriented behavior. The goal of such research is to contribute to general knowledge, and that knowledge is presented in the form of viewpoints, models, concepts and (grand) theories.

It is possible to distinguish several relatively independent stages of conducting a scientific research project, or the research process:

- Identifying the research topic. At the beginning, it is useful to present the initial research topic in the form of a question, and identify the key research concepts. For example: "What are the health risks of consuming marijuana among students?" "How do video-games affect the school achievement of high school students?" and so on.
- Collecting basic information. In this stage, it is useful to search for the references about the key research concepts in encyclopedias and textbooks, but also in the secondary literature, review articles, bibliographies, the media, the internet, etc.
- Gathering the relevant literature. In this stage, it is necessary to find more detailed and up-to-date literature on the research topic, i.e. results of the recent research, but also theories about it in the current monographs and scientific works.
- Evaluating the existing findings and providing a critical review of the sources. After gathering the basic information and the literature, it is important to critically analyze all the sources and findings – to differentiate the adequate from the inadequate ones, the useful from those that are not.
- Formulating the research problem, questions and hypotheses. Drawing from the literature and the evaluation of the existing findings, the researcher has to formulate the research question, the problems and the hypotheses they are trying to test, i.e. to verify it or disprove it.

As the stages of the research process imply, after identifying the research topic, the researcher has to establish "the current situation" in the

field, to examine the current understanding of a certain field, to spot some of the flaws in an adopted theory, to perhaps try to eliminate them, and then to add his or her results to the existing body of knowledge (most commonly in the form of a scientific work, study, monograph, or report).

The choice of a topic, for example, "class consciousness", "psychological stress", "creativity in organizations", etc., is indeed an important part of research, but that choice is not always easy. Sometimes, it is not even free, since it is possibly already determined by an employer or an investor. Research greatly depends also on the discipline or the field of the research. In such circumstances, what matters too is a number of unwritten rules and expectations, traditions, prominent work by other authors, etc. It is equally important to check if the research topic is practical and useful, and it is best if the researcher can formulate it in a few words, or in a short phrase. The research topic then becomes the central idea the researcher should explore and learn about in his or her field.

However, regardless of the research field, it is not very likely that there is not any similar research to be consulted. In other words, it is a good idea to map the research area, or problem, which actually reflects the ensuing research stages. In addition, it is very important to choose a topic, which is neither "big" nor "small", because it is important to conduct the research in a limited time and space, with the resources available to the researcher. In many cases, the research cost should be considered, as well as one's readiness to change the direction of the research if the expenses are too high for its completion, or if there are various other circumstances that sometimes require a change in the initial plan.

When the topic is selected (or a few possible alternative topics), the researcher needs time to narrow the focus of the research. This is the time devoted to reading the literature, thinking about the research methods, and working on the best possible research design. In the course of scientific work, many times even the data collection process implies also narrowing the focus of the topic, and it typically involves questions about the nature of the phenomenon, entity or social "reality" explored, as well as what the relevant knowledge or evidence for the researched entities is, what actually requires exploration or explanation, or what the goal of the research is, etc. What is helpful in this process is defining the key concepts, questions and contexts to be examined, since they make the research "area" – they point to the relevant literature, the methods and theories that should be applied.

Also, while narrowing the topic, it is quite important to try to create a research draft at least, and then also do some informal pilot research to check and formulate ideas. During the piloting process the researcher tests the techniques and methods, analyzing their practical application, and changes plans if necessary. The next important step is to choose the right

methodology and research techniques, which we already mentioned. In other words, it is important to decide which techniques are acceptable for a certain type of research and which are not. It is not unusual to use different techniques, especially in social sciences. Being open-minded about the methodology can also be useful when it comes to the change of the research direction, since it sometimes happens that the adopted method does not yield satisfactory results, while adopting a variety of methods can help.

Finally, in conducting research, the question of management is of great importance. First of all, it is necessary to think about the time-frame, that is, about time management and the dynamics of the research. In its course, the researcher has to maintain relationships with the key figures and institutions. On the personal level, those are the supervisor (who has an academic responsibility for guiding and advising), tutor, mentor or manager (who has a responsibility for directing and overseeing the work in a more general sense), and on the institutional level, those are the university, employer, or sponsor. The following steps in the research process are the preparation for data collection and data collection itself, followed by the preparation for analysis, and writing a report or publication, i.e. completing the research process.

1.8 Defining a research problem, questions and hypothesis

To put it simply, a research problem is an issue or concern that needs to be addressed by the researcher or a wider community (for example, the problem of racial discrimination, the problem of alcoholism, the problem of sex worker stigmatization, etc.). In other words, it is a problem in its wider interpretation, most often affected by the existing social and/or scientific context. A research problem most commonly stems from the flaws of the existing interpretations or a gap in the existing literature, or from the opposing views of that problem in the actual research. Also, a research problem often reflects the need to hear the voice of marginalized groups, or to address a current social issue on the micro, meso, and macro level.

In this case too, the choice or the formulation of the research problem points to specific methodologies. For example, if a problem requires the identification of the factors affecting a certain outcome, or the analysis of the utility of an intervention, it is best to take a quantitative approach, i.e. to test particular theories or explanations. Alternatively, if a concept or a phenomenon should be explored or understood better since there is comparatively little research on it, or the topic is relatively new, a qualitative approach is probably more suitable. Finally, sometimes a

combination of quantitative and qualitative methods is most adequate because it enables a generalization of the findings, and at the same time it provides a detailed view of the observed phenomenon.

Defining the research questions represents the next, more detailed stage of the research process. They often include one or two central research questions and a few related sub-questions, (not more than five to seven of them). The central research questions are broad questions that ask for an exploration of the main phenomenon or concept in the study. It is useful to start the research by asking "What?" or "How?". It is also important to focus on one phenomenon or concept, since the factors influencing it tend to emerge in the course of the research. This is why the researcher should ask "What exactly is the one concept I want to explore?" So, a research problem can be understood as a question or a problem one wants to learn about and/or a situation one should analyze or change.

Defining a research question determines the choice of an adequate research methodology. For example, quantitative methodology is suitable for the question "How much teenage girls read teenage magazines?", while the question "How do teenage girls interpret the content of the teenage magazines?" requires a qualitative methodology. When applying quantitative methodology, researchers commonly define the research questions that imply measuring relations among the variables under investigation, while qualitative methodology assumes a researcher asks wider and open-ended questions related to the overall, complex sets of factors that surround the research problem.

In a way, the research question follows from the definition of the research problem. It makes the basis for the research and in a way narrows the focus of the study, determines the method, and guides all the research stages, as well as the analysis and the writing of the report. Furthermore, the research question has to be worthy of research, which means it has to contribute to the corpus of knowledge of a scientific field. Finally, it is good if a research question improves education and/or the human condition. In other words, a good research question is feasible, clear, significant and ethical.

Finally, research hypotheses are formalized views that require verification, rejection or disproof in the research process. Hypotheses are the researcher's predictions about the expected outcomes regarding the relations among variables. Quantitatively, checking or testing the hypotheses commonly implies the use of statistical procedures, which the researcher uses to draw conclusions about the population from the sample. Hypotheses are also used in experiments, in which researchers compare experimental and control groups, as well as test the validity of a theory.

When it comes to a formal research project (as for example, a doctoral dissertation), advisors often suggest or recommend the use of hypotheses as means of stating the direction of a study. Also, there is a difference between a so-called null and alternative hypothesis. The null hypothesis represents the traditional approach, i.e. a prediction that within a population there is no significant difference among groups with respect to a variable (for example, "There is no difference between the school achievement of adolescents who play video games and those who do not."). The alternative hypothesis, on the other hand, predicts an expected outcome, based on prior literature and studies on the topic (for example, "The school achievement of adolescents who play video games is smaller than the school achievement of those who do not.").

In short, hypotheses include the variables described, compare or relate independent and dependent variables, which are measured separately. At the same time, they are predictions of the outcomes of the research results, that is, they state what is going to happen in the research in a concrete (not abstract) fashion. The research itself, then, proves or disproves such hypotheses, or in other words, it confirms the null or the alternative hypothesis. This research tradition is referred to as the hypothetical-deductive model. If the prediction is correct, the null hypothesis is rejected and the alternative one confirmed. Of course, many studies do not contain hypotheses, especially when it comes to the basic, but also the so-called explorative research, whose aim is to explore a problem in more detail.

1.9 Using sources and the literature review

In addition to choosing the research topic and deciding on quantitative vs. qualitative methodology, i.e. adequate methods and techniques, a researcher has to thoroughly review the relevant literature. This helps to establish whether the topic should be researched in the first place. The literature also provides new insight into the ways of directing, defining and carrying out the research itself. In other words, every researcher has to spend a lot of time searching for information, reading books and scientific journals on a particular research topic. This stage is extremely important for the entire study, because a beginner can come up with a good research topic and a specific research problem, choose the methodology and methods adequately, define the research question and hypotheses well, but it can happen that this research does not add anything new to the existing literature on the topic. Therefore, it is important to ask oneself: "How does this research project contribute to the current theories and scientific

work?" To answer that question, one must spend a lot of time on the existing literature, as well as on critically analyzing and evaluating it.

So, upon choosing the topic of their research, a researcher should start searching for the basic information and the literature about the topic. During this process, a researcher learns about other similar research, and then he or she relates their own work to a wider context in order to fill in certain gaps in the existing knowledge, to extend other studies, to take into consideration the thus far unanswered questions, etc. Likewise, one sets the frame for evaluating the importance of the research in a wider social context. All research should represent an original contribution to the existing corpus of scientific knowledge (unless it tests the results of previous research, is the replication of an experiment, etc.), no matter how narrow its scope is.

When it comes to using the literature for a concrete research proposal, it is best to provide a relatively short literature overview that represents only a summary of the most important studies about the research problem. So, in this stage, it does not have to be fully developed and thorough, especially because various changes and modifications occur during the research, just as new literature keeps emerging. It is only important to show that the researcher is aware of the most important and up-to-date literature about his or her topic. At the same time, the literature overview can be just a summary of what other theoreticians and researchers have done, or it can be a critical assessment of the previous research. This overview can also build bridges among different topics and concepts, it can identify the central questions and problems in a certain field.

However, the way the literature is used is much more important than the mere literature overview. It should integrate the sources and the literature, organize them in a series of interrelated topics and summarize it all while pointing to the key questions and problems. In qualitative studies, scientists often use the literature in accordance with their assumptions, without prescribing the questions that should be answered. The researchers who use quantitative methodology, on the other hand, try to verify or refute some of the previously confirmed hypotheses or theories they found in the literature. In other words, at the end of quantitative research, the researcher usually goes back to the literature and compares the results of his or her own study to the results of other research.

In any case, every review, and every critical analysis of the literature starts with locating and summarizing the existing studies about a topic or field. If a topic is being researched for the first time, it is useful to start with a kind of "wide synthesis" literature review, which includes encyclopedias, research monographs, dissertations, or review articles. Then, the researcher should study the literature in more detail, such as

articles from international journals, and find the studies and scientific work dealing with the same or similar research problems, questions and hypotheses and research plans. In this way, he or she "maps" the field and creates a rough research plan, which contributes to the informativity, adequacy and quality of the research itself.

1.10 Basic, applied, and evaluation research

In the process of research, it is very important to distinguish between the so-called basic and applied research. Research dealing with the current knowledge in a particular field (or the potential rejection of it) is usually referred to as basic or fundamental. There is, on the other hand, the so-called applied, or practical research. The results of this type of study are usually based on the assumptions from basic research. Therefore, applied research aims at acquiring knowledge about a particular problem and improving it.

Basic research is conducted to explore the questions relevant for supporting or dismissing theoretical or empirical stances. Its main goal is to gather general information about a phenomenon without considering a practical application. On the other hand, the nature of applied research is somewhat different – its main goal is to generate information directly applicable to real-world issues. However, these differences are not always clear-cut since some research contains aspects of both basic and applied research.

Basic research is also informally referred to as blue skies research or blue-sky science, which implies that its application in "the real world" is not immediately obvious. This is why it is sometimes considered to be research without a clear purpose, or guided by pure curiosity. Unfortunately, due to a relatively uncertain return on investment in such projects, they are less and less popular in a political and commercial sense, and compared to profitable or practical research, it is more difficult to find financial support for them. Also, basic research is motivated by curiosity and the desire for discovery, and its practical use is not considered in advance. If the research is successful, it contributes to the general knowledge and understanding of nature and its laws, and the general knowledge offers solutions to a number of practical issues, although it does not necessarily provide complete and specific solutions to all of them, because providing complete solutions is the purpose of applied research.

In relation to this, it should be noted that although a scientist doing basic research does not have to be interested in the practical application of his or her work, industrial progress would stagnate without it. The history

of science teaches us that many important discoveries resulted from experiments that initially had a completely different purpose. Basic research provides new knowledge, builds scientific capital, a kind of fund, from which practical applications of that knowledge are further derived. Therefore, it is important to understand that although it does not immediately seek practical application, basic research is by no means "impractical".

The crucial difference between basic and applied research is in the freedom a researcher has. In applied research, the research problem is predefined and the researcher looks for the best possible solution given the circumstances. In basic research, these restrictions do not exist, and the only limitations are those of one's imagination and creativity, because science is devoted to the expansion of knowledge of general validity, and basic research is its dynamic part. The difference between basic and applied research can be represented through the distinction between science and politics in the form of social institutions. The role of politics is to produce agreement, decisions and collective action, so applied research can be viewed as being at the intersection of science and politics – it greatly depends on the existing scientific knowledge and methods, but it is devoted to the solution of actual economic, social and political problems rather than to further development of that knowledge and scientific methods.

Finally, evaluation research can be considered both as a type of applied research and as a separate research category. It primarily deals with a systematic evaluation of institutions, projects and interventions, and it is sometimes based on quantitative measuring, while other times on interviews, reports, documents and the like. Thus, it is primarily concerned with the purpose of research, and not a specific methodology, and the purpose is to evaluate the impact of social interventions, such as new methods of medical treatment, innovations in the domain of services, etc. One could say that the goal of research is to prove, while the goal of evaluation is to improve, and it is suitable whenever there is a social intervention, i.e. an action within a social context aimed at achieving a particular result.

For all of the above, it suffices to say that evaluation research aims at establishing whether a social intervention has achieved a desired result or not. It can be conducted when a new program is planned, when a developing program is evaluated, when an existing, or finished program is assessed. Evaluation is conducted in order to gain insight into the program and its efficiency, to improve the existing practice, to evaluate its effects/consequences and to build its capacity (raise funding, enhance skills and strengthen accountability).

1.11 Intradisciplinary, cross-disciplinary, multidisciplinary, interdisciplinary and transdisciplinary approaches

In the end, it is important to point out that a lot of research requires a close and fruitful co-operation among different academic disciplines. The division of academic disciplines is still dominant at universities, which is reflected in the organization of the departments, jobs, promotions, the researchers' identity, etc. This division has both its advantages and disadvantages, because it creates barriers that sometimes make the work or even scientific progress more difficult. Although the term is not common, one could say that intradisciplinarity stands for working within a single discipline.

Still, interdisciplinarity is needed to achieve a more comprehensive synthesis of knowledge, which enables the revealing of a bigger picture, and it can be improved in different ways. The three main arguments for an interdisciplinary approach are intellectual, practical and pedagogical. In an intellectual sense, the existing ideas in a certain field can clearly benefit from the theories, concepts and methods from other fields and scientific disciplines. Specialization has led to a great progress in science, but over time, sub-specialization has led to a growing fragmentation of the research subject and mutual isolation among disciplines. The practical argument is that neither the natural nor the social environment is divided into academic disciplines, and that many problems can be solved better if the answers are searched for in more than one discipline. Finally, the pedagogical argument is related to the fact that fragmentation of the curriculum encumbers learning.

However, just as intradisciplinarity and interdisciplinarity require clarifications, the same goes for cross-disciplinarity, multidisciplinarity and transdisciplinarity. The cross-disciplinary approach assumes observing a scientific discipline from the standpoint or the perspective of another discipline. An example of this would be a professor of physics explaining the physics of music, or an Art Department offering a course in the History of Art. On the other hand, the multidisciplinary approach assumes a higher level of co-operation among sciences and scientific disciplines, and it includes several disciplines, each offering a different perspective on a specific issue or question. An example could be a situation where a historian, a social worker and a sociologist from the Department of Women's Studies, who are exploring the position of women in a society, each teach it within their field of expertise. The interdisciplinary approach is even higher in this hierarchy of co-operation among scientists, because it

integrates contributions from several disciplines regarding the same problem. Thus, independent parts of knowledge are brought together in a harmonic relation, and the best example of interdisciplinarity is the integration, and even the modification, of the contributions from various disciplines in the course of the research. Finally, the highest level of co-operation is assumed by transdisciplinarity, and it is characterized by the unity of the intellectual frames, outside the (narrow) perspective of individual disciplines.

This is not a commonly accepted division, just as there is no consensus on the meaning of these terms. Thus, interdisciplinarity is sometimes taken to refer to the integration of knowledge across disciplines, but also the interaction between (inter) disciplines and society. The latter is sometimes referred to as transdisciplinarity, especially in Europe. Multidisciplinarity is occasionally defined as an approach that juxtaposes disciplines, and this in return leads to wider knowledge, information spectrum and methods, while the disciplines themselves remain separated, or to put it differently, the elements of individual disciplines maintain their original identity. On the other hand, the advantage of this scientific research is the integration of different scientific discoveries, as opposed to divisiveness among the disciplines and the researchers' egos.

Given all of the above, one can conclude that a scientist or researcher is primarily an individual who accepts scientific methods in the search for knowledge. There are vast differences among scientists, but all of them should have the same goal – to acquire knowledge applying the scientific method and techniques. In other words, above all, science is made of or characterized by the scientific method, and is not the random collection of information, explanations, and facts about the world around us. For this reason, a rigorous focus on scientific methodology and the scientific method represents the very foundation and the most important task of any scientific research.

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CHAPTER 2: Processing, Analysis and Interpretation of Research Results

Blaža STOJANOVIĆ[4]

ABSTRACT: In survey research, independent and dependent variables are used to define the scope of study, but cannot be explicitly controlled by the researcher. Before conducting the survey, the researcher must predicate a model that identifies the expected relationships among these variables. The survey is then constructed to test this model against observations of the phenomena. A survey can be thought to consist of several interconnected steps which include: defining the objectives, selecting a survey frame, determining the sample design, designing the questionnaire, collecting and processing the data, analysing and disseminating the data and documenting the survey. The life of a survey can be broken down into several phases. The first is the planning phase, which is followed by the design and development phase, and then the implementation phase. Finally, the entire survey process is reviewed and evaluated.

KEYWORDS: data, collection, statistics, survey, result.

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2.1 Data collection in research programs and surveys

Data collection is the process of gathering the required information for each selected unit in the survey. The basic methods of data collection are self-enumeration, where the respondent completes the questionnaire without the assistance of an interviewer, and interviewer-assisted (either through personal or telephone interviews). Other methods of data collection include direct observation, electronic data reporting and the use of administrative data.

Data collection can be paper-based or computer-assisted. With paper-based methods, answers are recorded on printed questionnaires. With computer-assisted methods, the questionnaire appears on the screen of the computer and the answers are entered directly into the computer. One benefit of computer-assisted methods is eliminating a post-collection processing activity because data capture, the transformation of responses into a machine-readable format, occurs during collection of answers. Another benefit is that invalid or inconsistent data can be identified more easily than with a paper questionnaire [1,2].

During the planning phase of a survey, many decisions must be made regarding the method of data collection: Should the questionnaire be administered by an interviewer? If yes, should the interview be conducted in person or over the telephone? Should a combination of methods be used; should respondents fill out the questionnaire themselves and nonrespondents be followed-up with a telephone interview? Should the questionnaire be paper or computer-based? Should administrative data be used to collect some of the survey data? Should data collection for several surveys be combined?

The basic methods of data collection are [2]:

- **Self-Enumeration** - With self-enumeration, the respondent completes the questionnaire without the assistance of an interviewer. There are a variety of ways that the questionnaire can be delivered to and returned by the respondent: by post or facsimile, electronically (including the Internet) or by an enumerator. (If the questionnaire is returned by facsimile or electronically, then a secure line or encryption is needed to ensure the confidentiality of respondent data). When paper-based, this method is called Paper and Pencil Interviewing (PAPI), when computer-based it is called Computer-Assisted Self Interviewing (CASI).
- **Interviewer-assisted (Personal Interviews or Telephone Interviews);**
  - **Personal Interviews** - An interviewer assists the respondent to complete the questionnaire. The interview is conducted in person,

usually at the respondent's residence or place of work, although it can be conducted in a public place (e.g. airport, shopping centre). When paper-based, this method is called Paper and Pencil Interviewing (PAPI), when computer-based it is called Computer-Assisted Personal Interviewing (CAPI).

- **Telephone Interviews** - An interviewer assists the respondent to complete the questionnaire over the telephone. When paper-based, this method is called Paper and Pencil Interviewing (PAPI), when computer-based, it is called Computer-Assisted Telephone Interviewing (CATI).

Surveys are fixed sets of questions that can be administered by paper and pencil, as a web form, or by an interviewer who follows a strict script.

Interviews are discussions, usually one-on-one between an interviewer and an individual, meant to gather information on a specific set of topics. Interviews can be conducted in person or over the phone. Interviews differ from surveys by the level of structure placed on the interaction.

Focus groups are dynamic group discussions used to collect information.

Observation is data collection in which the researcher does not participate in the interactions. Examples of this include observing operating room procedures or Supreme Court proceedings. However, it should be noted that the researcher's very presence may have some influence on the participants and exchanges. For example, while the researcher is unlikely to influence a surgeon or a Supreme Court justice, it is not difficult to imagine the researcher's presence influencing other participants, such as small children at play.

Extraction is the collection of data from documents, records, or other archival sources.

This generally includes using an abstraction process to cull the information desired from the source. Examples of this might be collecting information on dates of diagnoses from medical records or decision dates from legal records [1,2]. In table 2.1 are given advantages and disadvantages of different information collection tools [3,4].

Table 2.1 Information collection tools – advantages and disadvantages [3,4]

Information Collection Tools	Advantages	Disadvantages
Observation	-Collect data where and when an event or activity is occurring; -Does not rely on people's willingness to provide information; and -Directly see what people do rather than relying on what they say they do.	-Susceptible to observer bias; -Hawthorne effect: people usually perform better when they know they are being observed; and -Does not increase understanding of why people behave the way they do.
Document Review	-Relatively inexpensive; -Good source of background information; -Unobtrusive; -Provides a "behind the scene" look at a program that may not be directly observable; and -May bring up issues not noted by other means.	-Information may be inapplicable, disorganized, unavailable or out of date; -Could be biased because of selective survival of information; -Information may be incomplete or inaccurate; and -Can be time consuming to collect, review, and analyze many documents.
Interviews	-Useful for gaining insight and context into a topic; -Allows respondents to describe what is important to them; and -Useful for gathering quotes and stories.	-Susceptible to interview bias; -Time consuming and expensive compared to other data collection methods; and -May seem intrusive to the respondent.
Focus Groups	-Quick and relatively easy to set up; -Group dynamics can provide useful information that individual data collection does not provide; and -Is useful in gaining insight into a topic that may be more difficult to gather information through other data collection methods.	-Susceptible to facilitator bias; -Discussion can be dominated or sidetracked by a few individuals; -Data analysis is time consuming and needs to be well planned in advance; -Does not provide valid information at the individual level; and -The information is not representative of other groups.

Table 2.1 continued

Information Collection Tools	Advantages	Disadvantages
Surveys and Questionnaires	-Administration is comparatively inexpensive and easy even when gathering data from large numbers of people spread over wide geographic area; -Reduces chance of evaluator bias because the same questions are asked of all respondents; -Many people are familiar with surveys; -Some people feel more comfortable responding to a survey than participating in an interview; and -Tabulation of closed-ended responses is an easy and straightforward process.	-Survey respondents may not complete the survey resulting in low response rates; -Items may not have the same meaning to all respondents; -Size and diversity of sample will be limited by people's ability to read; -Given lack of contact with respondent, never know who really completed the survey; -Unable to probe for additional details; and -Good survey questions are hard to write and they take considerable time to develop and confirm.
Town Hall Meetings and Other Large Group Events	-Can gather large amount of data at one time; -Allows respondents to describe the issues that are important to them; and -Provides a venue where people can build on each other's knowledge.	-Organizing the event takes time and resources; -Need of incentives to get people to attend; -Need to have access to people with good facilitation skills; and -Need to have "ducks in a row" to ensure attendance at event.
Case Studies	-Fully depicts people's experience in program input, process, and results; and -Powerful way of portraying program to outsiders	-Usually quite time consuming to collect information, organize and analyze it; and -Represents depth of information rather than breadth.
Illustrated Presentations – Photo Voice, Power Voice	-Fun to do and easier to get people involved because it doesn't seem "researchy";	-Takes some technological skill or expertise to "produce" the presentation;

Table 2.1 continued

Information Collection Tools	Advantages	Disadvantages
Illustrated Presentations – Photo Voice, Power Voice	-Especially useful as a way to get people of different cultures involved or people who are more visual than verbal; and -Powerful way to represent data: "A picture is worth a thousand words".	-Need to have good facilitation skills given that these methods are group work processes; and -May not speak to stakeholders who prefer more quantitative approach to data collection and may not be appropriate in situations where numbers are needed.
Skits, Dramatizations, Other Visual Representations	-An alternative approach to linear models of evaluation that may not fit well cross-culturally; and -Useful methods when part of the evaluation purpose is to move toward some form of action; and -Fun, innovative approach to evaluation that causes people to view program through another perspective.	-Takes some courage for people who aren't accustomed to public display; and -May not speak to stakeholders who prefer more quantitative approach to data collection and may not be appropriate in situations where numbers are needed.

2.2 Data acquisition in experiments

An experimental study may be conducted in many different ways. In some studies, the researcher is interested in collecting information from an undisturbed natural process or setting. An example would be a study of the differences in reading scores of second-grade students in public, religious, and private schools. In other studies, the scientist is working within a highly controlled laboratory, a completely artificial setting for the study. For example, the study of the effect of humidity and temperature on the length of the life cycles of ticks would be conducted in a laboratory since it would be impossible to control the humidity or temperature in the tick's natural environment. This control of the factors under study allows the entomologist to obtain results that can then be more easily attributed to differences in the levels of the temperature and humidity, since nearly all other conditions remain constant throughout the experiment. In a natural setting, many other factors are varying and they may also result in changes

in the life cycles of the ticks. However, the greater the control in these artificial settings, the less likely the experiment is depiction the true state of nature. A careful balance between control of conditions and depiction of a reality must be maintained in order for the experiments to be useful [5]. There are two methods for maintaining this balance:

- Method 1: The subjects in the experiment are randomly assigned to the treatments;
- Method 2: Subjects are randomly selected from different populations of interest [5].

In Method 1, the researcher randomly selects experimental units from a homogeneous population of experimental units and then has complete control over the assignment of the units to the various treatments.

In Method 2, the researcher has control over the random sampling from the treatment populations but not over the assignment of the experimental units to the treatments.

In experimental studies, it is crucial that the scientist follows a systematic plan established prior to running the experiment. The plan includes how all randomization is conducted, either the assignment of experimental units to treatments or the selection of units from the treatment populations. There may be extraneous factors present that may affect the experimental units. These factors may be present as subtle differences in the experimental units or slight differences in the surrounding environment during the experiment.

The plan should also include many other aspects on how to conduct the experiment. A list of some of the items that should be included in such a plan are listed below [6]:

- The research objectives of the experiment;
- The selection of the factors that will be varied (the treatments);
- The identification of extraneous factors that may be present in the experimental units or in the environment of the experimental setting (the blocking factors);
- The characteristics to be measured on the experimental units (response variable);
- The method of randomization, either randomly selecting from treatment populations or the random assignment of experimental units to treatments;
- The procedures to be used in recording the responses from the experimental units;
- The selection of the number of experimental units assigned to each treatment may require designating the level of significance and power of tests or the precision and reliability of confidence intervals; and

- A complete listing of available resources and materials.

A designed experiment is an investigation in which a specified framework is provided in order to observe, measure, and evaluate groups with respect to a experiment in order to obtain data from which statistical inferences can provide valid comparisons of the groups of interest.

There are two types of variables in a experimental study:

- Controlled variables called factors are selected by the researchers for comparison. These variables form the comparison groups defined by the research hypothesis.
- Response variables are measurements or observations that are recorded but not controlled by the researcher.

The treatments in an experimental study are the conditions constructed from the factors. The factors are selected by examining the questions raised by the research hypothesis. In some experiments, there may only be a single factor, and hence the treatments and levels of the factor would be the same. In most cases, we will have several factors and the treatments are formed by combining levels of the factors. This type of treatment design is called a factorial treatment design.

A special treatment is called the control treatment. This treatment is the benchmark to which the effectiveness of the remaining treatments are compared. There are three situations in which a control treatment is particularly necessary. First, the conditions under which the experiments are conducted may prevent generally effective treatments from demonstrating their effectiveness. A second type of control is the standard method treatment to which all other treatments are compared. In this situation, several new procedures are proposed to replace an already existing well-established procedure. A third type of control is the placebo quality control. In this situation, a response may be obtained from the subject just by the manipulation of the subject during the experiment.

The experimental unit is the physical entity to which the treatment is randomly assigned or the subject that is randomly selected from one of the treatment populations. Consider another experiment in which a researcher is testing various dose levels (treatments) of a new drug on laboratory rats. If the researcher randomly assigned a single dose of the drug to each rat, then the experimental unit would be the individual rat. Once the treatment is assigned to an experimental unit, a single replication of the treatment has occurred. In general, we will randomly assign several experimental units to each treatment. We will thus obtain several independent observations on any particular treatment and hence will have several replications of the treatments.

Distinct from the experimental unit is the measurement unit. This is the physical entity upon which a measurement is taken. In many experiments, the experimental and measurement units are identical [5,6].

The experimental error is term used to describe the variation in the responses among experimental units that are assigned the same treatment and are observed under the same experimental conditions. The reasons that the experimental error is not zero include [5]:

- The natural differences in the experimental units prior to their receiving the treatment;
- The variation in the devices that record the measurements;
- The variation in setting the treatment conditions; and
- The effect on the response variable of all extraneous factors other than the treatment factors.

2.3 Introduction to data mining techniques

Simply stated, data mining refers to extracting or "mining" knowledge from large amounts of data. The term is actually a misnomer. Remember that the mining of gold from rocks or sand is referred to as gold mining rather than rock or sand mining. Thus, data mining should have been more appropriately named "knowledge mining from data," which is unfortunately somewhat long. "Knowledge mining," a shorter term, may not reflect the emphasis on mining from large amounts of data. Nevertheless, mining is a vivid term characterizing the process that finds a small set of precious nuggets from a great deal of raw material [7].

Data mining involves an integration of techniques from multiple disciplines such as database and data warehouse technology, statistics, machine learning, high-performance computing, pattern recognition, neural networks, data visualization, information retrieval, image and signal processing, and spatial or temporal data analysis. We adopt a database perspective in our presentation of data mining in this book. That is, emphasis is placed on efficient and scalable data mining techniques. For an algorithm to be scalable, it's running time should grow approximately linearly in proportion to the size of the data, given the available system resources such as main memory and disk space. By performing data mining, interesting knowledge, regularities, or high-level information can be extracted from databases and viewed or browsed from different angles. The discovered knowledge can be applied to decision making, proccontrol, information management, and query processing. Therefore, data mining is considered one of the most important frontiers in database and information

systems and one of the most promising interdisciplinary developments in the information technology.

Because of the diversity of disciplines contributing to data mining, data mining research is expected to generate a large variety of data mining systems. Therefore, it is necessary to provide a clear classification of data mining systems, which may help potential users to distinguish between such systems and identify those that best match their needs. Data mining systems can be categorized according to various criteria, as follows (figure 2.1) [7]:

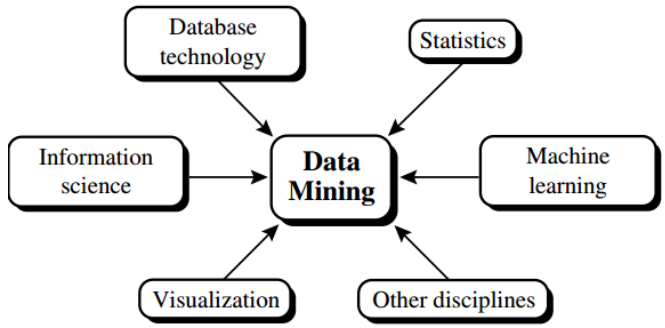


Figure 2.1 Data mining as a confluence of multiple disciplines [7]

Classification according to the types of databases mined - A data mining system can be classified according to the kinds of databases mined. Database systems can be classified according to different criteria (such as data models, or the types of data or applications involved), each of which may require its own data mining technique. For instance, if classifying according to data models, we may have a relational, transactional, object-relational, or data warehouse mining system. If classifying according to the special types of data handled, we may have a spatial, time-series, text, stream data, multimedia data mining system, or a World Wide Web mining system.

Classification according to the types of knowledge mined - Data mining systems can be categorized according to the kinds of knowledge they mine, that is, based on data mining functionalities, such as: characterization, discrimination, association correlation analysis, classification, prediction, clustering, outlier analysis, and evolution analysis. A comprehensive data mining system usually provides multiple and/or integrated data mining functionalities [8].

Moreover, data mining systems can be distinguished based on the granularity or levels of abstraction of the knowledge mined, including

generalized knowledge (at a high level of abstraction), primitive-level knowledge (at a raw data level), or knowledge at multiple levels (considering several levels of abstraction). An advanced data mining system should facilitate the discovery of knowledge at multiple levels of abstraction.

Data mining systems can also be categorized as those that mine data regularities (commonly occurring patterns) versus those that mine data irregularities (such as exceptions, or outliers). In general, concept description, association and correlation analysis, classification, prediction, and clustering mine data regularities, rejecting outliers as superfluous. These methods may also help detect outliers.

Classification according to the applications adapted - Data mining systems can also be categorized according to the applications they adapt. For example, data mining systems may be tailored specifically for finance, telecommunications, DNA, stock markets, e-mail, and so on. Different applications often require the integration of application-specific methods. Therefore, a generic, all-purpose data mining system may not fit domain-specific mining tasks.

A critical question in the design of a data mining (DM) system is how to integrate or couple the DM system with a database (DB) system and/or a data warehouse (DW) system. If a DM system works as a stand-alone system or is embedded in an application program, there are no DB or DW systems with which it has to communicate. This simple scheme is called no coupling, where the main focus of the DM design rests on developing effective and efficient algorithms for mining the available data sets. However, when a DM system works in an environment that requires it to communicate with other information system components, such as DB and DW systems, possible integration schemes include no coupling, loose coupling, semitight coupling, and tight coupling. We examine each of these schemes, as follows:

- **No coupling -** No coupling means that a DM system will not utilize any function of a DB or DW system. It may fetch data from a particular source (such as a file system), process data using some data mining algorithms, and then store the mining results in another file. Such a system, though simple, suffers from several drawbacks. First, a DB system provides a great deal of flexibility and efficiency at storing, organizing, accessing, and processing data. Without using a DB/DW system, a DM system may spend a substantial amount of time finding, collecting, cleaning, and transforming data. In DB and/or DW systems, data tend to be well organized, indexed, cleaned, integrated, or consolidated, so that finding the task-relevant, high-quality data becomes an easy task. Second, there are many tested, scalable algorithms

and data structures implemented in DB and DW systems. It is feasible to realize efficient, scalable implementations using such systems. Moreover, most data have been or will be stored in DB/DW systems. Without any coupling of such systems, a DM system will need to use other tools to extract data, making it difficult to integrate such a system into an information processing environment. Thus, no coupling represents a poor design [7].

- **Loose coupling -** Loose coupling means that DM system will use some facilities of DB or DW system, fetching data from a data repository managed by these systems, performing data mining, and then storing the mining results either in a file or in a designated place in a database or data warehouse. Loose coupling is better than no coupling because it can fetch any portion of data stored in databases or data warehouses by using query processing, indexing, and other system facilities. It incurs some advantages of the flexibility, efficiency, and other features provided by such systems. However, many loosely coupled mining systems are main memory-based. Because mining does not explore data structures and query optimization methods provided by DB or DW systems, it is difficult for loose coupling to achieve high scalability and good performance with large data sets [7].
- **Semitight coupling** - Semitight coupling means that besides linking DM system to DB/DW system, efficient implementations of a few essential data mining primitives (identified by the analysis of frequently encountered data mining functions) can be provided in the DB/DW system. These primitives can include sorting, indexing, aggregation, histogram analysis, multiway join, and precomputation of some essential statistical measures, such as sum, count, max, min, standard deviation, and so on. Moreover, some frequently used intermediate mining results can be precomputed and stored in the DB/DW system. Because these intermediate mining results are either precomputed or can be computed efficiently, this design will enhance the performance of the DM system [8].
- **Tight coupling** [7] - Tight coupling means that a DM system is smoothly integrated into the DB/DW system. The data mining subsystem is treated as one functional component of an information system. Data mining queries and functions are optimized based on mining query analysis, data structures, indexing schemes, and query processing methods of a DB or DW system. With further technology advances, DM, DB, and DW systems will evolve and integrate together as one information system with multiple functionalities. This will provide a uniform information processing environment. This approach is

highly desirable because it facilitates efficient implementations of data mining functions, high system performance, and an integrated information processing environment.

With this analysis, it is easy to see that a data mining system should be coupled with the DB/DW system. Loose coupling, though not efficient, is better than no coupling because it uses both data and system facilities of the DB/DW system. Tight coupling is highly desirable, but its implementation is nontrivial and more research is needed in this area. Semitight coupling is a compromise between loose and tight coupling. It is important to identify commonly used data mining primitives and provide efficient implementations of such primitives in DB or DW systems [7, 8].

2.4 Statistical methods for data and results analysis and processing

Statistics is the science of designing studies or experiments, collecting data and modeling or analyzing data for the purpose of decision making and scientific discovery when the available information is both limited and variable. That is, statistics is the science of Learning from Data [9].

Statistics (plural) is the field of science that involves the collection, analysis and reporting of information that has been sampled from the world around us. The term sampled is important here. In most instances the data we analyze is a sample (a carefully selected representative subset) from a much larger population. In a production process, for example, the population might be the set of integrated circuit devices produced by a specific production line on a given day (perhaps 10,000 devices) and a sample would be a selection of a much smaller number of devices from this population (e.g. a sample of 100 devices, to be tested for reliability). In general this sample should be arranged in such a way as to ensure that every part from the population has an equal chance of being selected. Typically this is achieved by deciding on the number of items to sample, and then using equi-probable random numbers to choose the particular devices to be tested from the labeled population members [10].

The term statistic (singular) refers to a value or quantity, such as the mean value, maximum or total, calculated from a sample. Such values maybe used to estimate the (presumed) population value of that statistic. Such population values, particular key values such as the mean and variance, are known as parameters of the pattern or distribution population values.

Whenever we perform an experiment and want to interpret the collected data, we need statistical tools. The accuracy of measurements is limited by

the precision of the equipment which we use, and thus the results emerge from a random process. In many cases also the processes under investigation are of stochastic nature, i.e. not predictable with arbitrary precision, such that we are forced to present the results in form of estimates with error intervals. Estimates accompanied by an uncertainty interval allow us to test scientific hypotheses and by averaging the results of different experiments to continuously improve the accuracy. It is by this procedure that a constant progress in experimental sciences and their applications was made possible.

Inferential statistics provides mathematical methods to infer the properties of a population from a randomly selected sample taken from it. A population is an arbitrary collection of elements, a sample is just a subset of it.

Statistics is at least partially based on experience which is manifested in fields like deconvolution and pattern recognition. It applies probability theory but should not be confounded with it. Probability theory, contrary to statistics, is a purely mathematical discipline and based on simple axioms. On the other hand, all statistical methods use probability theory.

In statistics, there are several different notions on what probability means. In the [11] we find the following definition:

"Probability, a basic concept which may be taken as undefinable expressing in some way a degree of belief, or as the limiting frequency in an infinite random series. Both approaches have their difficulties and the most convenient axiomatization of probability theory is a matter of personal taste. Fortunately both lead to much the same calculus of probability".

To achieve practical, useful results in the natural sciences, in sociology, economics or medicine, statistical methods are required and a sensible assignment has to be made.

There are various possibilities to do so [12]:

- Symmetry properties are frequently used to assign equal probabilities to events. This is done in gambling, examples are rolling dice, roulette and card games. The isotropy of space predicts equal probabilities for radiation from a point source into different directions;
- Laws of nature like the Boltzmann's law of thermodynamics, the exponential decay law of quantum mechanics or Mendel's laws allow us to calculate the probabilities for certain events;
- From the observed frequencies of certain events in empirical studies wean estimate their probabilities, like those of female and male births, of moons in cosmic rays, or of measurement errors in certain repeatable experiments. Here we derive frequencies from a large sample of

observations from which we then derive with sufficient accuracy the probability of future events;

- In some situations we are left with educated guesses or we rely on the opinion of experts, when for example the weather is to be predicted or the risk of an accident of a new oil-ship has to be evaluated; and
- In case of absolute ignorance often a uniform probability distribution is assumed. This is known as Bayes postulate. When we watch a tennis game and do not know the players, we will assign equal probabilities of winning to both players.

The following table provides a detailed description of the statistical value chain, where each group is given individual activities that describe in more detail the statistical chain. Statistical Value Chain (SVC) is given in table 2.2.

Table 2.2 Components of the Statistical Value Chain (SVC) [10,11]

	SVC Group	SVC Component Activities
1.	Decision to undertake a collection or analysis	-Analysis of user needs; -Formulate research hypotheses; and -Research on related studies (within NSI and international),
2.	Collection design	-Clarify objectives; -Research past and related work; -Develop measurement instruments, including testing; -Develop field procedures, including testing; -Develop edit/ imputation strategies; -Develop data management strategies; -Develop dissemination strategies; and -Document.
3.	Accessing administrative data	-Clarify objectives; -Arrange access (including any legal issues); and -Document data that is accessed.
4.	Sample design	-Clarify objectives; -Research past and related work; -Determine target population, frame, selection and estimation methods; -Design and allocate sample; and -Document.
5.	Implementing design	-Frame creation or cleaning; -Sample selection; -Sample cleaning; -Allocation of sample to interviewers for interview based surveys and dispatch of workloads; and

Table 2.2 continued

	SVC Group	SVC Component Activities
5.	Implementing design	-Allocation of sample to validators (self completion forms) and identification of workloads on corporate database.
6.	Implementing collection	-Dispatch of mail based or electronic questionnaires to respondents; -Interviewing for interview based surveys; -Management of respondent relations and feedback to frame information; -Resolution of queries relating to selected units; -Management of collection, including quality assurance of processes and monitoring of progress; -Follow up procedures, including re-issue of sample to interviewers and reminders to mail based respondents; and -Document procedures and outcome of processes.
7.	Editing and validation, derivation and coding	-Unit level editing and validation; -Imputation and construction; -Derivation of variables; -Quality assurance of processes; and -Document procedures and outcome of processes.
8.	Weighting and estimation	-Outliers; -Sampling errors; -Special adjustments; -Quality assurance; and -Document procedures and outcome of processes.
9.	Analysis of primary outputs	-Macro editing and drill down to unit data; -Tabulation; -Exception reporting; -Assessment of results against related information; and -Document including quality report.
10.	Index number construction	-Index construction (including deflation, chain linking).
11.	Time series analysis	-Interpolation; -Seasonal adjustment; -Trend analysis and extrapolation; and -Document including quality report.
12.	Further analysis (across data sets/ over time/more specialist analyses, includes spatial and longitudinal analysis)	-Identify and access relevant series; -Identify available methods; -Develop and evaluate new methods and extensions of existing methods; -Statistical analysis including tabulation, exploratory data analysis, spatial analysis and longitudinal analysis; -Adjusting data series for further analysis;

Table 2.2 continued

	SVC Group	SVC Component Activities
12.	Further analysis (across data sets/ over time/more specialist analyses, includes spatial and longitudinal analysis)	-Validate results; and -Document including quality report.
13.	Confidentiality and disclosure	-Identify user requirements for outputs and priorities; -Identify potentially disclosive information; -Apply solutions to avoid disclosure; -Evaluate results; and -Document.
14.	Dissemination (data and metadata)	-Dissemination of standard aggregated outputs including text, diagrams, numbers etc.; -Dissemination of nonstandard aggregated outputs; -Dissemination of micro data externally or within ONS under controlled conditions; -Dissemination of metadata; -Customer inquiries and complaints; -Content management; and -Document processes and report on quality.
15.	Data archiving and ongoing management	-Identify and maintain contact information, particularly data custodian; -Implement archiving policy; and -Document policy and practice.

2.5 Other methods for data analysis and processing

In conducting research, the area of investigation and the research questions determine the method that the researcher follows. The research method consists of how the researcher collects, analyzes, and interprets the data in the study [2]. Secondary analysis is a systematic method with procedural and evaluative steps, yet there is a lack of literature to define a specific process, therefore this paper proposes a process that begins with the development of the research questions, then the identification of the data set, and thorough evaluation the data set.

The key to secondary data analysis is to apply theoretical knowledge and conceptual skills to utilize existing data to address the research questions. Hence, the first step in the process is to develop search questions. The purpose of this study was to investigate the enablers and

barriers that school librarians experience enacting a leadership role in technology integration. The research questions that guided this work are: What enablers or supporting factors do accomplished school librarians perceive as enablers in enacting the role of leader in technology integration? What barriers or constraining factors do accomplished school librarians perceive to enacting the role of leader in technology integration? What is the association between accomplished school librarians involve data high level in technology integration leadership and the identified enablers/barriers in comparison to the other participants [12]?

Most research begins with an investigation to learn what is already known and what remains to be learned about a topic [2]; including related and supporting literature, but oneshould also consider previously collected data on the topic.

In the case of this research an in-depth literature review of the areas of interest was conducted examining the previous and current work of experts in the field of school librarianship and technology. Through the literature review other researchers on this topic were identified, answer agencies and research centers that have conducted related studies.

Once a data set that appears viable in addressing initial requirements discussed above is located, the next step in the process is evaluation of the data set to ensure the appropriateness for the research topic.

The major advantages associated with secondary analysis are the cost-effectiveness and convenience it provides. Since someone else has already collected the data, the researcher does not have to devote financial resources to the collection of data. When good secondary data is available, researchers can gain access to and utilize high quality larger data sets, such as those collected by funded studies or agencies that involve larger samples and contain substantial breadth. The larger samples are more representative of the target population and allow for greater validity and more generalizable findings.

The use of existing data sets can accelerate the pace of research because some of the most time-consuming steps of atypical research project, such as measurement development and data collection are eliminated [13].

Additionally, in the area of information policy, utilizing existing data can allow the researcher to answer important time-sensitive policy related questions quicker. Yet there are unique methodological considerations when utilizing existing data to investigate new research questions and generate new knowledge. The most recognized limitation to the secondary data analysis method approach is “inherent in its nature” in that the data were collected for some other purpose.

Since the data were not collected to answer the researcher’s specific research questions issues can arise.The specific information that the

researcher would like to have may not have been collected; or data may not have been collected in the geographic region of interest, in the years the researcher would have chosen, or on the specific population that is the focus of interest.

A second major disadvantage of using secondary data is that the secondary researcher did not participate in the data collection process and does not know exactly how it was conducted. Therefore, the secondary researcher does not know how well it was done and if the data are affected by problems such as low response rate or respondent misunderstanding of specific survey questions [13].

2.6 Preparation of graphs and tables

There are some general rules that we can call guidelines for layout of graphs, charts and tables, then for the presentation of results of statistical analyses. So, in principle, there are nine basic points [14]:

- Data can be presented in the text, in a table, or pictorially as a chart, diagram or graph. Any of these may be appropriate to give information the reader or viewer is supposed to be able to assimilate "from cold" while reading or listening. This objective, described as "demonstration", is our main concerning this guide. For reference purposes, tables are usually the only sensible option. These are usually put in an appendix, with a summary in the text for demonstration purposes. "Plain Figures" provides much more detail and numerous examples of reference tables;
- Text alone should not be used to convey more than three or four numbers. Sets of numerical results should usually be presented as tables or pictures rather than included in the text. Well-presented tables and graphs can concisely summarise information which would be difficult to describe in words alone. On the other hand, poorly presented tables and graphs can be confusing or irrelevant;
- When whole numbers (integers) are given in text, numbers less than or equal to nine should be written as words, numbers from 10 upwards should be written in digits. When decimal numbers are quoted, the number of significant digits should be consistent with the accuracy justified by the size of the sample and the variability of the numbers in it;
- In general, tables are better than graphs for giving structured numeric information, whereas graphs are better for indicating trends and making broad comparisons or showing relationships;
- Tables and graphs should, ideally, be self-explanatory. The reader should be able to understand them without detailed reference to the text, on the grounds that users may well pick things up from the tables or graphs

without reading the whole text. The title should be informative, and rows and columns of tables or axes of graphs should be clearly labelled. On the other hand, the text should always include mention of the key points in a table or figure: if it does not warrant discussion it should not be there. Write the verbal summary before preparing the final version of the tables and figures; to make sure they illuminate the important points;

- Descriptions of the numbers represented in a table or picture should be kept as simple as possible, while having sufficient detail to be useful and informative. As with the original data, it is important that summaries make clear what was measured. However, there is no important uncertainty about the definition and the units; where the data were collected. The extent of the coverage is clear, so the represented time period is explicit and if the data are quoted from elsewhere source;
- Statistical information, e.g. appropriate standard errors, is usually required in formal scientific papers. This may not be necessary in articles for a more general readership. Such statistical information should be presented in a way that does not obscure the main message of the table or graph;
- Conveying information efficiently goes along with frugal use of "non-data ink". For example, tables do not need to be boxed in with lines surrounding each value. Similarly, "perspective" should not be added to two-dimensional charts and graphs, as it impedes quick and correct interpretation; and
- Tabular output from a computer program is not normally ready to be cut and pasted into a report. For example, a well-laid-out table never need include vertical lines.

2.6.1 Graphs and charts

The two main types of graphical presentation of research results are line graphs and bar charts. Graphs can be small, so multiple plots can be presented on a single page or screen. Line graphs can show more detail than bar charts. They should be used when the horizontal axis represents a continuous quantity such as time spent weeding or quantity of fertilizer applied. When the horizontal axis is a qualitative factor; such as ethnic group, crop variety or source of protein; bar charts are natural. In this case, joining up corresponding points in a line graph clarifies which set the points belong to, but the lines themselves have no interpretive value.

Line graphs are useful to display more than one relationship in the same picture, for example the response to fertilizer of three different varieties. While there is no general rule, graphs with more than four or five lines tend to become confusing unless the lines are well separated. In the graph

with more than one line, different line styles (e.g. solid line, dashed line etc.), colors and/or plotting symbols (e.g.asterisks, circles etc.) should be used to distinguish the lines [14].

Bar charts display simple results clearly. They are not generally useful for large amounts of structured information. Since the horizontal axis represents a discrete categorization, there is often no inherent order to the bars. In this case, the chart is clearer to read if the bars are sorted in order of height, e.g. the first bar represents the variety with the highest yield, the next bar displays the second highest yield and so on. The opposite direction, ascending order, can also be used. This advice has to be compromised when there is a series of charts with the same categories. In this case, it is usually preferable to have a consistent bar order throughout the series. Also in a series of bar charts, the shading of the different bars (e.g. black, grey, diagonal lines etc.) must be consistent. It is frequently useful to "cluster" or group the bars according to the categories they represent, to highlight certain comparisons. The method of grouping should be determined by the objective of the chart.

It is easier for readers to make comparisons between adjacent bars than between distant bars, and the chart should be laid out accordingly. Figure 2.2 gives examples of two bar charts displaying the same data. These show grain yields for six groups formed by combinations of three wheat varieties and two cultivation methods (traditional and broad beds). Figure 2.2 a) is the better layout for demonstrating differences between cultivation methods, whereas figure 2.2 c) is better for showing variety differences [14].

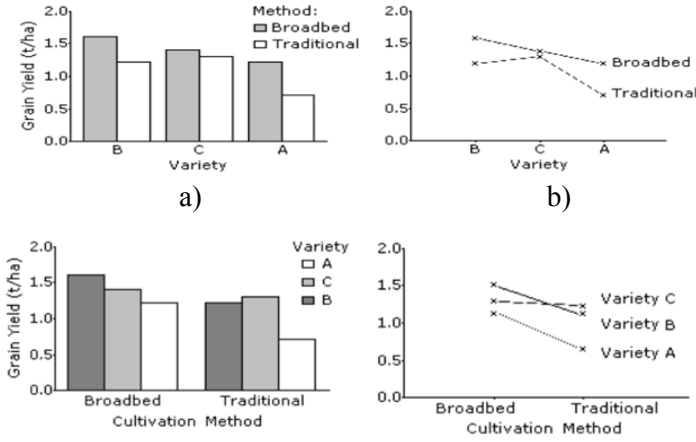
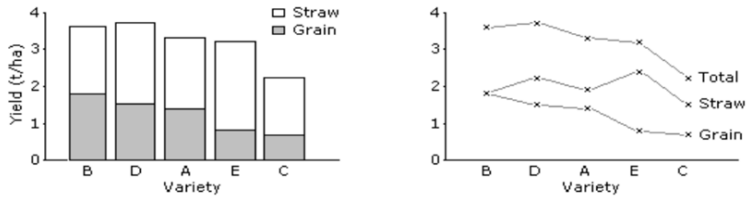


Figure 2.2 Examples of two bar charts displaying the same data [14]

Another method to display more complex information on the bar chart is to "stack" the bars. figure 2.3 a) gives an example of such the chart. It shows grain yield and straw yield for five wheat varieties. Note that the varieties are sorted according to grain yield. While this graph is good at displaying grain yield and total yield (i.e. grain and straw), it is very poor for displaying straw yield alone. For example, it is not obvious that Variety E has the highest straw yield. In this case, if straw yield is important, figure 2.3 a) is unsuitable, and the different presentation, such as that in figure 2.3 b) is needed [14]:



a) b)

Figure 2.3 Examples of bar chart displaying stack bars [14]

The purpose of a table needs to be thought out. There are two types of tables:

- Reference tables contain information that people will look up; they serve an archival function and often need to be laid out for economy of space, while preserving data accurately. It is extremely important that they include good meta-data, the descriptive information which allow the data to be correctly interpreted; usually a comprehensive version of the "what, where and when". Reference tables often appear as appendices.
- Demonstration tables are intended to be assimilated quickly by the reader or viewer. It is important that they are clear and well-presented, using reasonable approximations to reduce numbers to relatively few significant digits.

The simplest tables arising from surveys, or from coded qualitative information, are of counts or frequencies. If relatively large counts are to be compared in table with several rows and columns, it is often helpful to present them as percentages: common ways to do this involve making the percentages add up to 100 across rows, or down columns, or across the whole table. These facilitate different types of comparison, and careful choice should be made. The sizes of sample on which percentage table is based should be made explicit [14,15].

2.7 Preparation of pictures

Figures are often the best means of presenting scientific data. Poorly rendered figures or figures that merely repeat information given in the text, however, can confuse the reader or clutter the manuscript; thus, each figure should serve its purpose well or be omitted. Figures encompass at least four substantially different kinds of illustrations in black and white, shades of gray, color, or some combination:

- Graphs (line, bar, pie, etc.);
- Line drawings or maps;
- Photographs and micrographs; and
- Animated illustrations, which are shown in stop-motion frames in printed journals and sometimes also in full animation in the electronic edition of the journal.

Line or bar graphs are the most common figures in ASA, CSSA, and SSSA journals, followed by line drawings, micrographs, and standard photographs. Color may be used at no extra charge for online publications. Consult the editor of the publication to which you are submitting for information on requirements and costs for color figures for print publications.

Graphs and charts improve the general presentation of a technical publication by reporting data in an easily comprehensible manner. They are generally used to show trends rather than the detailed information in a table.

The style of the graphs and charts, and also the size and appearance of letters and numbers should be consistent within a paper. Whenever possible, figures should be horizontal in format, with the height two thirds the width. This format takes up minimal space in the article. Do not draw a box around line-art figures. Multiplanar figures should be labeled (lowercase a, b, c, etc.) and combined into one file [15,16].

2.7.1 File Formats

For ASA, CSSA, and SSSA publications, TIF, EPS or PDF files are the preferred file types. Images should have a minimum resolution of 300 dpi. For EPS files, be sure all fonts are embedded; all lines must be at least 0.5 point. Figure art submitted as PDFs should be distilled using Adobe Acrobat Distiller's "Press Quality" setting. For photographs, use high-resolution TIFF or JPEG files.

2.7.2 Figure Quality

Because authors are the only ones working with the original graphics file, corrections are the sole responsibility of the author. Authors should not submit figures under the assumption that minor errors will be corrected by someone else at a later stage. Clearly label all figures in the file name (e.g., figure1.tif). (If the paper is submitted for double-blind review, be sure to omit the author's name within the file name.)

2.7.3 Figure Size

The final size of the published figure depends to some extent on where it will appear. For journals, a single column is approximately 8.5 cm (3.5 inches, or 20 picas) wide, and full-page width is approximately 17.8 cm (7 inches, or 42 picas). Books have a single-column page width of approximately 11.4 cm (4.5 inches, or 27 picas). Figures occasionally are placed lengthwise on a page, but this is not the ideal layout.

Figures that fit within a single journal column's width are an economical use of space. Avoid creating figures that have unnecessary white space. Figures do not have to fill the allotted one or two columns; that is, reduction is based on content, not on a width of exactly one or two columns.

2.7.4 Font Size and Type

Use these recommended fonts where possible: Arial, Helvetica, Times New Roman, Symbol.

All figure elements, including letters, numbers, and symbols, must be legible at their final size. In general, authors should make the figure type size large enough so that it is at least 8 points after reduction. No type should be less than 6 points. As an example, for a 16 cm-wide figure, choose 16-point type, so that when the figure is reduced to fit in a single journal column, the type is reduced to 8-point size [15].

2.7.5 Style

Avoid labels in all capitals. Use either sentence-style capitalization (only the first word has an initial capital) or title capitalization (each major word has an initial capital). Use only lowercase for legends and for units of measure.

Position decimal points correctly, at the base of the numbers and in a size large enough to stand reduction. Decimal points should be in proportion to the numbers they accompany.

Be sure that the overall style in the figures follows journal standards. For example, if you use $Mg \cdot ha^{-1}$ in the text, do not use Mg/ha in the figures.

In particular:

- Define all abbreviations in the caption, even if they appear in the overall abbreviations list;
- Italicize variables; and
- Check the spelling of all text in each figure [15].

2.7.6 The Graphic Elements

Axis scale - Do not crowd the interval marks on axis scales. Fewer may be better. Rarely, if ever, rule in the coordinates grid; not even in light lines or dots. (Light lines will break up, and light dotted lines may disappear entirely).

Legend - Include a complete legend to identify symbols, lines, and patterns. (A legend is a miniature table of correspondence between the patterns and symbols and their meaning). Put the legend inside the figure box, preferably above it or to the right.

Fill patterns and shading - If you need to shade parts of your figure, keep in mind that the spaces between the elements of that shading will be reduced when the figure is reduced. Many patterns built into computer programs become solid black when reduced to 50% of the original size. Search for patterns, or create your own, that will not condense to black.

For bar graph patterns, use solid black, solid white, black diagonal lines, sharp crosshatching, a sharp dot screen, or a random dot pattern. Dot patterns must be fairly coarse to reproduce well. Light grays and fine, light dots are likely to become muddy or blotchy or even disappear altogether in reproduction. Shades of gray may turn into indistinguishable muddy blacks.

Choose symbols and patterns of similar weight and tone to avoid making one set of data look inherently more important than another.

Lines - Every line in a figure should have meaning and purpose, so authors should avoid using decorative borders, shadows, and other three-dimensional effects. Lines should be of consistent weight and sufficiently heavy (at least 0.5 point) to ensure a high-quality reproduction.

Three-Dimensional Graphs - Use three-dimensional graphs only to represent three dimensions of data. If there are no data for the z axis, do not use three-dimensional formatting. This may require changing the default settings on your software [16].

2.7.7 Photographs

Submit photographs as high-resolution TIFF or JPEG files. Indicate the scale, or at least provide a reference point to indicate relative size. For micrographs, indicate the power at which the image was taken (either in the caption or on the figure itself).

If photographs are taken in a series, maintain the same height and angle of the camera, the same distance from the subject, and the same angle of the sun (A picture taken 3 m from the subject at 800 h will appear quite different from one taken of the same subject from 6 m at 1700 h).

2.7.8 Selection

Make sure that the photograph shows something unique, interesting, and clearly identifiable. Use photographs only if they show something essential to your point.

2.7.9 Combinations

When two or more photographs are to be combined into one figure, each part of a composite figure should be clearly identified on the figure by large lowercase letters (a, b, c, etc.). Use the same letters to identify the parts in the caption.

Letters, numbers, arrows, scales, and other marks that appear in a light area of the photo should be black. If they appear in a dark area, they should be white, or placed on a white circular or square background. Sufficient contrast is also essential forsize bars used in photomicrographs.

2.7.10 Releases

Type all figure captions double-spaced. Number figures in the order they are cited in the text. Place captions after the references and before any tables. It is good to repeat the caption with the actual figures so that reviewers do not have to hunt through the manuscript to understand the figures [16].

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CHAPTER 3: On the research ethics

Milan ZDRAVKOVIĆ[5]

ABSTRACT: The values of trust, responsibility, mutual respect and fairness are critical for the open, heterogeneous and decentralized communities, such as the scientific one. Given that the impact of the results of its work to the society is uniquely tremendous and irreplaceable, it is vital to establish the red lines which will protect the above values. Those red lines are expected to ensure that the society will truly benefit from the outcomes of the scientific work, freed from any bias, manipulation, intentional or unintentional distortion of the results or any other form of misconduct. This book chapter aims to uncover the main principles of research ethics, to establish the classification and typology for the different types of scientific misconduct and to put the best effort to formally define those. Finally, it highlights some of the tools for ethical research norms, including the recent proposals with innovative approaches.

KEYWORDS: research ethics, scientific misconduct, career development

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Contents

3.1 Introduction

The research ethics establishes the norms for conducting scientific research that clearly distinguish between acceptable and unacceptable behavior by researchers and R&D organizations. Sometimes, these norms are moral rules (tend to be broader and more informal than laws), while in other cases they are legally enforced by the appropriate establishment, such as individual organization, state, publishers, scientific association or community, international organization and others.

Ethical norms are sometimes considered as a matter of common sense, but still they often differ in the different scientific communities, nations, cultures and religions.

Typically, research communities do not implement strong hierarchies and rigid rules; science is one of the rare industries where individual is characterized by the right and freedom to choose his/her own topic for research. In such circumstances, the research process and especially research collaboration simply would not work if there was no high awareness of the values of trust, accountability, mutual respect and fairness, present in the communities.

Researchers are pushing the limits of science to resolve different societal problems at different scales, with the biggest possible impact to society. For that reason, they are accountable to the public, especially when they are funded by the public money; they are also responsible to make the best effort to ensure the public support for their research, especially if its results are of large and immediate importance for the society.

The above values are essentially related to the research ethics. Namely, ethical norms are in service of the public because they protect the faith of the society to the achievements of the scientific research. Even though there is a rising number of ethical disputes in research, science is a main driver for the development of humanity and it is of outmost concern to protect the integrity of scientific method and scientific work in general.

The evidence produced so far shows that misconduct is still very rare occurrence in research, although it is quite difficult to measure its rate. The rate of misconduct has been estimated to be as low as 0.01% of researchers per year (based on confirmed cases of misconduct in federally funded research in US) to as high as 1% of researchers per year (based on self-reports of misconduct on anonymous surveys) [1].

Three percent of the 3,475 research institutions that report to the US Department of Health and Human Services' Office of Research Integrity, indicate some form of scientific misconduct [2]. Recent survey from the British Medical Journal indicates that one in eight UK scientists has

witnessed research fraud [3]. A detailed review of all 2,047 biomedical and life-science research articles indexed by PubMed, shows that motivation to intentionally commit a scientific fraud lays in the personal interest of the researcher. This interest is related to career ambitions and/or pursuit of profit or fame. Often, the personal interest is driven by the pressure by the institutional rules related to career development (for example, to publish the journal articles as a condition for career advance) or related to obligation (imposed by the employers) to obtain grants and contracts. In the latter cases, institution or the government who prescribed the rules and regulations from which these obligations are derived should take a part of the responsibility for the misconduct.

Also, misconduct could occur unintentionally, due to the negligence or lack of knowledge on the specific ethical norms and rules. In these cases, poor supervision of students and trainees and poor oversight of the researchers are the main reasons. Obviously, responsibility for the misconduct in the cases above is more complex.

This book chapter aims to uncover the main principles of research ethics, to establish the typology for the different types of scientific misconducts and to list main tools and practices for preventing those. In the first section, scientific method is explained, together with the oversight on the main ethical norms. Then, based on the review and synthesis of information from the different sources, classification of the scientific misconducts is presented. Finally, the last section highlights the main tools for enforcing the ethical research norms, including the proposals for innovative approaches.

3.2 Scientific method and basic principles of research ethics

The understanding of the formal scientific method is essential for setting up the basic principles of research ethics.

The scientific method is considered as the set of practices, techniques and principles for investigating the specific phenomena with objective to make an explicit and measurable contribution to the existing body of knowledge; this contribution can be expressed as acquisition of new knowledge or correction of the existing one.

In order for the method to be called scientific, it must produce explicit, measurable evidence which shows without any doubt that hypotheses made by the researchers are correct in precisely defined circumstances.

3.2.1 Scientific method cycle

The scientific method encloses different activities through which iterations are being made (figure 3.1).

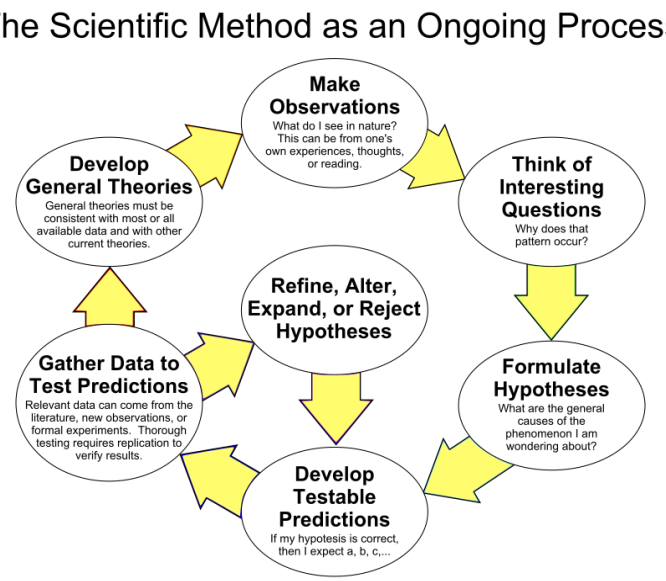

Figure 3.2 Scientific method [4]

Scientific work starts with making systemic, well-structured observations of the investigated phenomena and its environment. In this process, an investigated phenomenon is also considered by using existing body of knowledge. Second, the observation process produces research questions, not yet answered by the existing body of knowledge. Then, researcher sets formulations of the hypotheses, the best educated assumptions on the answers to previously defined research questions. Good hypotheses can be mapped to the predictions that can be tested in various ways. Based on these predictions, the experiments are being designed, in which empirical data, which will be used to test the predictions/hypotheses can be collected. The experiments need to be carefully controlled and replicable. Depending on to which extent the data confirm or deny the hypotheses, the latter can be refined, altered, expanded or even rejected. In case that data confirms the hypotheses, general theories, consisted with produced data could be developed. Finally, the results of the research are being disclosed or, specifically – published, in order to encourage professional scrutiny and critique.

The above guiding principles imply very high level of the professional responsibility and accountability of the scientists. The credibility of the process depends on the trust.

In fact, the whole academic research is built on a foundation of trust. Researchers trust that the results reported by others are sound and well-founded; they trust that the experiments were designed and implemented in a proper way. Society trusts that the results of research reflect an honest attempt by scientists and other researchers to interpret and describe the outcomes accurately and without bias. The scientific misconduct endanger this trust and in a final consequence, it contributes to distorting the perception of the overall society development by the society and people's belief in the scientific achievements that constitutes the whole way of living, today and in the future.

Imposing the principles of the research ethics and applying those principles in the daily work of the scientists is of extreme importance. Those principles are rigid and explicit, they are not the subject of interpretation and they are typically thought.

3.2.2 Basic principles of research ethics

Two basic ethical principles from which the others can be derived are related to the ultimate objectives of the scientific research:

- It needs to be beneficial;
- It needs not to provide any harm.

Each of the organizations in charge for enforcing ethical research norms has its own set of the basic principles of research ethics. The table 3.1 shows some principles addressed by various codes (adapted by David B. Resnik [17], from [1]).

Table 3.1 Principles addressed by various codes

Honesty	Strive for honesty in all scientific communications. Honestly report data, results, methods and procedures, and publication status. Do not fabricate, falsify, or misrepresent data. Do not deceive colleagues, research sponsors, or the public.
Objectivity	Strive to avoid bias in experimental design, data analysis, data interpretation, peer review, personnel decisions, grant writing, expert testimony, and other aspects of research where objectivity is expected or required. Avoid or minimize bias or self-deception. Disclose personal or financial interests that may affect research.
Integrity	Keep your promises and agreements; act with sincerity; strive for consistency of thought and action.

Table 3.1 continued

Carefulness	Avoid careless errors and negligence; carefully and critically examine your own work and the work of your peers. Keep good records of research activities, such as data collection, research design, and correspondence with agencies or journals.
Openness	Share data, results, ideas, tools, resources. Be open to criticism and new ideas.
Respect for Intellectual Property	Honor patents, copyrights, and other forms of intellectual property. Do not use unpublished data, methods, or results without permission. Give proper acknowledgement or credit for all contributions to research. Never plagiarize.
Confidentiality	Protect confidential communications, such as papers or grants submitted for publication, personnel records, trade or military secrets, and patient records.
Responsible Publication	Publish in order to advance research and scholarship, not to advance just your own career. Avoid wasteful and duplicative publication.
Responsible Mentoring	Help to educate, mentor, and advise students. Promote their welfare and allow them to make their own decisions.
Respect for colleagues	Respect your colleagues and treat them fairly.
Social Responsibility	Strive to promote social good and prevent or mitigate social harms through research, public education, and advocacy.
Non-Discrimination	Avoid discrimination against colleagues or students on the basis of sex, race, ethnicity, or other factors not related to scientific competence and integrity.
Competence	Maintain and improve your own professional competence and expertise through lifelong education and learning; take steps to promote competence in science as a whole.
Legality	Know and obey relevant laws and institutional and governmental policies.
Animal Care	Show proper respect and care for animals when using them in research. Do not conduct unnecessary or poorly designed animal experiments.
Human Subjects Protection	When conducting research on human subjects, minimize harms and risks and maximize benefits; respect human dignity, privacy, and autonomy; take special precautions with vulnerable populations; and strive to distribute the benefits and burdens of research fairly.

3.2.3 Basic principles of ethics in research involving human subjects

Lærd academy [18] identified 5 basic principles of the ethics in research that involves human subjects: minimizing the risk of harm, obtaining informed consent, protecting anonymity and confidentiality, avoiding deceptive practices and providing the right to withdraw.

3.2.3.1 Minimizing the risk of harm

Whenever there is a risk of harm for participants of the research process, a structured and detailed plan for minimization of this risk should be developed before the actual experiment or any other activity in which this harm could be made, takes place.

Potential threats for breaking these principles are related to physical harm of the participants, psychological stress and discomfort, social disadvantage, financial harm, invasion of privacy and anonymity, etc.

3.2.3.2 Obtaining informed consent

Participants of the research process, including researchers themselves and humans involved in experiments, such as drug testing, interviews, surveys etc., need to be aware that they are participating in this research process; they need to be informed about the research purpose, the methods being used, possible (expected and unexpected) outcomes, as well as the associated demands, discomforts and risks they may face, during that process.

Then, based on the information above, they need to be asked to give their consent. Failure to provide any substantially important information related to above to the participants, when asking for their consent is considered as a serious kind of scientific misconduct. In case that some information cannot be provided (because it is missing at the time or is protected), this situation needs to be explained in detail to participants, together with reasons for the incapability to disclose it.

3.2.3.3 Protecting anonymity and confidentiality

Even if the researchers are in possession of the private information of the participants (such as their identity), they are held accountable for applying all necessary measures to ensure that this information is not disclosed and that it is kept confidential, in the processes of data storage, its analysis or during the publication process.

The exception may be the case in which it might be possible to disclose the identities and various views of the participants, but only if permissions for the disclosure are granted by the participants.

3.2.3.4 Avoiding deceptive practices

Deceptive practices are mostly related to lack of informed consent of the participants of the research.

It is worth highlighting that sometimes, the consent is not feasible and even practical to get. Namely, sometimes observation is being carried out with the large group participants in very open settings (for example, internet forum, chat room, streets). In these cases, it is obvious that it is not feasible to get the informed consent of all participants.

More important and controversial issue is that informed consent of the participants may affect the research result – the awareness of the participants in experiment about the conditions of the experiment and purpose of the research may alter their behavior, and hence, it may alter the phenomenon which is investigated. Obviously, in the above case, the results will not be objective and therefore, useful.

3.2.3.5 Providing the right to withdraw

Research participants should always have the right to withdraw from the research/experiment, under no special circumstances. This right must be clearly communicated to them during planning of the research or experiment.

3.2.4 Cases of misconduct in scientific research

Many of the scientific misconducts are motivated by the pressure of the academic community to "publish or perish", which promotes the number of publications as the most important criteria for career development. Still, the most major misconducts are related to intent to gain significant benefit, financial or fame. Several notable cases are referred in this section.

Dr. Anil Potti [6] resigned from his job after disclosure of the research fraud which he made by exaggerating his credentials. Several papers on the individualized treatments for cancer he published in the respected journals were later retracted. This finding had a major impact, including suspending major funds which were allocated for his research and even a law suit against the university in which he worked, that was started by some of his patients.

In 1998, Andrew Wakefield [7] published a study which confirmed the connection between autism and the measles-mumps-rubella vaccine. The study received a lots of media attention, leading to major reduction of vaccination rate and eventually to very dangerous and widespread outbreaks in some areas. 12 years after, in an investigation, it was found that the facts about children were altered and that Wakefield's research

was funded by a lawyer who was planning to start a legal action against vaccine manufacturer.

One of the pioneering experts in stem-cell research, Korean researcher Hwang Woo-suk [8] was accused in 2006 for a research fraud and bioethics law violations and sentenced with a two-year prison and ban to do a stem-cell research in Korea, after it was revealed that much of his stem cell research had been faked. Still, today Hwang continued to lead research in creating embryonic stem cell lines from cloned pig embryos.

In US, undergraduates are not being prosecuted for the attempt to intentionally violate a research ethics. However, at graduate and professor level, this is considered as federal fraud and is subject to federal charges with extreme penalties. Professor Craig Grimes from Penn State University has been charged and sentenced for misusing 3 million USD of the National Institutes of Health and Advanced Research Projects Agency of federal grant [9]. The grant funds were misappropriated, largely for the personal use of Grimes. As a result, he was convicted with 35 years in prison and a fine of 750.000 USD.

3.3 The types of scientific misconduct

Scientific misconduct is considered as a violation of general research methodology or publication practices by the individual, which may occur willingly or as a result of lack of knowledge or negligence.

Research ethics' rules and practices, related to preventing the scientific misconduct, sometimes differ (though not necessarily contradict) in different types of scientific communities. It is often said that every scientific community has its own set of morals. These differences mostly occur in the lowest level of abstraction and they are typically driven by the differences in ways in which the evidences of the specific hypotheses are derived in different sciences (for example, human and animal testing).

Having a formal definition of the scientific misconduct is extremely important for the effectiveness and efficiency of the procedure in which the misconduct is established, argued or disputed. However, no established, widely accepted definition was made in the past. Most of the definitions are extensional, namely they list the different types of scientific misconduct, while there are some differences in understanding its cause.

According to the "Danish" definition, scientific misconduct is "intention or gross negligence leading to fabrication of the scientific message or a false credit or emphasis given to a scientist". "Swedish" definition does not recognize negligence as a misconduct; according to this definition, "scientific misconduct is intention[al] distortion of the research process by

fabrication of data, text, hypothesis, or methods from another researcher's manuscript form or publication; or distortion of the research process in other ways".

Extensional definitions fail in considering minor, while still important types of misconducts (such as suppression, knowingly making false claims of misconduct, retaliation, etc.). For that reason, in this chapter, no definitions will be provided. Instead, an effort is made to synthesize the classification of the scientific misconducts, which will encompass all of its forms. The objective is to enable the reader to identify the correct type of misconduct in case of its occurrence.

Based on informal review of the relevant literature and websites [21-31], the following main types of misconducts were identified:

- Violation of generally accepted research practices;
- Violation of legislative or regulatory requirements;
- Violation of generally accepted research publication practices; and
- Inappropriate behavior in relation to suspected misconduct.

The resulting classification is shown on figure 3.2.

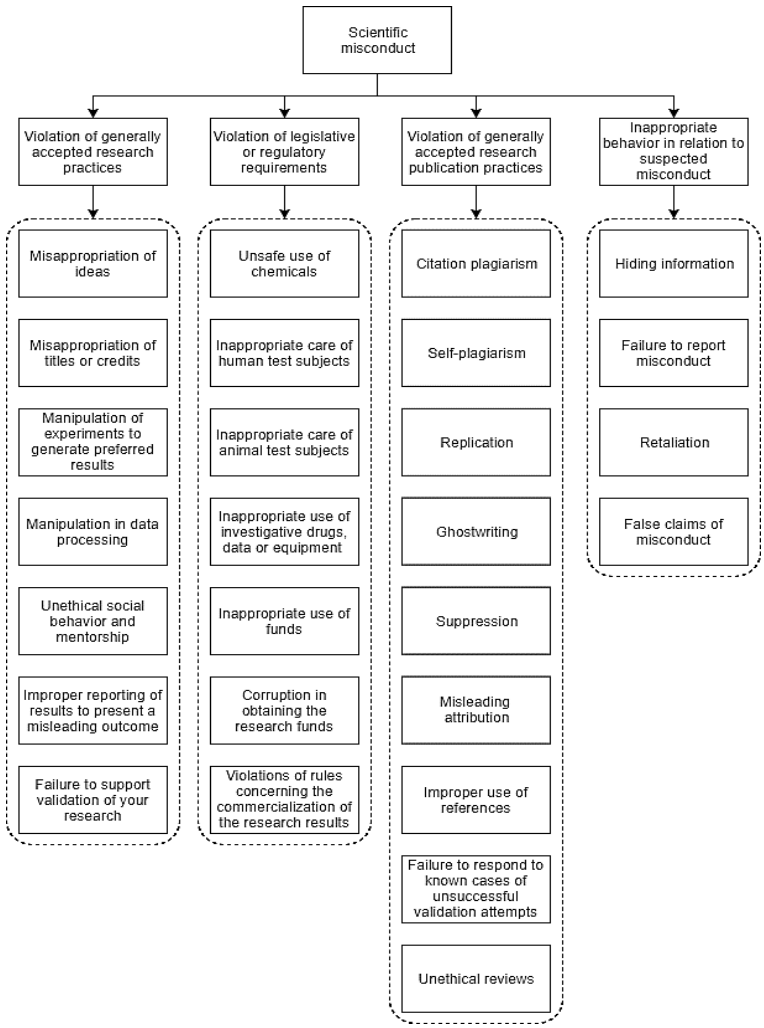

Figure 3.2 Scientific misconducts classification

Each of the identified types is elaborated in this chapter and further classification of misconducts is made in the following text.

3.3.1 Violation of generally accepted research practices

Intentional or negligent violation of generally accepted research practices occurs when a researcher, willingly or due to a lack of knowledge of a research methodology distorts the research results. The research results can be distorted during data acquisition, analysis, synthesis, reporting or validation.

The examples of the violations of generally accepted research practices are explained in subsections below.

3.3.1.1 Misappropriation of ideas, titles or credits

Misappropriation of ideas, titles or credits assumes taking the intellectual property of others (for example as a result of reviewing someone else's article or manuscript, or grant application) and proceeding with the idea as your own. It is considered as the most serious misconduct and it often results with a legal action, started by the owner of the intellectual property.

Misappropriation of ideas often occurs after the collaborative research work, in which suspected researcher even significantly contributed to the discovery. For example, a researcher could fail to inform a collaborator of his/her intent to file a patent in order to make sure that he/she is the exclusive inventor.

Sometimes, the researchers are misappropriating titles and credits, for the purpose of getting a job or a grant. For example, they can decide to stretch the truth in a job application or curriculum vitae. Or, they stretch the truth on a grant application in order to convince reviewers that their project will make a significant contribution to the field.

3.3.1.2 Manipulation of experiments to generate preferred results

Manipulation of experiments is related to failure to design the experiment in a proper way, for example, by using specific setup of the experimentation equipment that does not correspond to the realistic conditions, by using suggestive questions in interviews, by using non-representative samples, etc.

Sometimes, this failure is made with an explicit intention to commit a fraud. However, it may be done due to a poor knowledge of equipment, design of experiment process or a domain in which research is taking place.

It is often used to confirm the hypotheses that are difficult to prove in which cases only weak evidences are provided. Those weak evidences come from the experiment which is carried out in limited circumstances, with non-representative target groups, with specific sets of experimentation equipment settings, etc. In case that it is not possible otherwise, the researchers should clearly inform the reader about the approach used to validate the hypotheses.

However, sometimes the specific circumstances are used in experiment with intention to commit a fraud, motivated by pursuing the career development opportunity or funding.

Failure to report an adverse event in an experiment is a clear case of its manipulation. The design of experiment must implement measures to

produce actual data in a way, such that individuals cannot put the integrity of this data into risk.

3.3.1.3 Manipulation in data processing

Manipulation in data processing can be related to using deceptive statistical or analytical practices to generate preferred results. It is similar to manipulating the experiments, with exception that it assumes the clear intent to commit a fraud.

It means also a data fabrication or data falsification. Data could be selectively excluded from the processing in order to prove the initial hypotheses. Images, generated by the experimentation equipment or some device can be manually edited.

Manipulation in data processing can be avoided or evidences of proper behavior can be brought by implementing good practices of professional research.

If the data processing involves more iterations, then, researcher is responsible to keep a copy of each set of produced intermediary results, including primary data. All produced data should be kept in a responsible, professional way, by also implementing backup techniques, so the integrity of this data is not questionable.

3.3.1.4 Unethical social behavior and mentorship

Mentorship in scientific research is a process which also assumes guiding in acquisition of the professional, transversal skills, irrespective from the scientific branch in which researcher is implementing his/her own research. Ethical research is one of those skills. Lack of it is considered as the most common reason for unintentional scientific misconduct.

Overworking, neglecting, or exploiting graduate or post-doctoral students (for example, by giving the same research project to two graduate students in order to see who can do it faster) are also considered as unethical.

In general, inadequate leadership, mentoring, supervision and counseling are considered as not ethical. All these and other social relationships of the researchers must be maintained by taking care of social and cultural norms in which collaboration takes place.

3.3.1.5 Improper reporting of results to present a misleading outcome

One of the main responsibilities of the researcher is to ensure that his/her own research is peer reviewed or even replicated. Reporting the results without ensuring that peer review is made is unacceptable practice in scientific research.

For example, researcher can decide to bypass the peer review process and to announce the results through a press conference without giving peers adequate information to review that work.

3.3.1.6 Failure to support validation of research results

Refusing to supply complete datasets or research material needed to facilitate validation of the acquired results through a replication study is considered as a scientific misconduct.

Often, journals provide the opportunity to attach data sets for the published article and thus facilitate replication of the presented study. Also, specialized social networks (such as ResearchGate) and open repositories are often used to publish the data.

Special case of failure to support validation is the one where disclosure of datasets is forbidden, due to copyrights, registered intellectual property of the authors or even risk of disclosure of sensitive information residing in data sets (such as identities of the participants). In the above cases, the researcher is responsible to make the best effort to provide data, while still adhering to the contractual obligations towards its funder and/or employer, copyrights and other legal commitments taken before or during the research process.

Failing to maintain research data or other research records for a reasonable period of time is considered as a misconduct that can prevent the validation of your research. The above activities are considered as a part of the professional responsibility of the researcher and are often defined by the institutional rules and regulations.

3.3.2 Violation of legislative or regulatory requirements

The science can be and is regulated by academic and governmental bodies in order to facilitate restrictions in performing the specific practices which are considered as not ethical, harmful, immoral or dangerous in the selected cultures, countries and communities. The regulation is even sometimes closely related to religion and culture. It mostly covers, but is not restricted to the areas of biotechnology, including health care, agriculture, food and the environment.

Failure to comply with these regulations may lead to rejection of the research proposals, as well as legal actions with different possible consequences. Following violations of legislative or regulatory requirements are possible:

- **Unsafe use of chemicals -** Use of chemicals in the research process is subjected to very rigid safety regulations and rules. Exposing students and staff to biological risks in violation of the institution's bio-safety

rules is a serious misconduct that can endanger human health and even lives.

- **Inappropriate care of human test subjects -** All research involving human test subjects must go through prior independent review. This review aims to ensure the adequate protection of the privacy and other rights of the participants, including protection from injury, disability and death and acquisition of their informed consent to participate in research.
- **Inappropriate care of animal test subjects -** The rules and regulations related to care of animal test subject vary significantly around the world, but most of them control:
  - the number of times individual animals can be used;
  - the overall number of used animal test subjects; and
  - the degree of pain that may be inflicted without anesthetic.
- **Inappropriate use of investigative drugs, data or equipment -** Making unauthorized copies of data, papers, or computer programs is often explicitly prohibited by the organizational procedures and rules. Inappropriate use of experimentation equipment can produce damage that cannot be easily registered and thus, it may distort the future research data. Finally, procedures for using investigative drugs are very strict and often defined at the national level.
- **Inappropriate use of funds or corruption in obtaining the research funds -** As mentioned before, misappropriation of titles and credits and false claims of scientific contributions are often used in obtaining the research funds. One of the common cases of this type of misconduct are conflicts of interests; for example, a researcher may own a share in a company which sponsors his/her own research and decide not to disclose this information. Misuse of research funds for unauthorized purchases or for personal gain can have serious consequences, such as financial damage to the institution, black-listing of the individual researchers as well as their organizations and others.
- **Violations of rules concerning the commercialization of the research results -** For example, researcher or organization may deliberately overestimate the clinical significance of a new drug in order to obtain economic benefits.

3.3.3 Violation of generally accepted research publication practices

Plagiarism, as one of the violations of the ethical research publication practices is considered as the most common scientific misconduct. It means utilizing (in the manuscript) someone else's words, published work,

methodology and/or research processes, or results without giving appropriate credit by using full citation.

Beyond plagiarism, several other misconducts in research publishing topic are identified, such as those related to authorship, suppression, ghost-writing, etc. All those are explained in the remainder of this section.

3.3.3.1 Citation plagiarism

Citation plagiarism is willful or negligent failure to appropriately credit the published work or words of the others. This is also known as: “citation amnesia”, the “disregard syndrome” and “bibliographic negligence”. This is the most common type of scientific misconduct.

One of the most dangerous forms of citation plagiarism is paraphrasing, because it can be difficult to establish with the popular anti-plagiarism tools. It ranges from simple re-phrasing to completely rewriting the content of the non-attributed source of the critical importance (key contribution, idea, original methodology, etc.).

3.3.3.2 Self-plagiarism

Self-plagiarism or duplication occurs when the researcher recycles or re-uses his/her own work without appropriate citation. The ethics of duplication is often disputed and it depends on the content copied.

Multiple publication of the same content (or same data) with different titles and/or in different journals is sometimes also considered misconduct, and it is called “repetitive research”. It is referred to as “salami” (referring to many identical slices) publication. According to some editors this includes publishing the same article in different languages.

3.3.3.3 Replication

It is related to the submission of the same manuscript to the different publications, namely journals or conferences. It is often motivated by the need to publish the work fast (thereby addressing the issue of sometimes extremely long reviewing cycles of the journals), in pursue of the research career.

3.3.3.4 Ghostwriting

Ghostwriting is the phenomenon which occurs when someone other than the named author(s) makes a major contribution. Often, the ghostwriting is done to mask contributions from drug companies.

3.3.3.5 Suppression

Suppression is a failure to publish significant findings due to the results being adverse to the interests of the researcher or his/her sponsor(s).

Suppression is also when in conducting a review of the literature, researcher fails to acknowledge the contributions of other people in the field or relevant prior work, especially those who contradict to his/her hypotheses.

3.3.3.6 Misleading attribution

It is related to inaccurate attribution of the authorship and it means any of the following:

- Claiming undeserved authorship on your own behalf,
- Excluding material contributors from co-authorship;
- Including non-contributors as authors; or
- Submitting multi-author papers to journals without the consensus of all named authors.

3.3.3.7 Improper use of references

Improper use of sources is one of the most common types of plagiarism and it often occurs due to the lack of knowledge related to writing research article. It comes in different forms:

- Secondary source plagiarism occurs when secondary source is used in a research, but only a primary one (which actually only uses the research results presented in the secondary source) is cited;
- Invalid sources (non-existent or incorrectly attributed) are found in case of unwillful mistakes in personal references' management of the authors, but also when authors want to increase the perception of their work's credibility, by providing large number of (non-existent) references;
- Similar to above, one form of fabrication is when references are included to give arguments the appearance of widespread acceptance, but are actually fake, and/or do not support the argument;

3.3.3.8 Failure to respond to known cases of unsuccessful validation attempts

Published research that is found to be flawed should be retracted from the journal that published it.

3.3.3.9 Unethical reviews

Peer review is the process which can be easily abused. Some of the examples are not disclosing the potential conflict of interest in reviewing the paper of the known colleague and even collaborator, or unfairly holding up a rival's publication.

Reviewing a paper is confidential process. Discussing with your colleagues about confidential data from a paper that you are reviewing for a journal is not allowed.

Reviewing a peer's article should be considered seriously and responsibly as it can affect one's career, as well as the process in which large societal problems are resolved. Thus, review should objectively reflect the reviewer's view to the way in which scientific method is applied in a presented research. Making derogatory comments and personal attacks in the review of author's manuscript is not allowed. The reviewer must put the best effort to make clear suggestion on how the article should be improved to respect the commonly accepted research and research publication practices.

In the effort to boost publication, journals often ask the authors to suggest reviewers for their work, under the condition that they have no collaborated previously or even only in the research that lead to submitting the manuscript. This is controversial practice, as it opens many possibilities for the research fraud, the most obvious of which is suggestive email information about the assignment to the selected reviewers. In fact, it was recently found that at least four scientists, when submitting a paper to a scientific journal, suggested reviewers with email addresses that tracked back to themselves; then they wrote and submitted a positive review for their own work.

3.3.4 Inappropriate behavior in relation to suspected misconduct

Occurrence of the suspected misconduct assumes responsibility of the suspected researcher or any researcher passively or actively involved in actions leading to the suspected misconduct, to act ethically in responding to allegations until the misconduct is proven or denied.

That means that absolute and unconditional cooperation is required by the suspected researcher/s, including delivery of all relevant information, including evidences, per request of the body investigating the claim (e.g. ethical committee). Failure to cooperate in a professional way (namely, in cases of lack of responsiveness, hiding relevant information, delivery of false evidences, etc.) will be considered as a misconduct per se (in addition to the suspected one).

3.3.4.1 Hiding information

Destruction of any evidence or withholding evidences related to any claim of misconduct, whether the above is done by the witness of the misconduct or suspected researcher is considered as misconduct.

3.3.4.2 Failure to report misconduct

Misconduct is also a failure to report known or suspected misconduct, by any researcher who witnessed it. Misconduct can be reported to the ethical committee of the organization, or to its executive management.

3.3.4.3 Retaliation

Retaliation against any persons involved in a claim of misconduct sometimes occurs in the cases by the senior researchers who are suspected or related somehow to the suspected researchers.

3.3.4.4 False claims of misconduct

Knowingly making false claims of misconduct against the researcher is a serious misuse of the ethical process in one organization.

This can be motivated by the competition culture of the organization; it can be a result of retaliation, but also made as a response to the claims of misconduct directed to the researcher who makes false claims in his/her own defense.

3.4 Practices for facilitating ethical research

Ethical research can be facilitated by using two approaches.

First, bottom-up approach is related to the activities of learning, professional skills development, teaching, mentoring and supervision of the young researchers. The approach encompasses different ways in which the early-stage career researchers are thought to ethical practices in scientific research (including design of experiment and data analyses methods), research publishing, project management, intellectual property rights, and others.

Second, top-down approach is related to enforcing ethical rules and regulations (including resolution of disputes) by the journals, R&D organizations, associations, states and international organizations, such as OECD [5].

3.4.1 Good practices of HR management

In 2005, the European Commission adopted a European Charter for Researchers and a Code of Conduct for the Recruitment of Researchers [20]. These two documents, addressed to researchers as well as research employers and funders in both the public and private sectors, are key elements in the EU's policy to boost researchers' careers. The Charter and Code ensures researchers can enjoy the same rights and obligations in any European country.

It consists of 40 principles, classified in 4 groups, namely Ethical and professional aspects, Recruitment, Working conditions and social security, and Training. The implementation of the principles is being done individually by the European R&D organizations in HRS4R process, in which they develop HR strategies and action plan for ensuring full compliance to the principles above.

HRS4R is exceptional tool for implementing a bottom-up approach to ensuring ethical research, as it requires the organizations to make the explicit commitments to 11 principles of ethical and professional research, as written in The Charter and The Code. Those principles are listed in a table 3.2.

Table 3.2 Principles of ethical and professional research

Research freedom	Researchers should focus their research for the good of mankind and for expanding the frontiers of scientific knowledge, while enjoying the freedom of thought and expression, and the freedom to identify methods by which problems are solved, according to recognised ethical principles and practices. Researchers should, however, recognise the limitations to this freedom that could arise as a result of particular research circumstances (including supervision/guidance/management) or operational constraints, e.g. for budgetary or infrastructural reasons or, especially in the industrial sector, for reasons of intellectual property protection. Such limitations should not, however, contravene recognised ethical principles and practices, to which researchers have to adhere.
Ethical principles	Researchers should adhere to the recognised ethical practices and fundamental ethical principles appropriate to their discipline(s) as well as to ethical standards as documented in the different national, sectoral or institutional Codes of Ethics.
Professional responsibility	Researchers should make every effort to ensure that their research is relevant to society and does not duplicate research previously carried out elsewhere. They must avoid plagiarism of any kind and abide by the principle of intellectual property and joint data ownership in the case of research carried out in collaboration with a supervisor(s) and/or other researchers. The need to validate new observations by showing that experiments are reproducible should not be interpreted as plagiarism, provided that the data to be confirmed are explicitly quoted. Researchers should ensure, if any aspect of their work is delegated, that the person to whom it is delegated has the competence to carry it out.

Table 3.2 continued

Professional attitude	Researchers should be familiar with the strategic goals governing their research environment and funding mechanisms, and should seek all necessary approvals before starting their research or accessing the resources provided. They should inform their employers, funders or supervisor when their research project is delayed, redefined or completed, or give notice if it is to be terminated earlier or suspended for whatever reason.
Contractual and legal obligations	Researchers at all levels must be familiar with the national, sectoral or institutional regulations governing training and/or working conditions. This includes Intellectual Property Rights regulations, and the requirements and conditions of any sponsor or funders, independently of the nature of their contract. Researchers should adhere to such regulations by delivering the required results (e.g. thesis, publications, patents, reports, new products development, etc) as set out in the terms and conditions of the contract or equivalent document.
Accountability	Researchers need to be aware that they are accountable towards their employers, funders or other related public or private bodies as well as, on more ethical grounds, towards society as a whole. In particular, researchers funded by public funds are also accountable for the efficient use of taxpayers' money. Consequently, they should adhere to the principles of sound, transparent and efficient financial management and cooperate with any authorised audits of their research, whether undertaken by their employers /funders or by ethics committees. Methods of collection and analysis, the outputs and, where applicable, details of the data should be open to internal and external scrutiny, whenever necessary and as requested by the appropriate authorities.
Good practice in research	Researchers should at all times adopt safe working practices, in line with national legislation, including taking the necessary precautions for health and safety and for recovery from information technology disasters, e.g. by preparing proper back-up strategies. They should also be familiar with the current national legal requirements regarding data protection and confidentiality protection requirements, and undertake the necessary steps to fulfil them at all times.
Dissemination, exploitation of results	All researchers should ensure, in compliance with their contractual arrangements, that the results of their research are disseminated and exploited, e.g. communicated, transferred into other research settings or, if appropriate, commercialised….

Table 3.2 continued

Dissemination, exploitation of results	Senior researchers, in particular, are expected to take a lead in ensuring that research is fruitful and that results are either exploited commercially or made accessible to the public (or both) whenever the opportunity arises.
Public engagement	Researchers should ensure that their research activities are made known to society at large in such a way that they can be understood by non-specialists, thereby improving the public's understanding of science. Direct engagement with the public will help researchers to better understand public interest in priorities for science and technology and also the public's concerns.
Non discrimination	Employers and/or funders of researchers will not discriminate against researchers in any way on the basis of gender, age, ethnic, national or social origin, religion or belief, sexual orientation, language, disability, political opinion, social or economic condition.
Evaluation/ appraisal systems	Employers and/or funders should introduce for all researchers, including senior researchers, evaluation/ appraisal systems for assessing their professional performance on a regular basis and in a transparent manner by an independent (and, in the case of senior researchers, preferably international) committee.

3.4.2 Ethical committees

Ethical committees are bodies which are established by the organization, association or even at the state level to deal with allegations of the scientific misconduct. They can be form ad-hoc per specific occasion, as standing committees in research institutions or at national level.

3.4.2.1 Ad-hoc committees

Ad-hoc committees are established to deal with the specific cases. Such committees are often composed of prestigious individuals, and they are working in collaboration with or independent of the existing ethics committees in R&D organizations. The advantage of this approach is related to the limited scope of work of the existing ethics committees, already existing at many institutions; they are often associated with the life/medical sciences, and handle matters relating to human experimental subjects and patients. While the work of these bodies is vital, it cannot be assumed that they can handle all cases of misconduct in research. Ethical issues of concrete cases require the careful determination of facts and the detailed analysis of events, documents and other data records. This can be difficult to do without specialized expertise, as well as special-purpose rules, regulations and precedents.

However, ad-hoc processes suffer, to some extent, from a lack of consistency, since the functioning of each individual committee depends critically on its assembly, which is made per specific occasion. For misconduct investigations, fairness and consistency are critical attributes, which can be difficult to ensure in an ad-hoc process. Still, ad-hoc committees' work could provide valuable feedback to the existing ethics process in the organization and experiences gained can be used to improve existing rules and regulations, thereby establishing more formal approach in wider set of cases.

3.4.2.2 Organizational ethical committees

Most common tools to deal with scientific misconduct in the R&D organizations are standing ethical committees, with the elected members. The ethical committees work is based on the corresponding rules, procedures and ethical codes and they sometimes have the appropriate infrastructure in their disposal (for example, plagiarism detection tools and other forensic facilities, offices, etc.)

The ethical committees are responsible for receiving allegations, processing them (including conducting investigations), and recommending outcomes. Typically, these entities are not entirely autonomous: there exists an interaction with organization executive management and/or a government mandated central national authority, for example, a funding agency. For the above reasons, there is a risk of the unjustified suppression of cases, based on a desire to avoid unfavorable publicity for the local institution.

Still, this approach is generally well regarded by the scientists, who prefer to put their trust in local arrangements that operate under terms and conditions that they can observe and understand. Acceptance by the community is a vital attribute of any misconduct-processing system. Scientists are protective of their reputations and careers, which can be seriously damaged by allegations, or even rumors, of misconduct. A purely local arrangement ensures consistency of procedures throughout a given organization, but in cases when allegations of misconduct involve more than one institution, organizational ethical committees may not be so potent.

The cost, workload and administrative overheads of maintaining standing bodies must also be considered.

3.4.2.3 Ethical committees at national level

One or more dedicated committee(s) can be established at the national level, for example at the level of funding agency or ministry in charge for science. Such committee can work as an exclusive establishment for

handling ethical issue, or in coordination with the standing committees in the organizations.

The first option may be preferred by countries whose scientific communities are small, and where it may be difficult to establish committees of scientists, free of personal conflicts of interest. Members of permanent national committees can be selected so as to represent a wide spectrum of relevant expertise (for example, detailed legal experience).

In the second option, a national committee can collaborate with standing committees to maintain nation-wide or community-wide code of ethics, to establish a consistent track record of cases, and even to facilitate establishment of ad-hoc committees in very special cases.

There are also benefits from having a stable support staff, consistent long-term relations with funding agencies, and independence from the political issue of changing national governments. A committee of this kind can play a major role in reviewing and fine-tuning its own procedures, in advising the government on misconduct-related policies, in maintaining a permanent record of misconduct-related information, and in coordinating with similar committees in other countries.

3.4.3 Online resources

Even though research ethics is often a part of curriculum in PhD and master studies in many organizations, there are a number of online resources which can be used by the individual researchers for gaining knowledge and skills to professionally conduct a research process in the context of the existing ethical norms.

The World Health Organization (WHO) developed The Research Ethics Training course [10] as a pilot project in collaboration with University of Geneva. This course is not accessible to everyone, but it was adapted and published online by Global Health Training Centre [11].

The course is suitable for researchers and their teams, research ethics committees, technical officers, policy makers and others interested in international health research. No prior expertise in ethics is required but the course is suitable for those already engaged in ethical issues.

Research Ethics Course was developed through the Practical Ethics Center at the University of Montana with Office of Research Integrity (ORI) and it is accessible online [12]. This course is intended to provide a foundation for institutions that are working to promote Responsible Conduct of Research of the organization.

TRREE (Training and Resources in Research Ethics Evaluation) has published a series of e-learning modules for research ethics [13]. The courses are accessible in different languages and with participation of the

local experts explaining the specific requirements in individual countries. Modules include the topics of introduction to research ethics, evaluation, informed consent, good clinical practice, public health research ethics and others.

NIH maintains the online course [14] on research ethics, covering the topics of scientific integrity, data acquisition and management, publication and authorship, peer review, mentor/trainee relationship, collaborative science, human and animal subjects and conflict of interest and commitment.

EUREC (European Network of Research Ethics Committees) maintains a list of online trainings and learning materials repositories [15].

ORI (The Office for Research Integrity) of the US Department of Health & Human Services [16] provides extensive information on the research ethics, including interesting misconduct summaries, policies and regulations, assurance programs, detailed guidelines and information, etc.

3.4.4 Innovative proposals for facilitating ethical research

Besides the conventional approaches for fighting with scientific misconduct, many researchers have formulated proposals for innovative ways to address the issues. Although many of those proposals were transformed to effective tools, no official endorsements of the funding agencies, research integrity offices and other relevant bodies to these tools have been made so far. Some examples of innovative proposals are mentioned in this section [19, 30-31]. The proposed approaches are only illustrative and they are not exhaustive list.

Unlike the Impact Factor, which is based on a journal's citation rate, the proposed Retraction Index would indicate the number of retractions a journal has for every 1,000 papers published.

Adam Marcus and Ivan Oransky at Retraction Watch blog suggested creating a Transparency Index [19], which could include a complex score which would take into account the following practices of the journals:

- Its review protocol (including whether its peer-reviewed, number of reviewers, time for review, acceptance rate, appeals process);
- Names and expertise of the editorial board members (do they know they are on board?);
- How authors are asked to disclose possible conflicts of interest;
- Contact information for editor in chief and response rate of the email address provided;
- Costs for authors and readers;
- Whether journal requires reported data to be published together with the manuscript;
- Whether journal uses plagiarism detection tools;

- How journal handles allegations of errors and misconduct, do they accept anonymous reports; and
- Whether corrections and retraction notices are clearly highlighted.

Finally, the lab-services start-up Science Exchange and the open access journal PLOS ONE have collaborated to suggest the Reproducibility Initiative, which would provide a platform for researchers to submit their studies for replication by other labs for a fee. Studies that are successfully reproduced will win a certificate of reproducibility.

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CHAPTER 4: Scientific and Technical Communication

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ABSTRACT: In this chapter we tried to present some recommendations and insights, mostly based on previous experiences, how to make scientific communication better. We tried to classify and describe various types of scientific and technical communication: communicating to colleagues, to decision makers and to wider public audience. Further on, various directions for successful communication are discussed, such as, usage of "I" or "we", active or passive... Importance of team work for research and publishing is pointed out, and some directions for successful team communication are given. We tried to provide some specific recommendations on writing letters, memos and e-mails in scientific communication. Also, some important issues on, how to make successful conference reports and presentations, are discussed. Special part of this chapter is dedicated to oral presentations: their audience and purpose, structure, question answering and deliverance. The end of this chapter is dedicated to research proposals and reports, providing some advices for making them more successful.

KEYWORDS: scientific and technical communication, team work, letters, memos and e-mails, conference presentations, research proposals and reports

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4.1 Introduction

If we look at early cave drawings we hardly see any depth in them. But not just cave drawings, almost all paintings before the Renaissance lack depth. If we look at Andrei Rublev's "Annunciation" (1405) we see some depth, but it is not clear and looks strange (figure 4.1). We can see that painters tried to represent distance in depth on paintings, and tried intuitively to do so, but they often failed. During the Renaissance exact rules for drawing linear perspective were described, and ever since it became much easier to draw distance in depth. Painters like Masaccio, Paolo Uccello used linear perspective and in their paintings we can clearly see depth. Leonardo da Vinci studied and described various types of perspective. What was once intuition, after the Renaissance became a geometry rule and a useful tool.

Figure 4.1 Rublev's "Annunciation" left (weak depth, drawing based on intuition) and da Vinci's drawing right (strong depth, drawing based on perspective analysis)

A few centuries later, a new concept appeared to help those attracted to gambling. Prior to that, many people tried their luck and many of them believed that they could intuitively understand dice throwing and the outcomes. As expected, almost all of them were wrong, just like Antoine Gombaud (*Chevalier de Méré)*. He believed that he understood the dice problem, and lost, but fortunately for the rest of us, he asked Blaise Pascal for advice about it. Pascal wrote to Pierre de Fermat on this issue, trying to find a mathematical solution, and from these letters, a new concept was born – probability.

Perspective and probability changed art, mathematics, science and probably modern life as a whole. Before they were developed as concepts, people used intuition to solve problems regarding concepts they did not understand. Intuition sometimes helped, but most of the time it did not. Once we gained powerful concepts such as perspective and probability, it was much easier to draw depth or to predict uncertainty.

Now imagine what happens when we try to present new results of our scientific research. We mostly rely on our intuition. Some have talent, and present it without effort. But do we all have talent? As we know, that is probably not the case. Also, talent is so rare, that relying on the assumption that we have it is a very risky gamble, and all bets are that we shall probably lose if we rely on something rare, which we do not even know that we have. Unfortunately, we do not have Pascal, or Fermat to write to, and ask for assistance. So what should we do?

While waiting for a Pascal to appear with new concepts in the communication field, we can rely on previous vast experience and good practices. They can help, just as they helped Gerolamo Kardano to realize that some events in gambling appear more often than others, without knowing the rules of probability. In this chapter we shall try to present some recommendations, based on previous experience, how to make your scientific communication better. These recommendations are mostly not based on well documented scientific research, nor are they the only possibility. They are some insights and experiences which might be very useful as a starting point, giving you some input and helping you to predict the outcomes of your communication and presentation. They make you less of a gambler, and more of a scientist.

4.2 Types and elements of scientific and technical communication

Why do we need to communicate? Just imagine Kafka, writing a lot of excellent stories, without publishing them. Most of his work was published after his death. And truly it was excellent. But, would his work have been even better if he had published it, one by one, and received some kind of feedback? Even if it would not have been better, Kafka is probably an exception, an outlier, the one able to do it at a high level without having any feedback about it. The rest of us, excluding outliers such as Kafka, perform better if we receive feedback about our work. Also, written material is lost if someone does not read it. Imagine if Kafka's work had been lost and no one had ever read it. We could consider it as, never existing. So, in order to receive feedback and improve our work, or to

make our ideas reach someone, we need to communicate our findings. How?

Briefly we can define communication as an exchange of information (messages, ideas, needs, emotions...) by using various signs (verbal or non-verbal). But defining communication does not help much if we do not know who we communicate with. So, who is our audience?

Scientific communication might go towards three types of audience: colleagues, decision makers and the wider public. Based on who we communicate with, we shall use different types of communication (written papers or public talks) which will vary depending on the audience (scientific article for colleagues, project proposal for decision makers or public lecture for a wider audience) and on the signs which we use to communicate our message. Signs can be involuntary, spontaneous, through which we unintentionally send messages, and in those cases they are called signals. If, on the other hand, signs are voluntary, intentional and we are aware of the messages they send, we call them symbols. In all various types of communication, we will use different amounts of signals and symbols, depending on whether we are writing or if we are giving a talk or a poster presentation.

4.2.1 Communicating to colleagues

This is probably the most frequent type of scientific communication, which we all have in mind if we decide to do science. We imagine to do our research and to share it with colleagues. How do we do it?

Let us remember how it all started. Until 17th century, scholars used to write books if they had enough material and time, or they were writing letters to each other. These letters were actually the foundation of scientific communication and scientific journals. Letters were personal, with scholars addressing one to another. During the year 1665 two journals appeared, considered to be first scientific journals in history, *Philosophical Transactions* of the Royal Society established by Henry Oldenburg and *Journal des Sçavans* established by Denis de Sallo. Among rest, they published new discoveries found in science books or personal correspondence letters. This way new scientific findings and ideas were available to a broader audience. One of the consequences that can be attributed to journal publishing was reduction of simultaneous discoveries ended in dispute (figure 4.2). Since scientific journals were established, first to publish is considered as the author of the discovery [1].

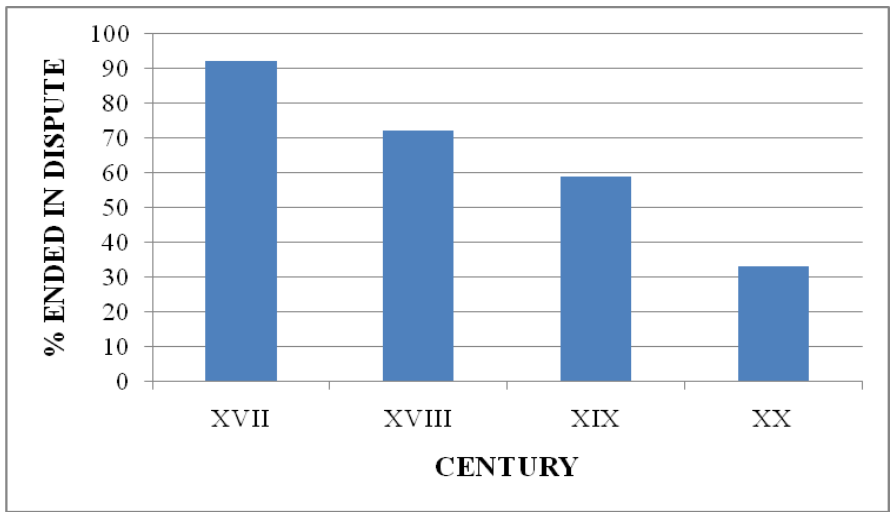

Figure 4.2 Percentage of simultaneous discoveries ended in dispute by century

First of all, we can divide our communication on:

- Written; and
- Oral.

Further on we will try to give short descriptions of some basic types used. We will not show them in details, since some of them are described in special chapters of this book. But it is usefully to have, in one place listed various communication types which we have and which we use during our careers.

Written communication - Scientific article is probably the most famous type of scientific communication. It is usually devoted to one research topic, providing introduction to the topic, methodology of the research, results and discussion. It is published in some of the peer reviewed journals.

Monograph is a wider in scope than the article, it usually contains many researches, but they are all devoted to one topic. It is just like if you have done several researches on perspective in art, and then you combine them all in one monograph on perspective.

Book is like combining several monographs. Of course, just like you will not simply add few articles to get the monograph, you will not add few monographs to get a book. It means that book covers more different topics, from some research area.

Besides writing a whole book or monograph, authors are often invited to write a book chapter on a topic they are considered to be experts. Various

chapters, written by various authors cover a broader scientific area, but it can be challenging to cooperate with other authors, and to adapt writing style so the book would seem as a whole.

Conference abstract is very frequent type of communicating scientific results. It is a short form, usually around 200 words, it can be written quite fast, but it is usually hard to write important information about research with such a limited number of characters. Although, to most of us it frequently seemed impossible, trust us, it is always possible to make it as short as it is required and to stay clear.

Necrologue is writing in honor to a colleague who died. It is quite different than the other forms of scientific writing, but scientists do that too. This form should represent work and life of diseased researcher to the community, scientific or even broader.

Biography and bibliography of researchers are often listed on their websites, which can be private, or integrated as a part of institutional website.

Writing formal e-mails is probably one of the most often communication done by the researchers.

Besides publishing our own research, we usually do reviews of other people papers. It is usually hard to write a good review, to be precise and detailed, to mention all possible mistakes or uncertainties, but not to sound offensive.

Young researcher looking for permanent position, post-doc or PhD, or experienced researchers changing their position, often need a letter of recommendation. This should be written precise enough, with enough information to a new employee, but taking care not to praise candidate over his true capabilities. You should avoid claims which are too general and have no actual meaning. Just imagine if you are employing someone and what would you like to know about that person.

Role of editor is also something that researcher doo. You need to organize, fit various writings into one unity. It differs from writing and publishing your own work.

Oral communication - Unlike written communication, oral includes verbal and non-verbal, it includes symbols and signals. You should take care of what you write, say, but also how you behave on the stage. In these cases you are more like a rock star than a writer.

Conference presentations can be talks or posters. If you have a talk you will need to prepare your slides (PowerPoint, Prezi...) carefully, check the timing of your presentation, talk clearly and understandable, and intriguing enough. Posters are a bit different format than slides, but they follow similar logic. Although you do not have limited time on poster, you will need to prepare your presentation not to take too long in order to keep your audience attention.

Plenary lecture is also a type of conference presentation, which you are invited to give if you are distinguished researcher in certain area. Difference between conference talk and plenary lecture is similar as difference between an article and a monograph.

Seminars and tutorials are often held and organized as independent events, or within some conferences.

Video abstract presentations are relatively new form of scientific result presentation, which include oral presentations as abstracts. One of the first abstracts published in form of video was Barry Sanders presentation of his co-authored work Dangling-bond charge qubit on a silicon surface [2]. Ottawa-based publisher Canadian Science Publishing (formerly NRC Research Press) started publishing video abstracts regularly, and provided instructions for this type of presentation, which can be found on their website: http://www.nrcresearchpress.com/page/authors/services/videos.

Also, there is a YouTube channel specified for video abstracts: https://www.youtube.com/user/cellvideoabstracts.

4.2.2 Communicating to decision makers

Written communication - Every research needs different kind of funding, and therefore, besides conducting a research and writing about our findings, we need to apply for various funds. So researchers often need to know how to write a good project proposal. This is hard, because you need to persuade people who are not researchers from our field, or even not researchers at all, that your work is relevant and important, that you will provide good results, and that you are the right person to conduct that kind of a research.

After getting some funding money, you will be asked to provide various kinds of reports and how is your project going. Especially, if your research is applicable, you will need to write a good report to policy makers, so they can understand your results, and to be persuasive enough so they will make decisions taking your results into account.

As an expert in certain field you will be asked to give some consulting services to decision makers.

Oral communication - Similar to lectures and conference talks, you will be asked to give oral presentation of your reports, or to advocate your project proposals.

4.2.3 Communicating to wider public audience

This way of communication is at the same time easy and hard. It can make you relax, since you are not in front of those who will take care of every word you say, but it can also make you even more stressful, since

you need to attract attention of someone who is not familiar to your area, or even to a scientific approach as a whole. Also, it demands even more responsibility from you, since researches will understand if you make some mistakes, but inexperienced audience wont. So, you need to be very careful, to make your findings simple, but correct, understandable and interesting, but precise. You will need to transform your formula into every day examples. On the other hand, it will be a good practice for you, since you will become a better lecturer, and also, you will probably better understand your own work that way.

Written communication - Textbook is usually written for students, and it should give an understandable, representative and good overview of some research field or even wider area such as whole discipline.

Popular science books are similar in scope as scientific books, but you will have to use quite different language, reduce the formulas and make it understandable and interesting to a broader, more and less educated audience.

Newspaper article is popular version of science paper, or a book review. You will need to be precise, but understandable and very intriguing to a wider audience, so you will need to adapt your language a lot.

Biography has different forms, from short ones having one paragraph, to more extensive ones including your education, work experience, skills, additional training, rewards and so.

As in more formal version for other researchers, you can make your website for a wider audience. As in other formats adjusted for this kind of audience, you will need to change information presentation in order to be informative enough to someone who is not a scientist.

Oral communication - Lots of scientists do teaching besides their research, and therefore give lectures to students. This form can be quite demanding since it requires you to change your usual ways of presentation, instead of talking to colleagues whose knowledge is similar to yours, you are communicating to persons who do not have and do not understand many concepts that you do.

Interview is a short form, since media usually will not give you too much time, in which you will be prompted to give a plenary lecture during conference talk time, to give 45 minutes talk in 10 minutes time. Of course, you will need to be intriguing, understandable, and precise at the same time.

Scientific theatre is not a frequent format, but it is very interesting, it allows you to transform your science into art. Imagine your research as a theatre play. Who would be a leading actor?

Many researchers make scientific exhibitions of their findings or their equipment. Public is usually very interested in these kind of events.

Science festivals are all into one kind of presentation. There you can find lectures, experiments, exhibitions. Festivals are well attended and can be pretty crowded. Scientists are expected to promote science on them, to attract public to make draw its interest into science. But also, scientist can train and improve their lecturing skills on science festivals.

4.2.4 Communication breakdown - directions for a successful communication

Independently of a type of scientific communication, there are several issues which can improve your writing or lecturing. First of all, remember that communication is about transferring information. If you do not send appropriate information, or if a receiver does not receive it, communication cannot be successful. Therefore, clarity and conciseness might be considered as a golden rule of scientific communication, regardless of the presentation type, or audience. All information you are presenting need to be shown as clear as possible. Do not save word nor sentences, you will not get interest from bank if you save them. If you are not sure whether it is understandable enough, ask a colleague who is not acquainted with your work, to read it and to give you a feed-back. On the other hand, do not spend too many words on something that is clear enough, try to be concise. These two borders, clarity as lower and conciseness as upper, will provide you a confidence interval for a good writing. Of course it is hard to calculate those borders, and that is why you have other colleagues to read, or reviewers. Imagine a scientific community as an ant colony. You are an ant, and your writing is a pheromone. If you release too little pheromone, other ants (scientists in case you have forgotten a metaphor) will not be able to track you. If you release too many, you will draw other ants on a wrong way, or you will not have enough pheromone for the next release. If you do not like to consider you self as an ant, just forget previous four sentences.

Scientists are often confused on whether to use “I or we” in writing. Is it better to say I found it, or we found it? Well there is no general rule on this one, except that more common is to say or write “we found it“, although there is just one author. Why is this so? It does not mean that author has multiple personality disorder, nor that he/she hides behind a group. It is just a consequence of a claim that knowledge spreading is collective and cumulative act, more than an individual. It puts a writer in a more neutral position. But, it should not be excusive rule, if you prefer using “I”, it should not be a problem, as long as it is in accordance to a certain journal rules to which you plan to send your article.

Similar dilemma is on using active or passive voice in your writing. Passive is more usual, and widely accepted, and puts you as a writer in a more neutral position. But, passive sometimes can be quite robust; it can make sentences too long, or even harder to understand. So, there is no need to insist on passive, especially if it breaks our golden rule, clarity and conciseness.

Illustrations are often quite good for almost all disciplines. They can help in understanding basic text, and they can break monotony in the text. But, one has to be very careful in choosing illustrations – in order to fulfil their function, illustrations must be related to text, and improve its understanding, not to draw attention away from it.

How to choose a title for your scientific article, presentation, or any other type of scientific communication? Well, just like choosing adequate methodology for your research – you will choose a methodology in order to answer your starting research questions and fulfil your aims. Title has two aims, to give a frame for the rest of your talk or paper, and to attract attention. So, choose it in accordance to those aims. If you have a dilemma whether to be amusing or not, it is up to you, and up to the journal in which you are sending your paper to be published. Humor will attract attention, but be careful not to draw attention away from your findings.

If you have a dilemma what type of language to use in your papers, whether to use more scholarly terms, or to use more plain terms and concepts, just remember the golden rules – clarity and conciseness. It will differ primarily based on who are you writing for, colleagues, decision makers or wide audience.

And of course, when we switch from writing to oral presentations, beside all previously mentioned you will have to control a bit your body language too. Look what others do and try not to repeat what you disliked about their behavior on the stage. Look at you self in the mirror and be aware of what you are doing. If possible, film you self, and watch your own presentation. You will be surprised how many things which you disliked in others talks, you also do.

4.3 Team working and communication

Imagine Pascal who is thinking on dice problem, and having no one to write to. Imagine, would discovering probability happen faster if Pascal and Fermat have met, and worked together on this issue. So, we might ask ourselves, do we need teams in scientific research?

In present it is hard to imagine doing and publishing your research without co-operators and co-authors. According to Thomson Reuters data [3],

average number of authors per one paper is increasing from a bit more than two in 1981, to more than five in 2012 (figure 4.3).

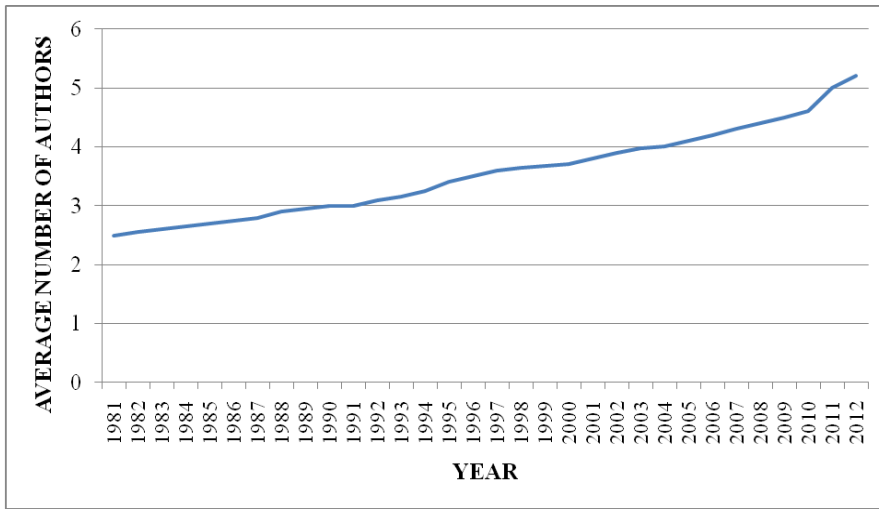

Figure 4.3 Average number of authors (all fields), per one paper per year, according to Thomson Reuters

Also, if we calculate percentage of single authored papers from the total number of published papers [3], we can see a huge decline and a trend in a same direction (figure 4.4).

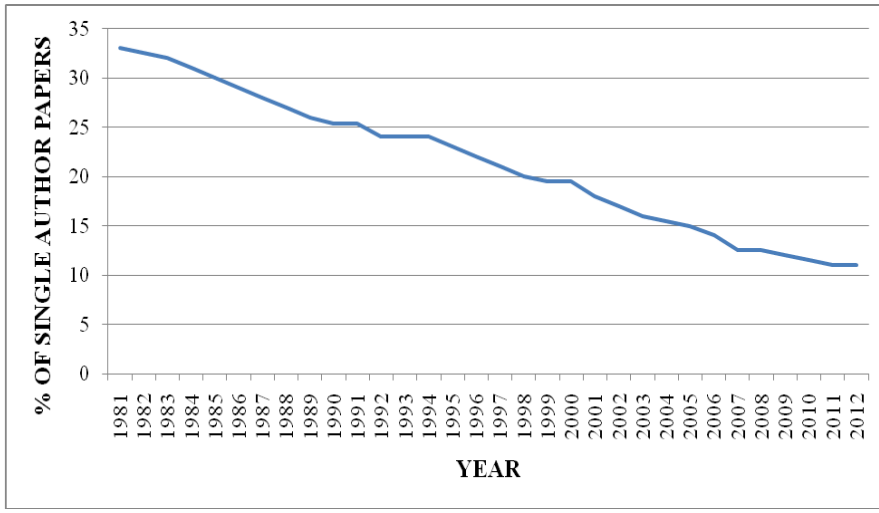

Figure 4.4 Percentage of single authored papers per year (excluding reviews), according to Thomson Reuters

These trends do vary depending on a research field, so we can notice that in social sciences nearly 40% of papers is still single authored [3]. On the other end, life-sciences and biomedicine indicate much higher collaboration since they have less than 5% of single authored papers. For instance, in microbiology there is only around 1.5% of single authored papers in 2012 (figure 4.5).

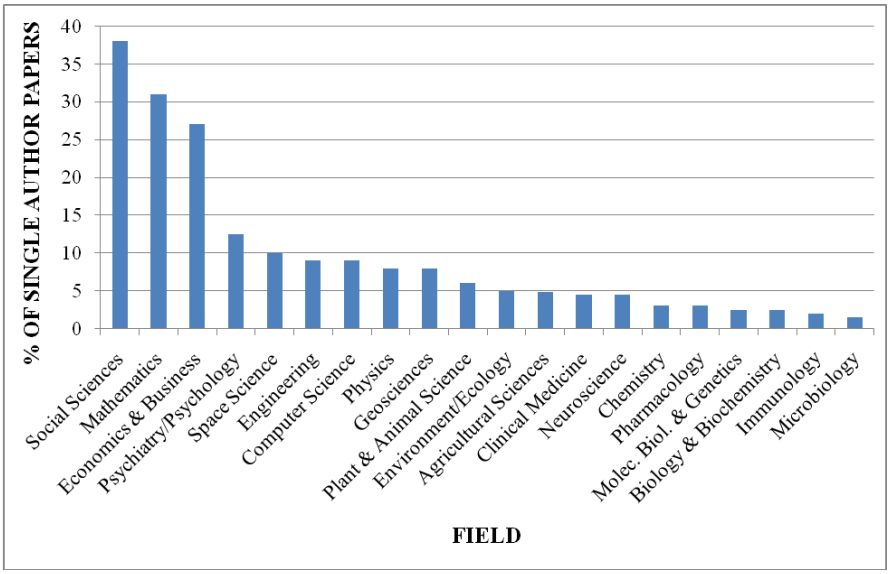

Figure 4.5 Percentage of single author papers per research field in 2012, according to Thomson Reuters

These data show us an increasing tendency towards collaboration and work in teams. What are the reasons for this tendency, we can speculate. Is it publish or perish paradigm, is it increased need for knowledge integration and multidisciplinary approach, or something else. Whatever the reason are, it is a factual tendency, and even in social sciences which still have relatively large number of single authored publications, this tendency towards co-authorship is present. So, how to work in teams?

On this issue we have several important questions - how to choose a team, how big should team be, and once we form it how to make it sustainable, and to communicate successfully within the team? Where to find team members?

There are several networking mechanisms developed within scientific community so far. First one is to attend scientific conferences, local, regional and international. Local and regional are usually smaller in size and you will make contacts easier, but do not forget international on which you

will have opportunity to meet some of the most important scientific names form your research field.

Second networking option, are joint publications, such as books, proceedings, or papers in international journals.

International or reginal projects are often impossible without collaboration between different institutions and researchers. You will have an opportunity to relate to others trough making various consortiums.

Study visits, for which you can find various funds (OSI, SCOPES, Fulbright) are often a good way to relate to colleagues from different institutions.

At the end, social networking and internet can provide a good starting point for creating your contacts with other researchers from your or some similar research field. You can make your own website, or make a profile on LinkedIn, Academia, ResearchGate, Google scholar, even on public networks such as Facebook.

Team size - When you make contacts, and start to create a team, you might wonder are there any limitations for my small ant colony (remember a metaphor on science community as an ant colony!). There are several tips from social psychology research which might be helpful on that issue.

We know that as the number of group member increases, satisfaction of individual member decreases. Group size does not only affect members' satisfaction, but also it affects productivity. Larger groups usually take much longer time to make a decision than smaller groups. After some point in increasing the number of group members, subgroups tend to appear, which usually leads to polarization of attitudes and slows down decision making and group functioning as a whole. If a group is too large, communication is quite limited, since usually only few members lead the discussion, while others stay on the side.

Having all previously mentioned in mind, and referring to some data in social psychology, we can say that optimal size for groups directed to problem solving is 5-7 members [4]. If you have groups larger than 20 members it usually happens that 5 most prominent members meets and discuss all the issues before they meet with the others.

If you have a larger group, which can be demanded by project proposal, or by funds you applied for, you can divide it into few smaller groups and name a coordinator which will integrate work of all subgroups. Just imagine project ATLAS in CERN which includes 3000 researchers from 180 institutions and 38 countries (figure 4.6).

Figure 4.6 Researchers included on ATLAS project in CERN, 3000 of them

Successful communication within the team - Once you managed to gather a team of an appropriate size you should take care if your team will survive. One of the most important prerequisites of team sustainability is good communication between team members. You might think that team members should be as similar as possible among each other, and there you go, problem is solved. But, Guimera showed that homogeneous teams have less probability to publish in journals with high impact factor (figure 4.7). Graphs show negative correlation between team homogeneity and journal impact factor, meaning that less diverse teams typically have lower levels of performance (they publish in journals with lower impact factor) [5].

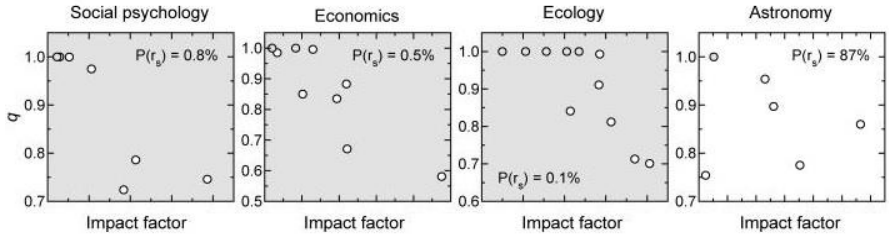

Figure 4.7 Relation between team assembly mechanisms (team homogeneity) and performance (journal impact factor).

So it seems that you will need a diverse team with members who communicate successfully. How? It is hard to give precise data on this issue,

but we can offer several advices from good practices. First, we can consider two different situations:

- We are the one who listens while someone else speaks about a problem;
- We are the one who speaks about a problem while someone else listens.

When you are a careful listener and you would like to maintain constructive communication with someone talking about a problem, you might like to:

- avoid asking too many questions, giving too many advices, talking about your own problems;
- if you do ask questions they should sound neutral, and avoid to make impression of interrogation or additional pressure;
- avoid nervous movements, which leave an impression of boredom and impatience;
- give various signs of listening, such as head nodding; and
- give some feedbacks from time to time, through paraphrasing or reflecting, which leave an impression of active hearing and motivate other person to continue talking.

It seems that people tend to accept other ideas and show higher probability for change if they are not under constant pressure or constant critique. Some behavior which are more likely to lead towards non-constructive communication contain: instant solutions, orders, warnings or threats, moralizing, too many advices, overflowing by lots of facts, derogation, judging, analyzing, underestimating of a problem... If you like your teams to last, these are the things you would like to avoid!

When you have a problem, and you decide to talk about it with other team members through constructive communication, you might like to use so called "I messages" instead of "You messages". If you use "I messages" your will communicate to others in such manner that you:

- do not attack others and therefore increase probability that others will listen to us;
- do not blame others and do not contain negative evaluation of others;
- describe other's behavior without negative evaluation;
- directly oppose other people's behaviors which cause problems to us;
- describe how certain behavior affects us and why it causes us problems;
- describe how we feel about those problems; and
- suggest what we would like others to change and how would that make us feel better.

Now imagine that you adopted and practiced all rules of constructive communication and your team communicates smoothly. You obtain information on new EU project funding competition and decide to discuss about it with your team and schedule a meeting. You spend few hours discussing on your possible project idea and proposal and decide to apply. But what if all members read the terms, but only one knew that it requires more than 10 team members and you are the only one knowing that two of your team members left and now you only have 9 members. In this situation nobody will assume that number of team members is relevant information – you do not know it is one of the terms, and your colleague knows that there are more than 10 of you. This situation is called hidden profile problem, since some information are available only to certain members and they do not share it with others because they estimate those information as irrelevant. This tendency can decrease the efficiency of group decision making. One meta-analysis showed that if hidden profile problem exists, groups have eight times less chance to make correct decisions [6].

Hidden profile problem shows that, beside successful communication tips, team members sometimes fail to exchange important information. There are several factors which increase hidden profile tendency and contribute to a lack of information exchange:

- Negotiation focus is a tendency of team members to orientate their behavior toward consensus, since they feel better and avoid conflict. But, conflicts do not need to be threatening, they can be very productive. Avoiding conflicts is actually a preference for consensus rather than for reaching the best decision. Have in mind that without cognitive conflict it is hard that group will achieve its full potential!;
- Theme choice bias shows that people tend to discuss more about common information (those which everybody already know) rather than other information, although former might be as important as prior;
- Pre-formed opinion: team members mostly explain decisions that they already made, instead of listening others and making decisions through discussion;
- Time limit can seriously decrease quality of decision making process, and therefore it is important to have someone who is leading group discussion, or to predefine time for debate;
- Conformity. Solomon Asch performed experiments in which he asked a group of people to estimate physical length of a vertical line (figure 4.8 – left) by comparing it to three other lines (figure 4.8 – right). But, only one member was true experiment participant while others were Asch's collaborators and deliberately gave wrong answers. Results showed participants' tendency to give answers which are similar to other group

member's responses, although they were obviously wrong [7]. This research shows a group member tendency to conform their opinions toward majority opinion, even in a case of evident physical length judgments. So, during group decision process, some members might manifest this kind of tendency, especially if there is a time pressure, debate questions are not clear and all other members show uniform attitudes. Most of us are not even aware of this phenomenon even when it happens. In order to reduce the probability of conformity appearance you should encourage all members to give their own opinions although they might differ from majority.

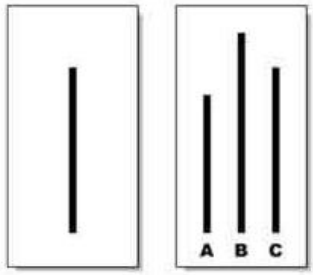

Figure 4.8 Stimuli from Asch experiments on conformity

Having in mind all previously said about communication and group decision making, can we conclude, what are the characteristics of so called efficient groups? We might say that if you want your team to show higher level of efficacy, you might want to have:

- Higher level of cooperation;
- Higher level of dedication toward achieving group aims;
- Higher concern for team member relations;
- Tendency to focus on topics on which members agree on and on common aims, rather than on explaining why others are wrong;
- Tendency to take other member's roles, change the viewing perspective on a problem;
- Less tendency to reject other's propositions easily;
- Assertive communication (using "I messages" and carefully listening to others).

Now remember how we compared scientific community to ant colony. By writing our articles, giving presentations or lectures we share information on our work like ants share pheromones. Have in mind that colony can function as a whole only if pheromones reach other ants and transfer information!

4.4 Letters, memos and e-mails

Computer technology has transformed science and engineering communication, and in recent years most correspondence is transmitted electronically. The timely exchange of information and efficient communication are important for successful scientific research. As stated earlier, scientists often use written communication to exchange ideas and different material (data, news, figures, etc.). One kind of written communication is correspondence that can be carried out using different types of documents: letters, memos and e-mails. Whereas letters and e-mails are used for external communication, memos are mostly used for internal communication within a department or a research group. Each document type has a specific structure which we will describe here. Also, each of these documents is considered as official communication. This implies that you should avoid informal language when writing a letter, memo or an e-mail. Both letters and memos, even e-mails, may be archived and reviewed later, often by those not originally addressed. They are important parts of a project record and can even serve as the basis for key decisions [8,9].

Letters - A letter usually contains the date, information about the sender and recipient, salutation, a few body paragraphs, a complementary close and signature. The sender's address should be written at the top of the page; then after skipping one or two lines the date should follow. Many institutions use a letterhead that already provides the sender's address. In such cases, you should not repeat that information. After the date, the recipient address should be written. If there is a letterhead, it should be printed only on the first page of the letter. On the second and subsequent pages the letterhead should not be printed. If your letter has more than one page, you should not staple the pages, but use a paper clip to keep them together. Letters should be typed and composed in a common font such as Arial or Times New Roman.

Next, you should write the salutation. "Dear" is an appropriate greeting for a letter. If you do not know the name of the person to whom you are writing, you can use "Dear Sir" or "Dear Madame". But, it is recommended to make an effort and find the name of the recipient. If you are writing to an individual who has a professional title - such as Professor, Dr. or for public officials, Honorable - use it. If not, use Mr. or Ms. (unless you know the recipient prefers Mrs. or Miss).

Then write the body of your letter, with no indentation at the beginnings of paragraphs. Skip lines between paragraphs. Make sure that the letter is clear and concise. Always be courteous. Even if you are writing with a complaint, you can be courteous.

After writing the body of the letter, type the closing, followed by a comma. The closing, like the salutation, is an indicator of respect and formality. “Yours sincerely” or “Sincerely” is often used; also consider “Cordially”, “Respectfully”, “Regards” and “Yours Truly”. Slightly less formal but still professional closings include “All the best”, “Best wishes”, “Warm regards," and “Thank you”.

Skip three lines after the salutation, and then type your name and title (if applicable). Sign your name in blue or black ink in that blank space. If you are signing the letter on someone’s behalf, write “pp:” before your signature. This stands for “per procurationem”, which means “by agency” or “on behalf of.”

Proofreading of the letter is extremely important. Reread the letter checking for typographical errors, grammatical problems and misspelled words. Also, make sure that important elements of information are not omitted. Furthermore, make sure that there are no repetitions. If you are using spellchecker software (and you should), check the letter for properly spelled, but wrong words [8,9].

And always keep in mind to be as clear and concise as possible. It might be useful to remember the words of the French philosopher Blaise Pascal: “If I had more time, I would have written you a shorter letter”.

Memos - While letters are most commonly used for communication with people outside an institution, a memorandum or memo is a document used for internal communication between coworkers or members of a department. Memos address a small or large group of people, but some of the memos may be intended for one person. If it is an issue involving only one person, it should not be sent to the entire group. The text of the memo is short. Usually a memo consists of one page, two pages at most. It is longer than an e-mail, but usually it is not a complex multipage document. Memos often share new information, like changes to schedules or invite readers to attend a meeting.

Memos have a subject line which is one of the most important parts of a memo and it should be as specific as possible. The subject line should be a summary of the memo. For example, the subject line “The Analytical Chemistry Conference” is too broad, whereas from the subject “Dr. Petrović presents a conference report – The Analytical Chemistry Conference”, the reader will immediately obtain information on what the memo is about.

When you write a memo, explanations should be kept short and simple. People are busy and need to concentrate on different problems. Most people will read a short, concise memo right away.

As in the case of a letter, the second and all subsequent pages of a memo should be printed on plain paper rather than on a letterhead. If your memo

is longer than one page, include an identifying heading on the subsequent pages. That will allow your document to be reassembled if the pages become separated [10].

E-Mails - E-Mails enable communication with coworkers in the same organization, as well as with people in other parts of the world or in different time zones. Also, sending e-mails is simple and easy. E-Mails became a valuable tool for scientific collaboration because it is possible, for example, to write a book exchanging documents via e-mail without meeting the coauthors.

But there are also problems – most people who use e-mail for work receive a large number of messages daily. Additionally, e-mails are easily misunderstood and can cause unintended anger or confusion.

Consequently, it is important to write an e-mail clearly and concisely. As you have figured out by now, the key words for proper scientific communication are clarity and conciseness.

In e-mail communication, no distinction is made between messages sent to the next office and messages sent across the country or around the world.

You should avoid informal writing, meaning you should not use emoticons, chat abbreviations (such as LOL) or different colors, backgrounds and fonts when writing an e-mail. Do not send spam messages to addresses from mailing lists that are work related.

Here are some additional guidelines for writing an e-mail:

- Use a neutral e-mail address, not a nickname or inappropriate names. The best option is if your e-mail address is a variation of your real name.
- The subject should be short and accurate.
- Proper salutation should be used. Basically, salutation instructions are the same as for writing a letter. You can start with “Dear”, and then use the person's title (Mr., Ms., Mrs., Miss or Dr.) with their last name, followed by a comma. “Dear Sir or Madame” can also be used, but it is recommended to make an effort and find out the name of the person you are writing to.
- Write a message that is short and focused. Be courteous and clear. People do not have time to guess what you mean and they like to be able to read and respond to the e-mail quickly. Use uppercase and lowercase letters; in that way it is easier to read the text. Separate paragraphs by skipping lines. The message should not have more than 5 paragraphs.
- Sign off appropriately (using “Yours sincerely”, “Yours cordially”, “Respectfully”) and then write your full name. You can use the signature which is attached automatically to your e-mails with relevant contact information.

- Proofread the e-mail before sending. Make sure you have not omitted any important details and that there are no spelling and grammatical mistakes.
- The legal status of e-mails is complex and ambiguous. Some institutions openly monitor e-mails, in some cases even erased e-mails are used as evidence in different legal actions, in other cases issues related to privacy and access are not well resolved. The best practice is not to mix personal and professional when writing an e-mail [10].

4.5 Conference, reports and poster presentations

4.5.1 Conference reports

A conference is a meeting that scientists and their associations organize to share results and exchange information about their research projects. There you can hear some cutting-edge scientific results, see how other researchers solve problems similar to yours, start new collaborations or renew old contacts. The most important difference between the presentation of your research results in a scientific journal or at a conference is that you can get immediate feedback and critical evaluation of your work. Many conferences result in the publication of a Book of Abstracts where the presented results are listed as abstracts or in a Book of Conference Proceedings where the results presented at the conference are published as a paper. The length of the paper varies depending on the conference requirements.

There are certain rules that must be followed when preparing an abstract or conference proceedings. These rules help scientists to efficiently communicate their results to colleagues.

The first rule of abstract writing is that it should attract the reader by telling him/her what your work is about and why they should find out more about it. An abstract should be a concise summary of your entire study. Also, the topic of your work must be relevant for a particular conference. Some highly attended meetings only accept a limited number of abstracts for either poster or oral presentations. The opportunity to publish and present your results at these highly competitive meetings will completely depend on how well your abstract communicates the quality and impact of your research.

Before you start writing an abstract, you should always check the conference instructions for the required abstract format (usually given in detail at the conference web site). This will allow you to identify the word limit, what type of file the conference accepts (Word document or pdf) and other formatting requirements which must be fulfilled. Furthermore, find

out the deadline day and time (keeping in mind possible time differences) and make sure to submit your abstract on time.

The title of the abstract is important. It should describe the subject you are writing about. But keep in mind that the most effective are short, attention-catching titles with less than 12 words.

Most conferences impose a strict word limit for abstracts, usually between 200 and 300 words. The abstract must be written within the defined word limit, which means that you need to communicate your research effectively in a very limited amount of space. For conference participants the abstract will typically be the only information about your research. Because they will use it to decide whether they will visit your poster or attend your talk, it is important that the abstract can be easily understood and that it highlights the importance of your results in an interesting way. Conference abstracts are usually written several weeks or months before the meeting and you might have some experiments in progress for which you do not have results at the time of abstract submission. Conferences will usually not allow changes in the abstract, but it is acceptable to include those results in your poster or oral presentation.

You should begin the abstract with a brief introduction of what is known about the subject of your research and what is the aim and importance of your work. The opening 2-3 sentences should describe the background of your research; sometimes, even a single sentence may be enough. The next 1-2 sentences should very briefly describe the methods used. The abstract does not need to provide details of the performed experiments since this information will be given in your poster presentation or talk. Then write 3-5 sentences about your results. It is the most important part of the abstract. The most significant results should be presented clearly and concisely. The abstract should end with a conclusion, the final 2-3 sentences, which explain how your results correspond to the topic you described in the introduction [11,12].

Make sure to write your abstract in correct English syntax and grammar. And keep in mind that writing a good abstract takes time.

Some conferences, instead of an abstract, require a paper as a contribution. The length of that paper can vary from one page to several or many pages. Each conference specifies the length of the contribution. Detailed instructions of the contribution format are given at the conference web sites. Usually, this type of contribution has the same format as a paper published in a scientific journal, i.e. it has the following sections: Abstract, Introduction, Materials and Methods, Results and Discussion, Conclusion and References. This type of paper presented at a conference is published in a volume called a Book of Conference Proceedings or a Book of Proceedings. There are inconsistencies in publishing these types of

volumes. Sometimes the proceedings are treated as a book and sometimes it is treated as a journal. Additionally, some papers from the conference never get published and are available only from the authors. A combination of all these factors makes conference papers sometimes difficult to find.

A Book of Abstracts or Book of Proceedings can be in paper or electronic form. Because conference submissions are typically works in progress, it may take months before such information is published as a journal article or it may never be published. However, in some fields such as computer science, this is not the case: conference papers are considered "final" publications and are treated as an article in a scientific journal.

Nowadays there are many conferences and young researchers will only have the opportunity to attend one or two a year. For those who are not able to attend conferences, browsing through a Book of Abstracts or Book of Conference Proceedings is very helpful for obtaining the latest news from a specific topic. Also conference reports can be very informative. Conference reports are written documents, sometimes published in a journal. If you need to write a conference report keep in mind that the readers of that text will be your professional colleagues. The text should not have more than ten paragraphs, each one dedicated to one of the most important presentations from the conference. Your report should not reflect the opinions of other participants, only your own. You should also make an effort not to be influenced by the reputation of the scientists, but to judge objectively on the quality of the presented work.

A conference report can be considered as an administrative report as well. Usually that type of report is required by the organization which funded your participation at the conference. In that case, travel tickets (air plane or bus tickets), proof of attendance (provided by the conference organizers), the conference program, receipts for the registration fee, accommodation and local expenses should be provided. This type of report usually contains a text, maximum two pages long, in which you present how that conference was beneficial for you (e.g. what new ideas you obtained, new information you obtained from colleagues in informal conversations…) [11,12].

4.5.2 Poster presentations

One of the customary ways to present results at scientific conferences is a poster. At every conference, a significant part of data transfer and interchange happens at poster sessions. This way of scientific communication began in the 1950s and 1960s when the number of participants at conferences increased and there was a need to present a large number of papers.

Nowadays many conferences have only invited and plenary lectures, whereas all other contributions are presented as posters. This makes poster sessions very important for communication at research conferences. Consequently, it is important to prepare a poster that is attractive because you have to fight for attention among tens, sometimes hundreds of posters. There are different kinds of conferences; some are very specialized and some cover a broader subject. Depending on the conference type, the poster should be adapted to the audience, which may include people with different degrees of knowledge of your topic and methods. Some of them may work in the same area and be familiar with your work; others may work in similar or different areas.

Poster sessions are a specific way of scientific communication. They usually take place in the exhibition hall, a large room, several small rooms, a corridor, etc. The audience walks around the venue, looks at the posters and sometimes asks you to give them a brief presentation of your study. The particularities of poster sessions are direct contact between the scientists, flexible time for discussion, both the presenter and audience are standing, there is no moderator, usually you are meeting people with a high level of interest for the subject, it is easy to exchange contact information (handouts, business cards….). Sometimes, you may learn more from your viewers then they have from you, particularly at conferences specialized in one topic. Generally, poster sessions provide an environment for a thorough discussion of research results and methods. But to be honest, sometimes it is more like a brief conversation at a cocktail party. Nevertheless, a poster represents you and your institution and should always look professional. As it needs to attract people who are passing by too quickly to make a decision to find out more about your work, the poster should be original and elegant and easily distinguished from other posters. Always have handouts (usually your poster printed in A4 format) and business cards prepared and put them on a nearby table or in an envelope attached at the bottom of the poster.

A poster serves to advertise your work and it should tell a story to the audience. Your first task is to think and decide on the main idea you want to share with your colleagues using a poster. It is impossible to present all the results from your research in a poster. Just focus on one or two main ideas (results). The story presented by the poster should be perceived at first glance and it should be easily read from an approximately 1-2 m distance. Think of the poster as a visual aid when discussing your work with the audience [13,14].

The layout of the poster can be “portrait” or “landscape”. That varies from conference to conference, and it is determined by the poster boards that the conference organizers prepare. For this reason, you should obtain

the instructions about the size of the poster at the conference web site. Usually the size of a poster is: width between 80-100 cm and length 100-120 cm. Your poster should fit the given dimensions. And you should present your results in that limited space. An example of a poster structure is shown in figure 4.9. The poster should have sections similar to scientific articles.

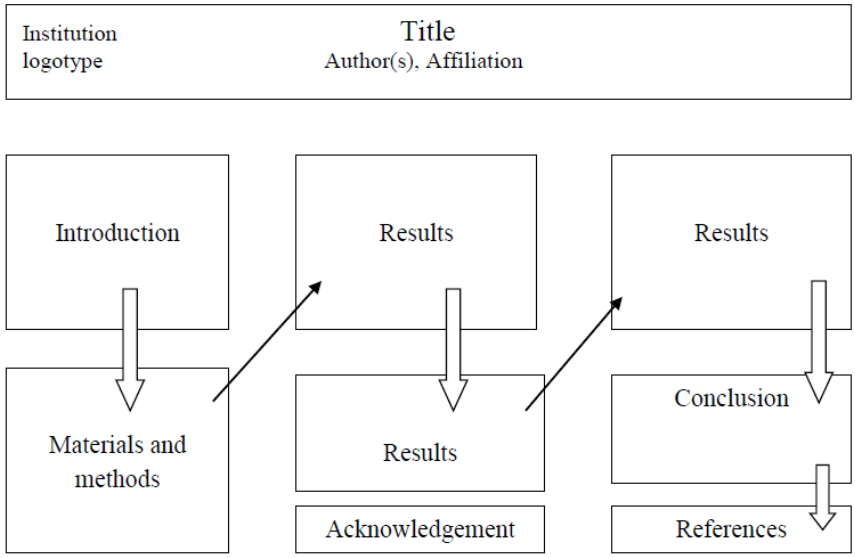

Figure 4.9 An example of a poster structure

The title, list of authors and their affiliations are always at the top of the poster. In the upper left corner you can put a logotype of your institution. Some authors put their photograph in the upper right corner of the poster. The title should be striking and should make people want to visit your poster. It can pose a question, define the scope of the study or it may give a hint for a new finding.

The introduction should be brief. Just clearly write what you did and why. Experimental procedures should be short, except in the case of some new method or approach which is the main focus of the poster. If colleagues are interested in experimental details you can provide them with additional explanations. The results are the largest and most important part of the poster. In that part of the poster you should use effective graphics to present your results. Remember, a picture (in this case a graph or chart) is worth a thousand words. Try to avoid tables, but if you use them do not make tables with a large amount of data. You should not have long text sections on the poster. Use bullets and short sentences. The conclusion

should emphasize the main results of your study. It should have a clear take-home message. The list of references is usually kept very short on the poster. In the acknowledgement section, you acknowledge contributors and funding organizations.

If you are artistic, you can break the rules for a poster presentation and still make a distinct poster. But you may also consider some of the following guidelines. Keep a balance between the text, graphics and empty space. Usually the distribution for a good poster is 30-40 % text, 30- 40 % graphics and 30-40 % empty space. Direct the reader to the direction of reading. You can use numbers, arrows, different colors or different shapes to achieve that. We are used to reading in a certain way, so posters should be organized that information is read from left to right and from top to the bottom. The title and subtitles should be a mix of upper and lower-case text. Do not use passive verbs too much. The poster should have some attention-catching details. You can use elements of different size or bring the most important aspects of the poster to the center and single it out with a figure or color. Do not overuse different colors. Too many colors will make your poster look chaotic and unprofessional, and having no color will make it plain and boring. Use neutral and light background tones. Recommended fonts are Helvetica, Courier, Comic Sans and Times New Roman. The size of the text should be sufficient for the viewer to read it from a 1-2 m distance. The font size for the title should be between 70-120 pt and for the text not less than 24 pt. Dark colored letters should be printed on a light background. Also, try to consider people who have problems differentiating colors (e.g. do not use red and green next to each other). The poster can be prepared using programs like Corel Draw or Microsoft Power Point. You should spend enough time to prepare a good poster because it is important for the presentation of your research. After the conference you can keep it in your laboratory or office as an advertisement of your work [13,14].

A few final suggestions: reread and check everything before printing. Keep in mind that something can look good on the screen but not so good when printed. Follow the instructions of the conference and mount your poster timely. Usually posters should be on the board before the poster session starts and removed as soon as it is finished. But that can differ at different conferences. Check if the conference provides materials needed for the attachment of the poster to the board, like pins, double-faced tape, glue sticks, scissors, etc. Even if it does, it is always helpful to have some of that material with you.

4.6 Oral presentation

Oral presentations are an effective medium to communicate with the audience. Compared to written documents, oral presentations enable better contact by means of commenting or asking and answering questions. There are four basic types of oral presentations: impromptu, scripted, memorized and extemporaneous [9]. We shall focus on the so called “extemporaneous presentation“, which is planned and prepared in advance.

Preparing an effective oral presentation takes just as much time as writing a good scientific paper. To avoid giving a boring or “too complicated“ presentation, before starting ask yourself to whom, why, what and how you are going to present.

Analyze your audience and your purpose - With regard to whom, we should consider the following audience types: clients and customers, colleagues in your organization, participants of scientific conferences, government agencies and the general public. When you know what the audience knows about the subject, you will be able to adjust the level of technical language and the concept of presentation. The why refers to: just for merit, to teach, to inform or to persuade. The what refers to the message, review, expectations, questions and the how refers to the satisfaction of the audience's needs.

4.6.1 Structuring your oral presentation

Oral presentations have the same aim as scientific papers, they must emphasize the motivation of the presented work and its outcome. Besides, presentations usually include interaction in the form of questions and answers, which enables omitting superfluous information and overloading the presentation. The three main parts of the presentation are as follows [9,15]:

- Introducing the presentation;
- The body of the presentation; and
- Concluding the presentation.

In **introducing** a presentation, the following suggestions should be considered:

- Introduce yourself and state the title of your work. The title slide should contain your name and position as well as the title of your presentation.
- At the beginning of any presentation it is important to attract the attention of the audience by stating the need for your work. It can be a statement, a question, a picture showing the problem, an anecdote, de-

pending on the topic and the audience. Usually, less specialized audiences require more creative pitching of the topic because they are less familiar with the topic. For specialist audiences, a simple link with a familiar context ("As most of you know, . . . ") or ("As Dr. Petrovic just pointed out, . . . ") may be helpful.
- Explain the purpose of the presentation. The purpose should be related to the needs of your work. It should enable the solution of the stated problem or provide an explanation.
- State your main message. The main message is the one sentence you want your audience to remember, it is your main conclusion.
- Provide an advance organizer. You should outline the body of the presentation, for example: "First, I'd like to describe our present system, highlighting recent problems we have experienced. Next, the influence of... will be shown... Finally, I'd like to invite your questions."

The body of the presentation - You can use different organization patterns, for example the "cause and effect" or "problem-method-solution" pattern. Throughout the body of your presentation there will be different kinds of information for each section of the presentation, in some cases there will be graphics, pictures, data in text or tables, or even objects that you want to pass around in the audience. Today, most speakers use some type of software to prepare slides. PowerPoint is the most popular, although Prezi has also attracted attention. The free version of Prezi is cloud-based, which means that you need an internet connection to use it. No matter which software you use, design the slides so they get the message across to your audience in a visual way, but remember the following:
- Slides are for the audience. They should not be designed as a memory aid for the speaker and should not contain too much text;
- Slides are for getting messages across. On each slide, state your message as a short sentence (a maximum of two lines, corresponding to about 10–15 words), normally in the title area. Then develop this message in the rest of the slide;
- Slides are visual aids. The audience cannot listen to what you say and read text at the same time. Because of this limitation, be as visual as possible;
- Text and drawings must be simple. Each graphic should present only one idea, otherwise it will be hard to comprehend;
- Text and drawings must be visible, easy to see and read. In general, the text should be in 24-point type or larger to be visible on a screen. Use clear, legible lines for drawings and diagrams; black on white works best. The fonts *Arial* or *Helvetica* are effective because they reproduce

clearly on the screen. An example of a poorly organized and ineffective slide is presented in figure 4.10;

- Language mistakes can distract the audience from your content. Revise your slides carefully.

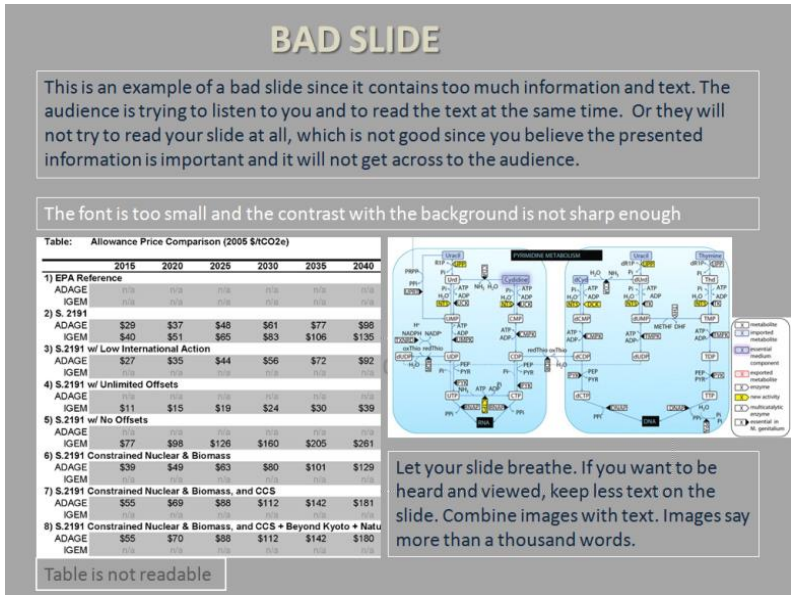

Figure 4.10 Example of a poorly organized slide

Concluding a presentation:

- Review the main points to help the audience remember them and to prepare the audience for your conclusion;
- Conclude by restating your main message and complementing it with any other interpretations of your findings;
- If applicable, give the perspectives and implications of your work;
- Finally, close the presentation by inviting questions.

4.6.2 Answering questions

After finishing your presentation, politely invite your audience to ask questions, for example “Thank you for your attention. If you have any questions, I'll be happy to try to answer them“. The questioning part might be even more frightening than the presentation itself. However, keep calm and focused. To prepare yourself for questions, try to think of what your audience might want to know, try to anticipate the questions. After you hear the question, you may repeat it to be sure that both you and the audience have understood it correctly. You will also get some extra time to

prepare yourself. Don't rush with the answer, take your time to construct the answer. However, if you do not know the answer, be honest and admit it. Instead of simple answering “I don't know!“, you may say “I am not sure, but I think...“. You may present some possible explanations or ideas how/where to find the answer or simply offer to continue your discussion after the session, or by e-mails.

4.6.3 Delivering the presentation

Three components contribute to an effective oral presentation: what you say, how you say it, and everything the audience can see about you. Regarding the verbal part, do not read or memorize your full text, since your presentation will sound like a recited text. Instead, speak informally, reinventing the words as you go along. Make your slides lead you through the presentation. Visually, try to control your body. Engage the audience by looking them straight in the eyes. At all times, keep in touch with the audience, tell the audience your story, do not just explain your slides. In particular, anticipate your slides. You should know what your next slide is about so you can insert an appropriate transition. Use your voice and body effectively [15].

How many slides should I have? It depends on your subject. Still, keep in mind it is far better to have a few simple slides than to have one complicated slide that can take several minutes to explain.

Budget your time. Do not take more time than you are allotted for your presentation! If you do, you will probably be interrupted or warned to finish the presentation. If you are given a maximum time of 20 minutes for the presentation and for questions and answers, a typical time allotment is as follows: Introduction - 2 minutes, Body of the presentation - 12 minutes, Conclusion - 2 minutes and Questions - 4 minutes [9].

4.7 Proposals and project reports

4.7.1 Proposals

Proposals are documents which you present to potential clients, funding bodies or sponsors to offer a product or service or to carry out research. Proposals can have different forms and length. In some cases a few pages should be enough to explain the main points, while sometimes a proposal can take 20-30 pages, explaining major points in detail. Proposals can be internal (within your organization) or external (written from one organization to another) [9].

Internal proposals are written within your own organization. For example, when you get an idea to improve or change some parts of the production process, you would write a proposal explaining your idea and the benefits that your organization will get from it. Depending on the amount of funding, you will write an email, a brief memo, or a more detailed report.

External proposals can be either solicited or unsolicited. When an organization is interested in some services or products it publishes either a call for a bid or a request for a proposal. In that case the supplier sends a solicited proposal to a customer. An unsolicited proposal is sent to a customer who has not requested it. Unsolicited proposals must convince the customer that he needs what you are offering, since he has not planned or budgeted for the proposal.

The outcome of a proposal is called a deliverable. Depending on the project type, deliverables can be categorized in two classes, *research* and *goods and services*. In a research project, a commitment is made to conduct some kind of research and the deliverable is a report. During the project researchers submit progress reports, while at the end of the project they submit a final or recommendation report. In goods or services proposals, deliverables are tangible products or services.

Before starting to write a project proposal, you must thoroughly analyze the request for a proposal. Once you understand the problem, you can write a persuasive document and you can convince your readers that: you understand their needs; you have a management plan, technical personnel, the right equipment and all the necessary technical support; you are competent to complete the task as you promised. Remember that a proposal is a persuasive document that should contain key information about your project. It is essential for your sponsors since they will decide whether or not to allocate funds depending on the content of the proposal [9].

4.7.1.1 Structuring your proposal

Project proposals do not follow the same structure, some of them are for NGOs, academia and some are for businesses. If an authorizing agency provides a guideline, follow it carefully. If this is not the case you may follow the structure shown here:

Title Page:

- Title of the project;
- Name of a beneficiary and a name of a contact person;
- The names and affiliations of the authors;
- Date;
- If applicable, the authors use letter head stationery for memos.

Summary -The summary is a vital part since some readers base their initial decision on this item. It contains the major elements of the proposal in brief form. Some professional project writers suggest writing this part last. The length might be imposed in a guideline, but usually it should be from one-third to one page depending on the length of the whole proposal. In the summary you should define the following:

- Background of the problem. You need to justify **why** you are doing this project;
- Highlight the proposed technical and management program. In this part you will briefly explain **what** you will be doing and **how** it will be done.
- Provide a brief statement of your expertise (**who** will be doing it);
- Explain **how long** it will take and **how much** it will cost;

Introduction - This section will enable the reader to understand the background, scope and organization of the proposal. The following information should be shared with the reader:

- What is the problem that is addressed? Describe the existing problem, the background, why the problem is important, what is the socio-economic impact of the problem. If applicable, use financial terms to explain the problem, for example "due to the conservative production process, each day the company loses around $3,000". Refer to all relevant sources of information (reports, articles, books, etc.). Keep in mind that your project needs to convince the sponsors that it will be worth spending money for what you propose.
- What do you propose to address the problem? Explain your proposal for solving the problem. The proposal should describe the activities and strategy that you will apply for solving the problem. Describe the objectives that will culminate in deliverables.
- What is the organization of the proposal? Explain the organizational pattern of the proposal.

Project objectives - The objectives should address the core problem in terms of the benefits to the project beneficiaries. You should describe the objectives of your project and the expected outcome. Describe the industrial, economic and/or social problem to be solved and/or business opportunity you intend to address. The objectives should be consistent with the expected exploitation and impact of the project. The typical hierarchy of the goal, objectives and activities in a proposed project are shown in figure 4.11 [16].

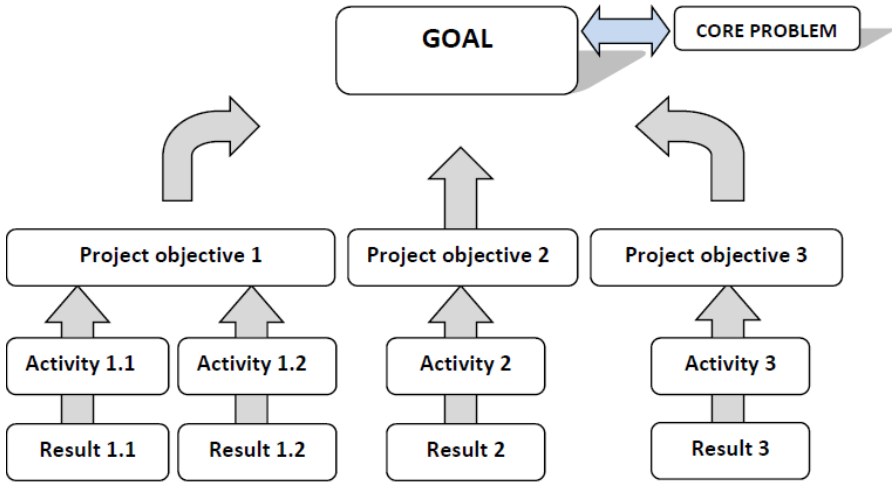

Figure 4.11 Hierarchy of the project goal, objectives and activities

Project implementation - The implementation plan or work plan should describe the planned activities and resource allocation. It is necessary to explain in detail who is going to implement the activities, when, where and how much they will cost. The implementation plan is usually divided into two key elements: the **activity plan** and the **resource plan (budget)**.

- The activity plan should define the duration of the project and all the proposed activities, sub-activities and tasks. It should define the beginning and the end of each activity and task. The activity plan should be prepared carefully following the proposed steps: list the project activities; break the activities into sub-activities and tasks; determine the sequence of the activities, their relation and the timeline for each activity and task; use milestones as a measure of the progress; distribute the tasks among the team members. When you have your task schedule ready, you may present the activity plan as a table or as a Gantt chart. Figure 4.12 is an example of a basic Gantt chart which shows how long each task will last and whether different tasks will occur at the same time. The Gantt chart can be more detailed presenting all the activities, sub-activities and tasks of the project in certain time frames. However, Gantt charts do not show the interdependence of tasks, so in some cases the activity schedule can be presented as a network diagram.

Weeks	1	2	3	4	5	6	7	8	9	10
Tasks/Dates	30-Jan	6-Feb	13-Feb	20-Feb	27-Feb	6-Mar	13-Mar	20-Mar	27-Mar	3-Apr
Task 1										
Task 2										
Task 3										
Task 4										
Task 5										

Figure 4.12 Task schedule presented as a Gantt chart

- Someone might say "Good ideas are not good unless they are affordable". The budget will show how much the proposed project would cost. The two main parts of the budget are direct and indirect costs. Direct costs are the costs anticipated for salaries, travel costs, costs for equipment, materials, suppliers, workshops, meetings. Indirect costs or overhead are usually calculated as a percentage of the direct costs and are aimed for general secretarial or operating costs such as for maintenance or utilities. The cost for each activity and the total project cost can be calculated using the resource plan.

Qualifications and experience - As already mentioned, your project proposal aims to convince the sponsors that it is worth investing in what you propose. In this section, you should provide a brief description of the qualifications of your team, management structure, facilities and the equipment that the institution/company has. In larger projects, a project leader needs to be selected keeping in mind her/his previous experience and competence.

Appendices - The appendix contains accompanying information/ documents for the proposal. Some documents are too large to be included in the text, or they are related to the general context, policy documents, the CVs of the project leader and personnel, etc. In that case they are provided at the end of the project proposal [9,16].

Examples of the project proposal templates for Horizon 2020 calls can be found on the website of the European commission https://ec.europa.eu/programmes/horizon2020 [17].

4.7.2 Reports

When the project is completed, one of the project deliverables might be a completion or recommendation report. On the other hand, if you are conducting laboratory research you might be asked to write a lab report to present routine findings. In between, many people are writing different informational reports, which explain some activities that have been completed or are in progress.

Writing informational reports involves the same writing process as in other kinds of technical documentation. You should identify key factors that will help you to write a clear, accurate and well-structured report: i) what is the purpose of the report and ii) who are you writing to?

In this section we focus on project reports and lab reports.

4.7.2.1. Progress and status reports

When your project proposal has been approved, you need to realize that a lot of paperwork lies ahead. At some point, depending on the duration of the project, the research team writes a progress or status report describing ongoing activities. The basic point of a progress report is to summarize the status, progress and to forecast the further stages of your project. No matter how well the project is proceeding, you are expected to submit an honest progress report. You might face some of the listed problems: i) the deliverables will differ from what you anticipated in the proposal, ii) you will not be able to complete the project on time, or iii) you will not meet the budget. In those cases explain clearly how they will affect the overall project in an objective tone, neither defensive nor informal. The professionalism of the progress report is very important for the future of the project [9].

Organizing progress and status reports - The structure of the progress and status report is very similar to a proposal.

Title Page -

- Title of the project
- Name of the beneficiary and the name of a contact person
- The name and affiliation of the authors
- Date
- If applicable, writers use letterhead stationery for memos.

Summary - Summarize the background of the project briefly, what are the objectives, and what is the status and progress of the planned activities. The reader wants to know if the project is proceeding as scheduled and budgeted. The summary serves as an advanced organizer and an overview of the entire document.

Introduction - Most of the information in the Introduction of a report can be taken from the proposal. An explanation of the problem and the

purpose of the suggested activities can be repeated. Provide a list of the tasks that you were supposed to do. Conclude the introduction with an advanced organizer of the proposal.

Results - Two organizing patterns are frequently used in progress and status reports: i) the time pattern, or ii) the task pattern. In the time pattern you describe all the work that has been completed and summarize the future work. In the task pattern you explain the work that has been accomplished by each task. The task structure used in the proposal should be used in the report as well. You may start with the following statement: "Here we present the completed work on Tasks 1 and 2, the status on Task 3 and then we discuss our future work: Tasks 4 and 5."

If the news in the report is good, convey your optimism. If the news is not good, you should share the problems that have arisen and assess whether you will be able to meet the objectives both in the schedule and costs. In some situations, the reader might direct you toward possible solutions or you might negotiate a revision of the original objectives in the proposal. In this section, you also discuss the work that lies ahead. Future work can be written in the same way as in the proposal, but you now have a better perception for the schedule and budget.

Updated schedule -The figure 4.13 represents an updated schedule. The dark cells stand for accomplished tasks, while the lighter cells denote future work.

Weeks	1	2	3	4	5	6	7	8	9	10
Tasks/ Dates	30-Jan	6-Feb	13-Feb	20-Feb	27-Feb	6-Mar	13-Mar	20-Mar	27-Mar	3-Apr
Task 1										
Task 2										
Task 3										
Task 4										
Task 5										

Figure 4.13: Updated task schedule in a progress report

Conclusion - The conclusion section briefly summarizes the status and the progress of the project that is explained in detail in the Results section.

References - This section usually begins on a new page. The reference list should follow the uniform style pattern.

4.7.2.2. Final or recommendation reports

The final report or completion report is the last report in the chain of documents starting from the project proposal. The main purpose of the final report is to summarize the outcomes of the project. It documents the success of the project, project performance (schedule and budget), unexpected circumstances, problems and the actions taken to overcome them. Here, we also focus on recommendation reports. Like progress or final reports, recommendation reports contain information and facts about the accomplished activities followed by suggestions and recommendations to the reader.

A typical report consists of three parts: the front matter, the body and the back matter. Table 4.1 explains the typical elements of these parts [9].

Table 4.1 Section organization in a final or recommendation report

SECTION	ELEMENTS OF THE SECTION
Front matter	Letter of transmittal
	Cover
	Title page
	Abstract
	Table of contents
	List of illustrations
	Executive summary
Body	Introduction
	Methods
	Results
	Conclusion
	Recommendations
Back matter	Glossary
	List of symbols
	References
	Appendices

Front matter - Letter of transmittal. The letter of transmittal may either be attached to the report or is placed on top of it. It may have the form of a memo or a letter. It contains the most important details such as the name of the beneficiary and the name of the contact person, the name and affiliation of the authors, date (see the title page of the project proposal) and aims to introduce the reader to the content and the objectives of the pro-

ject. The letter of transmittal should list the used methods, main findings and further recommendations. It is very common even for internal reports since it briefly introduces the primary reader to the subject of the report.

Cover. If the cover is part of the report it should contain the title of the project, the names of the authors, date and logo of the organization.

Title page. The title page contains all the information from the cover page. In some cases it can also include the project number.

Abstract. The abstract is a brief summary of the report. It has either a descriptive or informative form. A descriptive abstract usually does not provide the main findings, but introduces the reader to the subject of the report. An informative abstract provides more precise information about the objectives, findings and recommendations of the report. The abstract usually contains no more than 250 words. If you are not sure which kind of abstract to write, chose the informative one.

Table of contents. This section is very useful to the reader, since it helps him/her to find the information he/she needs. In order to have a helpful table of contents do not make only generic headings, for example: Introduction, Methods, Results, Recommendations, etc. Combine generic and specific headings, such as: Results of the... or build more subheadings of the generic headings. When adding page numbers keep in mind that the front matter is numbered by Roman numerals (i, ii, iii, etc.) and the title page is not numbered. Arabic numerals start from the body of the report (1, 2, 3, etc).

List of illustrations. This section contains the list of figures followed by the list of tables. You will call it List of figures or List of tables if the report contains only figures or tables.

Executive summary. The executive summary is a brief summary of the report addressed to managers. It differs from the informative abstract since it focuses on the management implications of the report and contains two major parts: i) the background of the problem that you were solving, and ii) the major findings and recommendations. In both parts be as specific as possible keeping in mind that the best proof of improvement is in the form of costs and savings using monetary terms. If you are not sure how long the executive summary should be, you can calculate it as 5 percent of the entire report. For a report under 20 pages it should not exceed 1 page [9].

Body of the report - A typical report usually contains the elements listed in Table 4.1. However, you may include some other parts in different order from the one suggested here.

Introduction. This section provides the reader with the following information: i) the subject of the report, ii) the purpose and the background of the studied problem (identify the problem and opportunity), iii) describe your methods of research (primary and secondary research), iv) summarize

your principal findings, v) summarize your recommendations, vi) give an advanced organizer of the report. If the report follows the proposal, it is ethical and efficient to reuse all the information listed here from the proposal.

Methods. This section explains how you performed your research in a technical manner. It provides sufficient details and enables the reader to understand the method and to repeat it if necessary. If you explain the methods by each task, follow the same organizing pattern as in the proposal.

Results. The Results section collects the data obtained during the project by applying the approach explained in the Methods section. The Results are a suitable mixture of text, tables and illustrations which enable the reader to follow the author's thoughts. A good practice is to explain in the text what was found, and then to back it up with the data shown in tables or figures. In that way the readers will not be left to interpret the results themselves. It is important that both the tables and figures should be capable of standing alone, which means that figure and table captions must contain sufficient information. In this section the results are commented or interpreted but the main conclusions and recommendations are left for the further sections.

Conclusions. The Conclusions explain the main results of the research in terms of the objectives and implications. You will not discuss the results any longer, here you will explain what the results mean. If your investigation was based on analyzing different options you should draw conclusions about each option. You may choose one of the following ways: i) to rank all the options, ii) to classify the options as acceptable or unacceptable, iii) to present a compound conclusion (the first option is the best value, the second option is technically most appropriate, and so on.

Recommendations. Here you need to send a clear message to the reader what he/she should do. Upon drawing conclusions about each option, you should formulate recommendations. You should judge and recommend the best course of action and give the best advice you can.

Back matter - Glossary and list of symbols. Sometimes the reader is not familiar with all the technical terms used in the report. If that is the case, you can add a list of alphabetical definitions called a glossary, placed before the appendices or after the table of contents. The list of symbols defines the symbols or abbreviations used in the report.

References. The reference list acknowledges your resources of information or ideas and helps the reader to locate and review them. There are many different styles in presenting references, however whatever style pattern you choose, it is important to follow it consistently.

Appendices (or appendixes) are used to unload the body of the text from complicated technical details (large technical diagrams, maps, equations, program source codes, etc.). Usually, appendices are labeled with letters (Appendix A, B, etc.).

Here we present a typical report. However, your report may include some other sections, parts or different order from the one suggested here.

4.7.2.3. Lab reports

Scientists or researchers usually record their work in notebooks or use software to record data. However, if they want to communicate the results of their work with others they must be capable of writing a concise and persuasive report to convince the readers that their findings are valid. A lab report contains almost all the elements of a scientific paper, which means that a good lab report can lead to a good scientific paper. The most important elements of a lab report are [9]:

- Title
- Abstract
- Materials and methods
- Results
- Discussion
- Conclusion
- References

Here are some brief tips for writing lab reports for undergraduate science and engineering courses.

Title. The title should be as straightforward as possible, informative and concise. It should be specific enough to differentiate your research from the research of others. Underscore "novelty" if possible.

Abstract. The abstract needs to provide the following information to the reader: the motivation, aim and purpose of the work; summary of the essential methods; summary of important results; the main conclusions and implications of the research.

Introduction. The introduction defines the problem. In the first part of this section you need to justify the needs for your research, to emphasize why your research is important. It should contain a concise review of previous research in this field. You must indicate a gap in previous research and place your study in the same context. When you occupy the gap, you proceed with a brief explanation of your methods and principle findings.

Materials and methods. This section indicates how you studied the problem. Give a complete description of all the methods used enabling the reader to reproduce your results. Describe your procedures, including all relevant conditions (temperature, pressure, dates, times, instrument set-

tings, etc.). Organize the methods logically by tasks or chronologically. The materials and methods section in which the passive voice usually overrides the use of active voice.

Results. The result section provides the answer to the question: What you found and what does it mean? When summarizing your results, combine the text with tables and figures. The text tells the story, while the tables and figures support the evidence and underline the point. Do not overload the report with data following the rule "too much information kills information". Number the figures and tables according to their appearance. Provide complete titles of the tables and figures which enable them to stand separately from the text. Do not interpret your results in this section, just present them with accuracy, brevity and clarity.

Discussion. The discussion section is where you interpret your results. Organize the discussion section starting from the most important findings. Support the answers with the results, discuss both the expected and unexpected findings, identify the weaknesses of your work, confront them with the literature. Summarize the principal implications and recommendations for further research.

Conclusion. This section enables you to persuade your audience once again why your research is important. Begin by restating the hypothesis, continue by summarizing the major results and the most important implications of your findings. Consider suggesting further research on this topic.

References. List all the literature sources that you used in your research. Make sure there is correspondence between the references in the text and the list. There are several different styles to present references. The most commonly used system in the text is the "author-year" system. You can also number each reference according to its appearance in the text. Whatever style you choose, be consistent.

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CHAPTER 5: Career Starting and Planning

Zenan ŠABANAC[9], Emir KURTIĆ[10], Nina BEGOVIĆ[11], Saša MADACKI[12]

ABSTRACT: This chapter explores specific areas of career development focusing on pre-employment phase (preparatory stage) which is characterized by careful (re)examination of desired field of engagement, desired outcomes and timeline forecasted for completing goals defined. This should be accompanied by abilities to write successful curriculum vitae and targeted application letters. Evidence based approach to achievements of researchers over time is essential to document personal and scientific growth which is contained in Research Portfolio. Defining this documentation set is prerequisite for rewarding employment seeking and notable performance at job interview. At the end of chapter transfer of created documentation to social networks is explored.

KEYWORDS: researcher, carrier, planning, employment.

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Contents

5.1 Setting Career Goals

According to Merriam-Webster dictionary, 'career' represents a speed in a course/ race ("ran at full career") [1]. The word's different historical roots (from Middle French *carriere* "road, race course"; from Old Provencal or Italian *carriera*; from Vulgar Latin (*via*) *cararia* "carriage (road), track for wheeled vehicles"; from Latin *carrus* "chariot") all led to the "modern" context: sense of "course of a working life" first appeared in 1803 [2]. These contemporary meanings of the word 'career' are also given in the dictionary [1]:

- A field for or pursuit of consecutive progressive achievement especially in public, professional, or business life;
- A profession for which one trains and which is undertaken as a permanent calling.

As any pursuit, a career starts with goal setting: what is it you want to achieve, where do you want to go? In a career management model, four steps are specifically outlined:

- Development of overall goals and objectives;
- Development of a strategy (a general means to accomplish the selected goals/objectives);
- Development of the specific means (policies, rules, procedures, and activities) to implement the strategy; and
- Systematic evaluation of the progress toward the achievement of the selected goals/objectives to modify the strategy, if necessary.

At this point, we are focused on the step 1: development of overall goals and objectives.

As Benjamin Franklin has put it, "If you fail to plan, you are planning to fail!" Planning what's next, which move to make, which step to take, which path to follow is a quintessential task for any person wishing to succeed, not to mention young aspiring researcher. Unless one knows his final destination, it is hard to say which move, step, path... is the best choice. The acknowledgment of the final destination, the idea of goals one wants to achieve, is therefore a prerequisite for a successful endeavour, a prerequisite for a successful career. In other words, setting career goals makes successful career ever more possible.

But how does one set career goals?

Career goals are, obviously, about young researcher's wanted, expected, desired achievements in his/her career:

- What do I want to achieve?
- By when do I want to achieve it?
- How do I want to achieve it? (Which assets do I need to achieve it?)

- Where do I want to achieve it?

Even though many authors won't mention it, we believe it is necessary to emphasize the importance of one more question a young researcher should decide on:

- WHY do I want to achieve it?

The first four questions are about crystallising your goal(s) – making them as clear as possible in terms of scope, time, means, and place. The fifth question is about internal or so-called intrinsic motivation – about an inner desire, drive, fuel which galvanizes our aspirations. If one's WHY is strong enough, the grounds for the goal achievement are solid.

However, at this point we will not deal with the question WHY for several reasons. Most obvious among them are:

- the WHY can take many forms and it would be hard to classify it in certain groups;
- unlike WHAT, WHEN, HOW/WHICH and WHERE, the WHY is not technical at all – it is a question of sense and thus extremely hard to establish any rules related to answering this question;
- the answer to the question WHY is usually rather intimate and many are not ready to share it.

As mentioned above, we will not deal with it within these pages, but we strongly suggest any young researcher to take some time to question his/her reasons for pursuing any career. Within his/her reasons many important answers could be found.

5.1.1 Simple Steps

According to Randall S. Hansen of Quintessential Careers, a career advising web-based platform, there are five simple steps on the way to articulating a career goal, a sort of a vision statement, that can energize you:

- Carve out a chunk of time;
- Review your core values and goals ('THE GOALS');
- Suspend logic and pragmatic thinking;
- Try one or more of these visioning exercises to help get your creative juices flowing; and
- Put it all together [3].

Carve out a chunk of time. - .for envisioning your career. In other words, take your time for this important assignment. Remember, you are dealing with your career – a long-term endeavour which will affect your life in so many aspects. Therefore, there is no need to rush. And nobody

can rush you – it is between “You’ and “Yourself”. This is more of a thinking exercise, a pre-condition for the steps to come. It is about clearing your mind and visualizing what would you like to achieve.

Review your core values and goals ('THE GOALS') - As it is true when it comes to organizations, core values are the essential and enduring tenets of any successful individual: a set of few timeless guiding principles. Since they have intrinsic value and importance to this is very individual, they require no external justification. The individual, in this case a young researcher, decides for himself/herself which values he/she holds to be core to him/her, independent of the environment he/she operates in. There is no universally right set of core values. Of course, within academia, some values are expected to be deeply ingrained within the individual. Such is the case with integrity and respect, for example. This category of values is related to general ethics and they are non-negotiable. However, there are values which are not necessarily expected to be part of one's identity but could be found on a young researcher's core values list. An example could be the value of “creativity and innovation”. A young researcher could find within himself/herself that he/she values creativity and innovation in work very much. If this is the case, then he/she should ask himself/herself would he/she ever, under any circumstances be ready to abandon this value in favour of pragmatism or something else. If the answer is no, then this value should probably be on one's core values list. But why would this be important? Well, values help us make decisions rather fast. If a young researcher values “creativity and innovation” and suddenly gets an offer to work on a project which requires no such skills (i.e. of creativity and innovation), nor develops them, but rather just consumes one's time which could be spent on a project in which creativity and innovation could be exercised and/or developed, it is easy to say what this researcher should decide. But without core values being clearly articulated, one might wander around, from project to project, without utilising or developing his/her strong points to its best. A young researcher should, therefore, pay strong attention to articulation of core values. Three to five – no more, no less. This could prove to be a time-, money-, and nerves-saving decision. In the long run, of course. While core values are foundation, an identity issue, goals are about future you want to achieve, future you are aspiring to. Most of the authors suggest a simple procedure for defining your goal(s). Once you have a general idea of what you want to achieve (remember step 1: “Carve out a chunk of time”), you should put it in a S.M.A.R.T. goal form [4]:

- Specific: Rather than defining a general goal (“I want to produce more research.”), a young researcher's goal should be SPECIFIC (“I want to conduct at least two studies a year in the area of organizational

behaviour and publish it in best European journals for this field."). The goal should be specific for a pragmatic purpose: it has a much greater chance of being accomplished than a general goal. When setting a specific goal a young researcher must answer the "W" questions (some of them already mentioned above):
- What: What do I want to accomplish?
- Where: Where do I want to accomplish it?
- When: When do I want to accomplish it?
- Which: Which assets do I need to accomplish it?

- Measurable: If it is measurable, then it is possible to track progress. If it is possible to track progress, it keeps you focused on the goal attainment and provides you with the feedback necessary to take actions in the process. But how do we know if it is measurable? Simply ask questions such as those which start with "How much?", "How many?", or even more direct "How will I know when it is accomplished?". If, in the first case, there is a quantifiable answer, or, in the second case, a clear idea of accomplishment, than your goal is measurable.
- Attainable: Don't be scared to "dream big". The goals you set say very much about you. So, look for goals that will galvanize you, goals you care for, and goals which once achieved would make you feel very proud of yourself. Let the heart speak. Once you identify goals you most deeply care for, you will see how you suddenly begin to look for ways to achieve them. So, when we say "ATTAINABLE", don't interpret it as "modest". Most of the goals are not attainable in the very moment of their creation (otherwise those wouldn't be goals), but they are attainable in the future if you decide to work on your attitudes, abilities, skills, and financial capacity to reach them, which are attainable in the present.
- Realistic: A realistic goal represents an objective toward which you are both *willing* and *able* to work. Again, do not interpret "REALISTIC" as "not-so-high-a-goal". When setting a goal, keep in mind a quote by Henry Ford: "Whether you think you can, or you think you can't – you're right." You create your own reality. Therefore, a realistic goal is rather individual thing.
- Timely: Last, but not the least, to create a sense of urgency, a goal should be set within a time frame. If there is no "deadline", you will most probably just procrastinate and delay your work on the goal you have set. The "deadline" puts you into action and guarantees progress from the very beginning.

Suspend logic and pragmatic thinking - If you start to rationalize your goal, it is an excellent way to make goal which will not be a goal of your heart. Such a goal will produce no drive, no energy, no motivation. You

will delay, procrastinate, and work on some other issues, and if you, by some miracle, decide to put some effort in your "sterile" goal, it will most probably be a lousy effort. Eventually, your goal will be abandoned, unfulfilled, incomplete. That is, unfortunately, a story of so many goal-setters. They wanted to be rational and pragmatic. They ended up doing some work they dislike, but the work which they never ended since they never did it wholeheartedly. You will find so many of them around you. Goals do not need logic and pragmatism. Goals need courage and audacity, boldness and spirit. That is the fuel of the goals. No energy in your goals – no goals attained. Suspend logic and pragmatic thinking. Allow heart and passion.

Try one or more of these visioning exercises to help get your creative juices flowing - And to allow heart and passion in your goals, think of these questions:

- What would you want to do today if money was no issue for you (i.e. if you would have more than enough of it to cover all your needs and desires)?
- If you had the power to make your career any way you wanted, what would it look like?
- What would you most like to achieve in your career if no obstacles stood in your way?
- What is the one activity you most like and is it part of your career? If not, how can you make it part of your career?
- Where would you like to be career wise in five/10/15 years?

Put it all together - In no more than a paragraph, put your career goal. Take everything you've read above. Put your whole heart in the paragraph. Make it. Own it. Feel it. When you do it, try a simple test. Ask yourself: Does this motivate/energize/galvanize me? If the answer is yes, than you'll know you're on the right path. If no, remember step one. And do it all over again.

5.2 Career Planning and Management

Career planning could be defined as the ongoing process of contemplating about your interests, values, skills and preferences, researching the available life, work and learning options, caring about a fit between your personal circumstances and your work, and continuously adapting your work and learning plans to help you manage the changes in your life and the world of work [5].

The career planning process has four steps [6]:

- knowing yourself – identify information about yourself;

- finding out – identify information about options;
- making decisions – targeting your employer; and
- taking action – action planning.

The combination of a structured planning and the choice of one's own professional career could be defined as career management.

You - The first step is in direct relation to the goal setting process and the step one of this process: take your time. Once you have defined your goal, you should approach the evaluation of your personal skills, preferences, abilities and other factors which will tell you how far you are from your goal.

Your options - Step 2, finding out your options, is about exploring the vocations and occupations of your preference. It is a sort of a "mining" work – you need to dig up a lot of information on occupational prospects through general secondary data collection, as well as informational interviewing of professionals already working within occupational boundaries. This process will help you eliminate many, if not most of the occupations and vocations from the original list. By eliminating those you are definitely not interested in, you will narrow your options to just a few of them which you might pursue. The next logical move is to thoroughly examine each of the occupations which are potentially yours. This deep examination is about researching the specific skills and qualifications required for those occupations. Once the list of "requirements" is complete, you should put those occupations in perspective of your own skills and qualifications:

- Do my skills and interests match with those expected among professionals in these occupations?
- Which expected skills do I lack?
- How can I make up for it?

Again, answers can lead your way. Some of the paths which will be laid in front of you just by answering these questions will right away become less interesting since the gap between owned and expected skills will be huge and the idea of filling this gap will be found unattractive. Eventually, your list of preferred occupations and/or learning options will get even more narrowed.

Your potential employer - When your list has been narrowed to the point where no further elimination is possible and all the options on the list look and sound attractive, you will have to make a decision, or, precisely, make a choice. In order to do so, you will start comparing your options and analyzing what fits you best at this very moment. In the comparison process you can ask yourself some of the following questions:

- What are my best work options and how does each of them match with my skills, interests and values?
- What are my best work options and how does each of them match with my current situation and responsibilities?
- What are the pros and cons of each of the options?

However, solely relying on the logical and pragmatic thinking will not help you make a decision with which you can live. Remember, we make decisions on the basis of emotions. Sometimes it can lead us astray. But still, important life questions should always include your heart. Actually, they will. Whether you like it or not. And since it is already in the process, make sure to listen to it. And make a decision. Once the decision is there, you can now look for specific employers within the occupation of your choice. Which of them are among the most desired employer? Where would you like to work the most? It is hard to answer this unless you do some googling and information gathering, and unless you talk to people already working there or have been working there. All these information can help you making the right choice of potential employer. Sometimes, what looks good on surface can prove to be rotten inside. Thus, be careful. Ask the right people. And ask them the right questions.

Your action - Once you have made a decision, take action. Since you have identified your desired employers, it is time to contact them. If they are hiring, it is simple – simply follow the instructions outlined in the job ad and wait for the feedback. If not, make sure to put yourself on their radar. To do so, you'll have to do some self-promotion by submitting your materials (CV or resume, motivational letter, recommendations of previous employers, colleagues, partners, and any other materials that might be interesting and serve the purpose of presenting you in the best possible way and within the context). Your materials might be just another application among hundreds, even thousands of other already submitted. Find a way to stick out if you want to stand a chance of being noticed in a pile of applications (use specific colour, format or texture of your paper, or do something else). But submitting your materials might just not be enough. And you shouldn't stop there. Visit the company/ organization/ institution and arrange a meeting. Meet the decision-makers, if possible and present your case. And don't give up after one or two rejections. It sounds easy-to-say, but what other options you have? You simply have to take the reigns in your hands. If you don't do it is hard to expect something to happen by accident.

This four-step model is not a single-use procedure. It is something you should do from time to time during your career, but especially whenever you are at a sort of crossroad: when you need to make a game-changing

decision of following the current path or pursue a new one. It is wise to revise your values from time to time. Our values change during our lifetime. And several times so. Things we value as a young researcher might (and probably will) change when we step into the next phase of our lives and careers. Since values are foundations of our personal and professional lives, whenever they change, it is tectonic. Our whole world changes and we need to see where we stand and do we still want same things. The final outcome of this process might not necessarily end up as a need for a huge change. But it is still a change. And this change just might dictate new decisions to be made. Instead of making this process visible, rather make it smooth. It is possible to do so by staying engaged in your own professional development on a daily basis. Keep yourself informed about the industry and stay connected with other professionals in your network. That way you will notice changes in the industry earlier but also changes in your values.

Instead of conclusion, as Valentich and Gripton argue, success could be defined as managing one's career effectively through the attainment of wanted positions and other rewards. A successful career management should result in personal fulfilment, work/life balance, goal achievement and financial security [7].

5.3 CV Preparation

In this chapter we will present a short guide to developing your curriculum vitae (CV). We will focus on applying for jobs in academia and/or research oriented institution. However, principles discussed here are common for other types of CV and can be used accordingly (for more information see [8]).

First of all, CV is a comprehensive statement of somebody's educational background, teaching and research experience, and administrative activities. The purpose of a CV is to show a prospective employer that you have the necessary qualities and qualifications to do the job you're applying for.

Before you start with writing a CV, first read a job description and think about yourself. Ask yourself why you are the right person for that job. Your CV has to convince the employer that you are the right person for a job.

Next step is drafting your CV. Here are the types of information that a CV may contain. It depends on position you are applying for:

- Contact information – Here, include your name, address, phone, fax, and e-mail for home and office, if applicable;

- Education – Indicate your major, type of degree, and the date each degree was awarded for each postsecondary school attended. Sometimes you'll include information about secondary and elementary school attended. Eventually you'll include titles of master theses and/or PhD dissertations, and names of your mentors/supervisors. If you haven't yet completed your degree, indicate the expected graduation date and name of your supervisor and his/her title and position;
- Honours and Awards – List each award, granting institution and the date awarded;
- Teaching Experience – List any courses/modules that you assisted with as a teaching assistant, co-taught, or taught independently. Note the institution, role held in each, and supervisor, if applicable;
- Research Experience – List assistantships, practice, partnership and other research experience. Include the institution, nature of the position, duties, dates, and supervisor and main researcher/leader of particular research activity you have participated in;
- Statistical and Computer Experience and Knowledge – This section is especially relevant for research-oriented positions/jobs. List courses that you've taken, statistical and computer programmes with which you're familiar, and data analysis techniques with which you're competent;
- Professional Experience – List relevant professional experience such as previous jobs not directly related to your teaching and/or research experience, administrative work, and part-time jobs. Include the institution, nature of the position, duties and dates;
- Grants Awarded – Include title of agency, projects for which funds were awarded, and money amounts;
- Publications – List all your (scientific or research) publications in case you are applying for a job in academia. Include articles, chapters, reports, and other documents. Document each publication in the citation style appropriate for your scientific or research discipline. If you are applying for job in research institution you may make a selection of publications which are most relevant for a position you are applying for. In that case, you can add annex to your CV containing list of all publications or provide a link where it can be seen;
- Conference Participation and Presentations – Similar to previous section, list all or most important conferences you participated at. In case you had poster or oral presentations, separate this category into sections for posters and papers and use the appropriate documentation style for your discipline;
- Professional Activities – List service activities, committee memberships, administrative work, lectures you've been invited to deliver, professional

workshops or trainings you've delivered or attended, editorial activities, and any other professional activities in which you've engaged;

- Professional Affiliations – List any professional societies with which you're affiliated;
- Language(s) – List all languages you are familiar with and describe language proficiency, starting with the highest level of proficiency. Commonly used descriptions for language proficiency: native speaker, near native/fluent, excellent command/highly proficient in spoken and written (name of language), very good command, good command/good working knowledge, basic communication skills/working knowledge. You may also use the Council of Europe's Common European Framework of Reference for Languages (CEF) [9] which provides a comprehensive and transparent system for describing levels of language proficiency and for the easy comparison of language qualifications. The system describes what a learner should be able to do in listening, speaking, reading and writing at six levels of language proficiency as follows: proficient user (C1, C2), independent user (B1, B2) and basic user (A1, A2). The CEF enables you to give differentiated descriptions of your individual language skills. For example, you can say that your level of proficiency in writing English is B2, whereas you're spoken English is C1. A more detailed version of the CEF is available at the Council of Europe website [9].
- Soft skills – List all useful abilities/skills that cannot be easily seen in the previous sections such as: communication skills, organizational skills, teamwork, critical thinking, social skills, creativity, interpersonal skills, adaptability, friendly personality, and so on;
- Research Interests – Briefly summarize your research interests;
- Teaching Interests – List courses you're prepared to teach or would like the opportunity to teach;
- References – Provide names, phone numbers, addresses, and e-mail addresses for your referees. Ask their permission beforehand.

Present items chronologically within each category of the CV, with the most recent items first.

Read it again. Be sure that you did not forget something. Don't leave empty sections. If you are not forced to use provided format by employer, erase empty or irrelevant sections. In case you use given CV format, put N/A (not available/applicable) rather than left blank.

Update your CV frequently. The best is to keep it 2 to 4 pages long. If you do not need full CV, you may use resume (up to 2 pages long) instead of CV.

Example of Academic CV

Marko Marković

Street Dositeja Obradovića 222/IV
11 000 Beograd
Serbia
Mobile Tel. No.: +381 99 999 9999
E-mail: m.markovic@emailaddress.com
Nationality: Serbian

Education

PhD in Computer Science

2011 – 2014

University of Belgrade, Faculty of Mathematics, Department of Informatics

Dissertation: "Fuzzy Logic and Neural Networks"

Mentor/supervisor: Prof. Dr. Savo Savic, academician

Key features of research:

- Deriving fuzzy rules from trained RBF networks.
- Fuzzy logic based tuning of neural network training parameters.
- Fuzzy logic criteria for increasing a network size.
- Realising fuzzy membership function through clustering algorithms in unsupervised learning in SOMs and neural networks.
- Developments of algorithms.
- Representing fuzzification, fuzzy inference and defuzzification through multi-layers feed-forward connectionist networks.

MSc in Applied Mathematics

2009 – 2011

University of East Sarajevo, Faculty of Philosophy, Department of Mathematics and Informatics

Thesis: "Fuzzy Logic and Decision Processes"

Mentor/supervisor: Prof. Dr. Niko Nikic, full professor

- Selection of an appropriate family of parameterized membership functions.
- Interviewing of human experts familiar with the target system to determine the parameters of the membership functions used in the rule base.
- Refining the parameters of the membership functions using regression and optimization techniques.

BSc Mathematics

2005 – 2008

University of East Sarajevo, Faculty of Philosophy, Department of Mathematics and Informatics

- Basic mathematical studies, mathematical analysis, algebra, geometry, topology, programming, networks, intelligent systems.

Research Interests

My principal research interest is in the field of data analysis and data modelling, mathematical and statistical modelling, as well as neural networks, simulation, algorithm design, decision analysis, development and application of various software packages.

Teaching Experience

University of East Sarajevo, Faculty of Philosophy, Department of Mathematics and Informatics

Teaching Assistant and Lab Demonstrator

2008 – 2014

- List courses and skills developed

Professional/Industrial Experience

Company Computers and New Ideas

2014 – present

- Development of software
- Decision making algorithms development
- Modelling and prediction of human behaviour

Academic Prizes

- UNES Faculty of Philosophy Dean Prize for academic year 2007/8 for excellent achievement during undergraduate studies.
- UNES Rectors Prize in 2011 for excellent achievement during undergraduate studies.

Skills

IT skills: experienced in programming in C++, Java, Python, PHP, Visual Fox Pro 5, proficient in MO packages, UNIX and LINUX operating systems, use of database packages.

Team-working: member of software development team, monitoring creation of algorithms and reporting to team leader.

Problem-solving: working across different areas in mathematics, computer science and decision processes, demonstrated independent thought in analyzing problems and developing and using suitable strategies and techniques.

Languages

Serbian – native speaker

English – writing B2, speaking C1

German – writing B2, speaking B2
Professional Affiliations
Chair of UNES and member of UNBG alumni association.
Member of Balkan Mathematical Society.
Member of European of Association of Computer Scientists.
Publications
Include journal articles, conference papers, and presentations.
References
Available on request

5.4 Application Letters

When applying for certain job, the application letter, or the cover letter, is the most important part of your application. It is a document filled in by applicant used to convince employer that you are the right person for offered position (job). A good application letter will attract employer's attention and motivate employer to read the rest of your application (CV, bibliography, references).

In general, an application letter should be no more than two pages long. Keep it formal and professional and try not to repeat items from your CV unless you include some additional context for repeated items. An application letter should demonstrate your enthusiasm for advertised job and should answer the question "Why should we give you this job?" [10].

Traditionally, application letters are written in paragraphs (or sections), and most of them follow this pattern:

- Address and salutation: give your name, address, contact phone number and email, date, address letter to a named person or relevant body (Dear Prof. X or Dear Committee Members);
- First paragraph or Introduction: explain which job you are applying for, how you heard about it, and give some brief background on who you are in terms of your research interests and education background;
- Middle section or Dissertation paragraph: give an evidence of how you meet the top criteria for the role, with brief illustrations of your research and your latest achievements. Make sure you emphasize the most important aspects that fit the particular job ad;
- Final section: explain what attracts you to this job and how it fits in to your career plans as a researcher or member of academia;
- Conclusion: a conclusion summarising what makes you suitable for the job. You may express your interest in an interview, or a chance to meet to discuss your qualifications and the open position. Finally, thank the employer for his or her time and consideration.

Before you start writing application letter, read carefully the job ad. Do little research and explore what are strengths and weaknesses of the institution you are applying for. Think about your motivation to get a job there. Why you should apply? What are potential benefits for you? How can you contribute to the institution? What they will benefit from you?

For example, if you have strong research qualities, but your teaching component is less developed, you may find applying for job in academia as a potential benefit to develop your teaching capacities. An institution may benefit from your research potential. You feel highly motivated to start your academic career and you should apply for it.

Then you should think about yourself. Which words best describe you? Rebecca Corfield suggests to pick up to ten words from the list on figure 5.1 [11].

flexible	articulate
calm	organized
punctual	tactful
sensible	alert
quick to learn	reliable
practical	cooperative
polite	loyal
lively	responsible
dedicated	versatile
creative	good at keeping to deadlines
confident	able to work under pressure
approachable	hardworking
assertive	capable
accurate	thorough
perceptive	able to work alone
consistent	good team member
innovative	committed
careful	good at managing others
strong	competent
direct	humorous
adaptable	decisive
bright	enthusiastic
thoughtful	cautious
imaginative	patient
dependable	dynamic
friendly	methodical
outgoing	self-motivated
serious-minded	sensitive
quick	honest
buoyant	cohesive

Figure 5.1 Which words best describe you? [11]

The same author suggests the following words shown on figure 5.2 to describe your experience.

coordinating	inputting
computing	growing
caring	advising
persuading	recruiting
establishing	performing
serving	leading
travelling	developing
diagnosing	filing
assessing	sorting
analysing	typing
copying	loading
negotiating	handling
managing	communicating
training	researching
teaching	selling
memorizing	inventing
deciding	recording
checking	stocking
compiling	delivering
carrying	playing
helping	working
mending	making
problem solving	monitoring
evaluating	interpreting
writing	selecting
reading	translating
cleaning	supervising
driving	planning
drawing	enabling
liaising	changing

Figure 5.2 Words to describe your experience. [11]

Think about these two groups of words and then draft your application letter following the given composition of paragraphs. When you are done, read it again and revise it if you feel you have to do it. Keep it maximum two pages long.

Attach your CV, references and check the whole package once again. Good luck with your application!

Example of Application Letter

Marko Marković
Street Dositeja Obradovića 222/IV
11 000 Beograd, Serbia
Mobile Tel. No.: +381 99 999 9999
E-mail: m.markovic@emailaddress.com

Date, ...

The Committee on Appointments and Promotions
Faculty of Science
Department of Mathematics
University of Sarajevo

Dear Members of the Committee on Appointments and Promotions,

I am applying for the post of Assistant Professor for Computer Science with your Faculty after seeing the advertisement on your website and Euraxess job platform. You can see from my CV that I hold PhD in Computer Science from the University of Belgrade and that I have spent 3 years working in industry relevant for the computer science field.

I expressed my interest in research and teaching during my graduate studies and worked as a teaching assistant and lab demonstrator at the University of East Sarajevo. Right after obtaining a PhD I stared to work in industry since I wanted to work in innovative environment and to obtain practical experience in using knowledge I gained during my formal education. I took part in several surveys and was a member of project teams working on computer simulations, algorithm design, modelling and prediction of human behaviour using neural networks.

I would love to use my practical skills and knowledge in educating young students and bring my enthusiasm and fresh ideas to your institution. I see your respected institution as a potential for progress in my career in both roles – as a researcher and as a teacher.

I would be delighted to discuss any detail of my application with you or your colleagues at your convenience and would like to thank you for considering my application. I look forward to hearing from you.

Yours sincerely,

Marko Markovic

5.5 Professional Portfolio

Evidence based approach to achievements of researchers over time is essential to document personal and scientific growth. Professional portfolio is not to be seen as expanded curriculum vitae but as document containing reflection on what and how one performs in research discipline that we are engaged in. Probably most comprehensive definition on portfolio is given in the University of California, Berkeley guide "A professional portfolio, in either electronic or hard-copy format, showcases your skills, experiences and accomplishments to a potential employer. A portfolio can help guide your conversation with the interviewer about your professional goals. It can include pieces from your professional work, education and training, volunteer experience and personal interests, and should be updated as you complete more projects." [12] or it can give essential answer to question of your professional achievements as stated by Tumbusch in simple wording: "Whether it's digital or print, your professional portfolio is essentially a collection of work samples that demonstrate your creative skills. Think of it as a 'visual resume' that communicates the message "I have done great creative work for others and I can do the same for you" [13].

Placed in little bit conservative wording, professional research portfolio for postgraduates, as viewed from university perspective needs to demonstrate researcher ability to: "Master sophisticated subject matter; Design a well-structured, relevant and integrated plan of research; Carry out research projects using appropriate methods of investigation and analysis; Identify and critically evaluate the findings and discussions in scholarly literature and other forms of information; Engage in rigorous intellectual analysis, criticism and problem solving; Engage in independent thinking, informed by relevant scholarly literature and other research; Argue and reach conclusions that are informed by independent enquiry and other available information; Use language effectively to communicate research findings and supporting argumentation [14]".

Researchers must bear in mind that portfolio is much more than "just a retrospective account of continuing professional development activities" [15].

Therefore, professional (research) portfolio is composed of the following elements (besides CV or resume with recommendation letters):

- Research statement;
- Research interests;
- Research collaborations;
- Journal articles and articles in Proceedings;

- Grant proposals and approved projects;
- Impact on others (citations).

Research portfolio may be accompanied by statements on activities in voluntary work and personal interests. Also, newspaper articles documenting your achievements are more than desirable.

When you compile all necessary evidence, you may start writing reflective essay which will be placed before all documents and artefacts that you have collected. This essay should provide evaluation of the work in your portfolio in terms [16] of your growth in your knowledge of the disciplines in your fields of research, your ability to integrate these disciplines, your ability to write research papers and analytical essays on subjects in the disciplines in your program, the technological skills you have acquired through your major; your intellectual growth.

Basically, professional portfolio is a snapshot of your career and should be constructed in a way that can speak for itself, and that your possible employer has clear picture on your abilities, past performance, and research talents and proficiencies.

5.6 Interview Preparation

Interview is a standard procedure in most of the job/assignment/ project task offerings. Whenever there is someone looking for some candidates, an interview is a very typical tool to use for assessment of candidates. Interview can take many forms and shapes: from rather informal to strict and very formal, from one-to-one interviews to one-vs.-committee, from structured and semi-structured to rather open-ended and non-linear forms. Whatever form it takes, there are some points shared among most of the interviews, if not all. In other words, in most of the cases, there is a standardized procedure: a typical pattern of how an interview is being conducted by an interviewer or an interviewing committee.

The good news is: if something is standardized or typical in its implementation, one can generally prepare for it. And one can for sure get prepared for an interview. At least for most of them.

A candidate's job during an interview or a set of interviews is to convince a potential employer that he/she has what it takes for the job: the skills, knowledge, and experience. But that is not enough: the candidate must also show drive and motivation, as well as a cultural and a job fit.

According to several top career services organizations, an interview preparation plan is a seven-step process:

- Google the company/ organization/ institution;

- Check the match between your skills and qualifications with the job requirements;
- Prepare your answers;
- Pay attention to what you will wear;
- Keep in mind what you'll bring;
- Keep track of non-verbal communication;
- Follow up.

Google the company/ organization/ institution - When googling the company you should look for background information by visiting its website, checking their products and/or services, as well as their mission. If possible, look for industrial publications to assess company's position, industrial trends and potential changes. A good thing to do would be to prepare two current facts you could cite and two questions to ask during the interview. This is how you most effectively demonstrate your knowledge of and interest in the company. You could also check their mission statement to identify personal qualities the organization might value in potential employees. When you identify them, you should go through your memory and find situations in which aspects of those personal qualities were demonstrated by you.

Check the match between your skills and qualifications with the job requirements - When reading a job description, pay close attention to the expected knowledge, skills and abilities potential employees should have. Make a list and compare it to your own list of personal knowledge, skills and abilities you already possess. It is obvious that you should go after this interview only if you are able to offer most of these. However, even if you firmly believe that you match those requirements, you still have to prove it during the interview. To prepare for this the best way is to use the so-called PAR technique. It is a technique in which a candidate demonstrates his possession of certain skill, ability or experience by using a personal situational example which proves it. The acronym PAR comes from PERFORMANCE OBJECTIVE, ACTION, and RESULT:

- Describe the situation or objective;
- Explain your actions taken for the sake of accomplishing the objective; and
- provide the results of your actions: financial outcomes, time savings, relationships preserved...

Prepare your answers - As mentioned above, each interview includes some typical questions. You might not be prepared for the unexpected questions, but at least make sure to come prepared for the typical ones. By going online you will find hundreds of guidebooks which include huge

lists of questions which might be asked at an interview. Go through these lists and prepare as many answers as possible. You can ask a friend of yours to simulate the interviewer. But you can also practice your answers alone, in front of the mirror or not.

Interview questions usually come in three different categories:

- Resume-based or traditional;
- Behavioural; and
- Case.

Resume-based or traditional questions are usually simple ice-breakers, or show-and-tell type of questions. They can also question your interests and motivation, education and experience, strengths and developmental areas, as well as work situations. Typical examples of traditional interview questions are:

- Tell me about yourself. (*ice-breaker*);
- What can you tell us about our organization? (*show-and-tell*);
- Why should I hire you and not the next candidate who walks in the door? (*show-and-tell*);
- If you had six months ahead with no obligations and no financial constraints, what would you do? (*interests and motivation*);
- Why did you choose to attend University of Sarajevo? (*education*);
- Describe the course that has had the greatest impact on your thinking. (*education*);
- Tell me what you learned from your volunteer experiences. (*experience*);
- What specific skills have you acquired or used in previous jobs that are related to this position? (*experience*);
- What is your greatest strength? Your greatest weakness? (*strengths and developmental areas*);
- What kinds of tasks and responsibilities motivate you the most? (*work situations*).

Typical behavioural type of questions are:

- Describe an experience in which you showed initiative;
- What would you do if someone asked you to do something unethical?
- Tell me about a time when you had a personality conflict or disagreement with a supervisor. How did you resolve it?
- Give me an example of how you would motivate a co-worker who was performing poorly on a team project;
- Tell me about an unpopular decision you made. How did you make the decision? If you could handle the same situation again, would you do anything differently?

Finally, case questions are most non-typical of all typical questions since they always include unique situations. However, some examples are given here so you could relate to the potential interview situation you might find yourself in:

- Your analysis of the client's problem leads you to solution X. However, this is not the solution your client favours. Your client likes solution Y. You are convinced that solution X is the most effective plan. What do you do?
- Our client manufactures sunscreen products. It's thinking about entering the hair products market. Is this a good idea? What marketing strategies might you implement?

There are literary thousands of interview questions you might expect and you can never say that you have prepared all of the answers. But if you put some thinking and include some additional effort of talking to people who have already been at the interview with this company, you'll manage to narrow this list for a bit and focus your attention to some questions typical for this specific employer.

Pay attention to what you will wear and keep in mind what you'll bring - Any specific advice here might prove to be counter-productive. Therefore, this is your decision. Keep in mind what this company is about: if you come formally dressed it might be good for you, but it also might create an image of you as being too uptight with some employers. On the other hand, being informally dressed might be a minus with some employers. However, with some employers it might be just the best thing to do. Still, there is probably one thing you will probably not make a mistake with just about any employer: come neat and clean. When it comes to things you'll bring, good idea would probably always be to have some extra copies of your resume on quality paper, a notebook or a tablet – generally any kind of tool for making notes if necessary, and a portfolio with samples of your work.

Keep track of non-verbal communication - It could take dozens of pages just to discuss non-verbal communication at the interview: your own, as a candidate, and interviewers'. However, we will just focus our attention to several important details:

- If you want them to perceive you as a confident person, then look like one: handshake firmly, smile, establish and keep eye contact. They will see what you project. Therefore, project some good vibes;
- Sit up straight, but not uptight – stay relaxed as much as possible;
- Respect their space – sit where you are supposed to sit and just behave as a normal person would behave in a formal situation;

- Be generally respectful – never roll your eyes, don't interrupt them, manage your tone.

Keep in mind that what they see is very often more important than what they hear. Therefore, they need to SEE a confident, respectful individual, not HEAR. Choose your words but never forget that words always come in the overall context of you. Be congruent.

Follow up - At the end of a typical interview, they will ask you if you have any questions. Be prepared. Some questions you might ask at the interview are given here:

- What does it take to be successful in this company?
- What are the three most important day-to-day responsibilities of the job?
- Are there the opportunities for promotion and advancement?

Be aware that your questions will, just as much as your answers, tell a lot about you. Therefore, don't forget that you are directing their perception of you by posting this or that question. Choose those questions wisely.

5.7 Employment Opportunities

Fulfilling a scientific career may go in a lot of different directions. Researchers were used to be perceived only as scholars linked to the world of academia. The world has changed immensely since this was the case, and we have been living the time of knowledge-based economy in which the skilled researchers are present in the labour market as same as any other professionals. This is the time in which doctoral graduates are potentially a key factor in creation of innovation and development of economy, and in which doctoral studies, being on the top of the ladder of education system, offer advanced and specialised forms of education and training, providing graduates with capacities and skills to carry out high quality research and contribute in different roles throughout the economic world, as well as to meet the challenges of our society [18]. The employment opportunities for such candidates should therefore be vast. Government labs, industry, start-ups, would be to name just a few from among research jobs the researchers can choose.

Broad horizons of employment opportunities for researchers are best illustrated by the internet sites and social networks offering literarily a sea of not only employment opportunities, but virtual guides and advices how to forward on in a researcher path towards their first, new, or any different job within their road of fulfilling the scientific career. “PhDs go into multitude of career sectors” states a review of the UK Higher Education Statistics Agency’s survey on UK post-graduates, citing that the market for

PhDs is enormous and the options are huge, varying in type occupations as well as destinations [19].

An Academic Career may seem as logical pathway for young researchers being in their doctoral or post-doctoral training. This would include "climbing" through academic positions of assistant lecturer, senior lecturer, associate and full professorship, which is of course far from the only path or opportunity one has or should consider after doctoral or postdoctoral studies, particularly having in mind the increased number of PhDs entering the labour market not followed by the increase of jobs in academia, which produces the situation of "lack of room at the top" in the academic world [20].

Scientific career outside academia can be even more challenging and rewarding. "In fact, PhDs working in industry list many advantages to seeking a job outside academia... among them are better job security and pay, interesting work colleagues, and more chances to be promoted [21]".

Of course the career in academia or outside it, regardless of whether it is industry or something else, must not be considered as divided, separate, and without any connections. It is the very collaboration between the academia and the industry that drives innovation and development. The researchers pursuing careers and doing research in both of the sectors at different points of their career are potential factor of contribution to better collaboration between the two sectors.

The work of researchers, their efforts, and contribution to innovation, economy and society development in general has been given a lot of thought and attention by the decision makers in Europe. In March 2005, the European Commission adopted the **European Charter for Researchers** and **Code of Conduct for the Recruitment of Researchers** [22] setting out the roles and responsibilities of researchers, and their employers and funders, as well as ways to make recruitment fairer and more transparent. This action reflects clear intention to contribute to the advancement of the European Research Area, and the emphasis is on ensuring that there is a good supply of researchers to the labour market outside the academic world [18].

When considering opportunities available for researchers pursuing a scientific career, apart from academic career already mentioned, one might among others think of the following [23]:

Higher Education Institutions – in which, apart from academic career already mentioned, possibilities for researchers might include positions at the institutes in various fields, but also expert positions in the fields of technology transfer, research funding, or research management.

Government/public Sector could be considered as an employment opportunity for those looking to stay in the motherland and serve it by

doing research in public policies in national institutes and agencies, or pursue some scientific work in governmental laboratories. Also, at the EU level, the *JRC – Joint Research Centre* should be mentioned which is the European Commission's science and knowledge service, employing scientists to carry out research in order to provide independent scientific advice and support to EU policy [24].

Consulting in for example information technology, finance, human resources, law, pharmacy/biotechnology, engineering or many other different fields also seems acceptable in terms of employment opportunities for researchers.

Private Sector/Entrepreneurship/Start-ups – would include:

- working "in industry" or in other words working for private companies/ organisations doing research (such as the ones in pharmaceutical/ biotechnology sector, engineering, IT, or food production to name just a few);
- having or developing an idea/product from the begging phase to market readiness and investing own resources to realise this path; and
- consulting others in doing so – setting up their own companies.

While some of the possibilities, whether or not suitable to someone's interests, may seem scarce or even odd in a given country or continent, these are often quite common elsewhere in the world. And the possibilities are indeed many, diverse, and dispersed in different parts of the world. They should all be considered and evaluated, considering at the same time one owns needs, skills, and desires. Evaluating the full range of options for researcher's career advancement therefore requires a lot of time and consideration, but knowing which job suits you best should make mapping your options an easy task.

5.8 Research Jobs Offers

Once the opportunities have been examined, let us find a job! Regardless of whether one decides to pursue an academic career or continue in industry, governmental/non-governmental sector, or go any other appropriate career path, there are on-line platforms available as well as the EU initiatives that can help a young researcher grasp the amount of jobs offered.

Some of the on-line platforms for job search and assistance to researchers in the EU include:

- Academicpositions.eu (https://academicpositions.eu) – the European career network for academics, researchers, and scientists;

- Academics.com (https://www.academics.com/) – offers a variety of relevant articles to advance your career. Here you can find information on funding, salaries and alternative career paths outside of academia in Germany, Austria and Switzerland.

In the United States:

- Science Careers of the Sciencemag (http://www.sciencemag.org/) offers a wide variety of content designed to assist scientists of all disciplines, backgrounds and experience levels navigate their career path. This includes thousands of job listings that are updated daily, thousands of career advice articles providing all the necessary career resources for scientists as well as effective recruiting solutions for employers.

When in search for a job offer, researchers should also be aware of the *EURAXESS* (https://euraxess.ec.europa.eu). ***EURAXESS* – Researchers in Motion** is not just another web based job-search platform; this is a unique pan-European initiative delivering information and support services to professional researchers. Backed by the European Union and its Member States, it supports researcher mobility and career development, while enhancing scientific collaboration between Europe and the world. At the Euraxess platform one can find thousands of job offers and funding opportunities. More importantly this platform provides researchers with free assistance when changing countries for work [25].

The Euraxess is useful for researchers in any stage of their career. Researchers just starting a career can find a job, find funding opportunities, search information on how it is to live in another country, get help with the move (including family related issues), and get help in connecting with other researchers. Experienced researchers can post job vacancies, find a good candidate to help them with their work, find funding for projects, and understand better rights of researchers.

This platform develops its activities under the following key services**:**

- Jobs and Funding– a recruitment tool where no charges apply. Researchers can find a wealth of constantly updated information on job vacancies, funding opportunities and fellowships throughout Europe. Posting their CV will allow recruiters to find them. Companies or research institutes can post vacancies free of charge and search for the CVs of excellent international researchers. Users can also directly access the national Euraxess portals of the partner countries which contain information on research job and funding opportunities, as well as on personalised services in each country. Apart from jobs, funding opportunities, grants, employment, listing thousands of vacancies and fellowships from more than 40 European countries and other regions in the world, and over 5 000 research organisations, companies, universities and SMEs regis-

tered on the Euraxess, this platform also promotes creating better working environment by informing researchers and employers about their obligations and rights through several EU initiatives aimed at making research careers in Europe more attractive. The Euraxess also provides support in career development, supporting researchers through the process, with the help of its career development centres, useful information, training resources and many more.

- Partnering service provides you to search for researchers, entrepreneurs or partners to join a consortium and apply for EU funding through the Euraxess database, or in other words to find organisations or individuals for the perfect business match.
- Information and Assistance offers a network of over 260 Euraxess centres around Europe to help you with a range of issues including visa requirements, work regulations, taxation and social security. This service has been developed to assist researchers in any issues they may encounter regarding living in Europe, working in Europe or leaving Europe.
- Euraxess worldwide offers you the chance to interact on a global scale. It is a networking tool supporting researchers working outside of Europe who wish to connect or stay connected with Europe. Through networking, researchers can strengthen European research and scientific cooperation with the world. Whether you want to know more about European research policy, funding or further collaboration opportunities, EURAXESS Worldwide has dedicated teams in ASEAN (Indonesia, Malaysia, Philippines, Singapore, Thailand, Brunei Darussalam, Cambodia, Lao PDR, Myanmar, and Vietnam), Latin America and Caribbean States (CELAC), China, India, Japan and North America (US and Canada) ready to assist you.

Web based job offering platforms are very important, one might say even essential job search tools. “Just enter a few keywords and have job listings delivered directly to your e-mail inbox” might be a true statement – but no set of key words will ensure that a posted position is never missed [26]. Science Career editor Jim Austin says that “... online job-search tools are lovely, but if you want to get hired you also need to get out into the real world [27]” and seek different opportunities such as to give talks/lectures on other universities or departments, go to conferences, ask questions, talk to people, because regardless of how comprehensive the on-line job-search platforms are, not every job is posted online.

Having this in mind, a good option to consider when in search for job offers would be the job fairs, but under a condition that one prepares for such events. Being prepared for job fairs means knowing participants,

knowing what your demands and needs are and being ready to answer different questions about your work.

To conclude, as with any other effort you were or will be undertaking, invest your time and your energy to make the best out of the possibilities out there.

5.9 Social Networks: LinkedIn, Research Gate

Social networks today are one of the immense resources for researchers belonging to a hub of tools for personal growth and advancement. Those networks can be seen as a window of opportunities for individual in terms of leisure activities and information seeking and social development. When narrowed down to researchers and their cognitive and social space of scientific activity, social networks are to be examined in terms of communication, collaboration and sharing of materials [28]. In this Guidebook the two networks will be presented: LinkedIn – for communicating abilities and career path of a researcher to fellow researchers and possible employers, while Research Gate will be presented in terms of sharing their scientific output to colleagues and possible co-authors in foreseeable future.

5.9.1 LinkedIn (www.linkedin.com)

LinkedIn is a professional social networking website with more than 500 million members with standard profile that contain a wealth of individual employment data and career growth [29]. As well, LinkedIn community represents 10+ million active jobs, access to 9+ million companies, and with more than 100,000 articles published every week it's helping researchers to stay informed on the news and views impacting their professional world [30].

User can open his/her profile containing personal data in curriculum vitae format on education completed (both formal and informal), professional experience gained (positions held), featured skills and endorsements to those skills by co-workers and fellow colleagues, accomplishments achieved during career (publications and research papers published, projects carried out, certifications received (i.e. Coursera certificates may be embedded in LinkedIn profile), language competencies, honours and awards received. Besides this presentation module, high level of interaction with others may be reached. One may have professional network established in similar way like on the Facebook, having list of connections creating opportunity to make visible their

competencies to others and possibility of engagement in joint projects or paper co-authorship with colleagues with similar interests. Those interested in career change may review pages of companies and research institutions and spot interesting job advertisements. It has to be noted here that other way round process is taking place: hiring companies and employers are also using/reviewing individual profiles seeking suitable candidates for employment in their respective institutions. Besides personal promotion and job seeking, LinkedIn allows members to follow interest groups gathered around specific topic or institution. For example, researchers interested in Research, Methodology, and Statistics in the Social Sciences can join group and ask questions when in dilemma which particular method to apply in research. This group has more than 130.000 members, and is open to anyone involved or interested in research, methodology, and statistics in the social sciences. Disciplines that are included are psychology, education, sociology, political science, migration studies, economics, econometrics, anthropology, history, criminology, law, and linguistics. Discussion topics include: qualitative methods, quantitative methods, software like SPSS, STATA, R, and ATLAS.ti, statistical advice, ideas for research, and research projects [31]. One may search for research group of their interest. On the other hand, professional groups exist as well, i.e. the UNDP Group, allowing former and current, local and international staff of the UNDP to keep in touch with latest job opportunities within the UNDP. Also, member can follow particular field of science engaging in dialogue with colleagues. Example for this is Computational Physics group with more than 19.000 members.

There are more than one million groups on the LinkedIn platform.

5.9.2 Research Gate (www.researchgate.net)

Idea that led to the establishment of this social network was simple as it was stated in very introduction to RG: It started when two researchers discovered first-hand that collaborating with a friend or colleague on the other side of the world was no easy task [32]. Following this conclusion Madisch and Hofmayer created platform intended for making your research publicly accessible striving for “open science” model. With more than 13 million members, RG is platform that enables users to establish a personal profile with academic information, share publications and data sets, engage in discussions, up/down vote publications and discussion topics, write messages, search for and monitor peers as well as their own impact via the ResearchGate score [33]. Profile consists of three main sections. Overview offers possibility to view recent research papers, statistics (reads, citations, co-authors, affiliation). Contributions is section

with access to research papers, while the section *Info* offers data on skills and expertise, topics that researcher is dealing with or is interested in, research experience and links to followers and those that member is following. Beside score idea of finding or presenting researcher, RG is acting as digital library as well, allowing access to more than 100 million papers in their database, that can be searched by subject area or publication name, data, authors or questions posted for discussion.

Both platforms act as invisible college. As it was noted by Crane back in 1972, those networks are of immense value: "Members (of invisible colleges) convene meetings; talk to and write other members; battle over claims and theories; exchange drafts, preprints, and reprints of their articles for critical scrutiny; and routinely enter into various forms of collaboration, including co-authorships" [34].

The networking is essential.

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CHAPTER 6: Writing PhD thesis

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ABSTRACT: One of the most challenging endeavor in the professional life of an academic, researcher or any professional is attaining a doctoral degree and successfully defending it in front of a body of experts in that particular field of research. However, as any other project in life, careful planning, self-discipline and sticking rigidly to a schedule are some useful tips to be taken into consideration.
This chapter aims to provide an overview of some of the stages or steps that any researcher should take when it comes to writing a PhD thesis, where among others, careful planning is highlighted. It also outlines the different types of research and the various approaches employed when analyzing and reporting the data and the findings.
Finally, it gives an overview of how a doctoral thesis should be, in terms of its organization and the content of each part. The order or some details may vary depending on the requirements of each HE institution.

KEY WORDS: research question, hypothesis, data analysis, findings, qualitative/quantitative, applied/fundamental, conceptual/empirical research.

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Contents

6.1 Introduction

A PhD (doctor of philosophy) thesis is considered the longest scientific writing, which is a demonstration of the ability of a scholar to conduct research in a particular area of study. The thesis is a research report that elaborates a problem or series of problems in a specific area of research and it should describe what was known about it previously, what is the original contribution towards solving the problem, what do the attained results mean, and where or how further progress in the field can be made (Wolfe, 1996).

The problem or the series of problems that the thesis addresses is often stated as a central research question. After developing the question, the researcher tries to answer it and provide evidence for it. It is important that the question is not too broad or vague as the answer, which consists the thesis itself, may not be relevant or focused on the topic. Still the research question may also be modified as the research is conducted and more knowledge is acquired.

As an attempt to answer the research question, a typical PhD thesis normally includes the following:

- Carrying out a **literature review** of the existing research available;
- Conducting **original research** and collecting the **results**;
- Producing a **thesis** that presents the conclusions as an answer to the research question;
- **Writing up** the thesis and submitting it as a **dissertation**.

As noted from the above, the whole process consists of some stages and steps that any researcher finds it useful to follow, as having a clear timeline helps you stay focus on the task and accomplish it within the deadlines. While following these steps any researcher should also be clear about the expectations of the reader, the latter can either be the examiners or perhaps a future researcher. Every step or stage is associated with some useful advice to be followed or at least to be taken into account when writing a thesis. A summary for each of the steps is given in further text [1].

6.2 Stages in thesis writing

Thesis writing consists of 9 steps, and they are:

- **Step 1. Choosing and defining an appropriate area of study.** It is very important for researchers to make sure that the area of their research is possible to investigate and there will be a useful contribution to the existing body of knowledge.

- **Step 2. Drafting a research proposal as a platform for the research.** The researcher should be able to state it clear from the beginning why the proposed research is important. The research proposal should consist of a clear statement of what it is hoped to be achieved through the research and what the results will be in terms of practical benefit and/or addition to knowledge. A concise statement of what the research will investigate and why. The major insights expected, and if it is expected that the research will prove, disprove or discover any hypotheses, then these should be stated. There should also be a very brief indication of other work that has been done before on the topic, demonstrating the gaps that the proposed research will aim to complete. This should refer to well-known pieces of research and not to information from textbooks. A brief account of how the proposed work might be carried out, with some indication of the proposed sources of information and research approach and methods. A provisional outline of how the research will be completed in a proposed period of time, suggesting how many months will be spent on each of the various stages involved. A note as to why the researcher believes that he/she is particularly qualified and suited to undertake this research. A note about the chances of success: what are likely to be the main problems, how when and where will the results of the research be publicised and written-up [1].
- **Step 3. Consulting the proper sources and using appropriate data collection methods.** Any researcher should be well informed about the previous studies that have been conducted in that particular area of study, so that they can compare their research with the previous ones and making sure that their research is different, in terms of originality and contribution.
- **Step 4. Drafting the outline.** Preferably, the outline should be drafted as the first step and it should be regularly updated as progress is made in the research work. The outline should be like a scaffold containing roughly the structure and the number of chapters, such as the introduction, literature review, methodology, analysis chapters, conclusion and any tables or figures that is to be included in the research. At this very first stage the researcher should have a clear idea of the thesis as a whole, what the thesis is about and what is the aim and what is the new or different contribution that is going to be provided. These are the kind of questions that should be addressed in the beginning stages of the research to be later included under the introduction chapter. (Dunleavy: 2003)

The research proposal can be a preliminary outline for the dissertation. However, any researcher will need a more detailed outline, making sure

that they include in their outline any new points, which potentially can lead the research towards a different direction.

In the natural sciences it is still common to 'write up' the thesis at the very end once all the outcomes of the experiments are known. As a result the scholar should keep a logbook to record the results of the experiments and daily observations. On the other hand, a doctoral research in the humanities requires that the scholar should have an outline from the initial stages. The outline is crucial as it helps the scholar to better manage the thesis by breaking it down into manageable sections. It serves as a road map for the researcher to guide them through the journey to its completion. Following, there is a basic outline that will make it easier for any researcher to write the dissertation [2].

- **Introduction.** The first chapter should include a background of the problem, and a statement of the issue. Then the purpose of the study, as well as the research question should be clarified. Next, there should be provided clear definitions of the terms related to the research. The assumptions and expectations of the final results should also be introduced at this stage.
- **Literature Review.** In this chapter of the dissertation, the research process will be reviewed by giving credit to the sources of the information included in the research.
- **Methodology.** This part of the dissertation is focused on the way that it was used to locate the resources and the methods of implementation of the results. Depending on whether the research is a qualitative or quantitative one, the methodology used will vary. If there is a qualitative dissertation, it should include the research questions, setting, participants, data collection, and data analysis processes. On the other hand, if there is a quantitative dissertation, the focus of this chapter will be on the research questions and hypotheses, information about the population and sample, instrumentation, collection of data, and analysis of data.
- **Findings.** This is the most important stage in the whole process of dissertation writing, since it showcases the intellectual capacity of the researcher. At this point, the research questions will be restated with a view of discussing the found results and explaining the possible directions that these results led to. In other words, your research questions will be answered.
- **Conclusions.** Generally, this is the final chapter of the dissertation, which is a summary of the study and a brief report of the results. The conclusions reached during the research should state whether these findings make a difference in the academic community and how they

are implied in practice. At the end of this chapter, it will be advisable to include a "Recommendations for future research" section, where there should be made a proposal for future research in order to clarify the issue further. The proposal should state the reasons why further research is suggested as well as what form it should take.

- **Bibliography.** There is a citation style corresponding to the field of study and the same style should be used consistently. In order to avoid any claims for plagiarism, the researcher should make sure that they have included all the sources, which were used during the research and the writing stages.

- **Step 5. Providing a clear analysis and supporting arguments for the research question.** The analysis of the data, the evidence, the findings, the relevant discussion, conclusions and recommendation should be clearly elaborated and organized in a way that there is a cohesion and coherence of ideas where they lead naturally into each other.
- **Step 6. Considering carefully and objectively the conclusions and recommendation.** Even though the success of a thesis depends on the degree of originality and personal contribution, still a researcher should not be carried away with the idea of novelty. Walking on new grounds is not always safe! Therefore, the new ideas, the conclusion and recommendations should be made in ways that make them understandable based on the old and existing ideas.
- **Step 7. Keeping a good record of references.** It is crucial to keep a record of the sources consulted or references from the very beginning of the work, as they will be accurately reflected in the text and as a table of references in the end. Being consistent with the credited sources avoids the problems associated with plagiarism. The references should not be quoted just as a list of books or authors that have been read or consulted. On the contrary, it is advisable that the sources are studied in depth and reflected in the body of the thesis in a way that there is a clear connection between the existing study and the new research that is being conducted in that particular area. The number of sources does not necessarily reflect the quality of research.

For this reason, it is encouraging and helpful to start a filing system [3]. One way of doing it is by opening a word-processor file for each chapter and one for the references. Normally, notes as well as texts can be included in these files, or if there is something interesting or relevant for any chapter. When it comes to the point of working on the respective Chapter, the more of these notes have been accumulated, the easier it will be to write. There should also be a physical filing system, for instance, a collection of folders with chapter numbers on them.

- **Step 8. Write the first draft.** The advice related to this stage is quite common and general in nature. It is important to stay away from distractions, stick to a timeline, follow the outline, and complete the first draft.

A researcher should not wait until they have read everything. They should start to write along with onward reading. Some researchers tend to postpone the writing process until they have read everything available on the topic. The body of the text will be modified several times and the resources that a researcher might like to use as they proceed with the writing of the thesis may be different from the original planned books.

The dissertation paper should follow the strict rules of academic writing. You should write in proper form, style, and language; and you should make sure to implement the correct citation guidelines.

Regardless of the fact that numerically, the bibliography chapter comes in the very end of a dissertation, it should not be left as a last thing to do. It is important to manage the bibliography while writing the thesis.

- **Step 9. Editing and proofreading the dissertation.** The best way to edit a piece of writing is by allowing a few days space between the writing and editing stage. The "distance" in time will allow any writer to notice the flaws or any inaccuracy.

However, there is a difference between editing and proofreading. The first focuses on the essence and the proofreading focuses on the form of the paper. The editing stage takes into consideration the cohesion and coherence of the thesis as well as getting rid of parts, which are unnecessary or adding more details, when necessary. The ultimate goal is not the quantity but the quality and clarity of research. Finally, the researcher can correct all spelling, grammar, and style errors with the help of a dictionary or thesaurus, in the event of any doubts.

- **Step 10. Get feedback.** The defense committee provides the final feedback or evaluation; however, it is advisable that a researcher gets some feedback either from a friend or colleague or the mentor. They can discuss together the dissertation and provide some comments or suggestions for improvement.

The mentor will usually provide some more instructions on how to finalize the process, which is the presentation or defending the thesis in front of a scientific committee. This will also be the concluding stage of the educational journey, which is undertaken by any researcher.

6.3 Planning thesis and research

If you fail to plan, you plan to fail
Benjamin Franklin

Research is usually carried out for different reasons, nevertheless the actual process of researching follows certain stages and it is performed according to certain rules and guidelines. In general terms the whole process is carefully planned and it can be applied to any particular piece of work either academic or not, such as researching for an appliance you want to buy or holidays you want to make etc. When researching for some academic purpose such as a course assignment, a project, an article, or for a PhD thesis, there are some other aspects to be taken into account, including here, the type of research compatible to the area of study, the approaches we take, the methods we use to gather and analyze our data and how we are going to report those findings and results of the research.

As per an appropriate definition of this process we could mention the following: "Research refers to the systematic method consisting of enunciating the problem, formulating a hypothesis, collecting the facts or data, analyzing the facts and reaching certain conclusions either in the form of solutions(s) towards the concerned problem or in certain generalizations for some theoretical formulation" [4].

Still, the research process and the type of results that are collected will depend upon the subject area, in Science, Technology, Engineering and Mathematics (STEM) subjects, the focus of the research will be on designing experiments, before recording and analyzing their outcomes. In Social Science subjects, the focus will be more on designing surveys or conducting case studies, thus producing quantitative or qualitative data, depending on the nature of the work. In Arts and Humanities subjects, there will often be less raw data, but it does not mean that there will not be any 'hard' factual information to work with. There will normally be an analysis of texts, sources and other materials according to an accepted methodology and reflect upon the significance of the findings. The research community and those using the findings have a right to expect that research be conducted rigorously, scrupulously and in an ethically defensible manner. All this necessitates careful planning, and there are some key planning issues, which need to be tackled at the very outset.

6.3.1 Creating a research plan

Working on a PhD thesis requires that the researcher manages the time effectively and undertakes a variety of tasks. The way that a PhD course

program is designed and the respective timeline will depend on the requirements and policies of individual universities. Whichever way the course is organized, it is essential that a researcher create a plan, which will help them to allocate enough time to each task that needs to be completed.

It is useful to work out a schedule with the number of weeks available to complete the thesis and based on it a chart could be drawn. An example of schedule is given in table 6.1.

Table 6.1 Example of schedule [5]

Task	Time Completed
Choose a research topic	During previous year
Develop your thesis proposal	December to March
Present proposal	March - April
Write the literature review and method chapters	February - April
Collect data	May - July
Analyse data	July - August
Complete thesis writing	August - November

It is very important to be realistic about how long each task is likely to take. In order to improve the prospect of completing on time, it is necessary to devote sufficient time to planning and revising the plan. The timeline should be realistic and the objectives to be reached should be achievable and an appropriate amount of time should be allocated. It is also advisable to leave some time for editing and correcting and in the event of falling behind the schedule, replan and adjust the work to accommodate each task in order to be completed within the deadline.

The research plan could also include information about what equipment is needed to complete the project, and any travel costs or other expenses that are likely to incur. Once the plan is created, it might be a good idea to discuss it either with a member of the academic staff or with a colleague or a friend, who might suggest anything that might have been left out or if there are any unrealistic points in the plan.

Once the planning is finished, the researcher may start with the actual research by taking into account that there are different types of research and various methods, which can apply in accordance with the area of study.

McKay (2006) has based her book on the following assumptions in relation to research:

First, all researchers should begin the research process by clarifying their own beliefs and specifying the theories and assumptions that inform

their study. Because these beliefs will influence the questions that researchers ask, researchers should clarify for their readers their beliefs and assumptions.

Second, research methods need to be judged in relation to the question asked. If, for example, a researcher wants to look at interaction patterns in student group work, then the method must be one that examines oral discourse patterns. What researchers need to do is select the most appropriate method for answering the questions they ask and apply this method with rigor and integrity.

Third, those involved in the research process need to be protected and benefitted. When researchers ask teachers and learners to participate in their research, they need to make certain that the participants are fully aware of the risks and benefits that can arise from taking part in the project. In addition, the identity of the participants needs to be fully protected. Finally, it is important that those who participate in a research project gain some benefit, particularly in increasing their own understanding of the particular area of study under the scope of the research.

Fourth, research is a rigorous process that involves specifying a research question, selecting a method that can best answer this question, gathering relevant data, and carefully analyzing this data.

Moreover, Paltridge and Starfield (2007) suggest that it is important to explain how the research was conducted and how the data were obtained: how the particular method(s) were used. This will require a detailed description of the research processes and procedures as well as an explanation of the reasons for doing so. Writers should consider the extent to which the method(s) chosen have shaped their data. For example, in qualitative research, writers will need to describe: how they obtained their informants or drew their sample; the location/setting of interviews; the themes covered in the interview; piloting, adjustments made, reasons for this; how they overcame obstacles they encountered. This explanation is usually done under the "Methodology" chapter in the dissertation and it will also be explained later in the sections below.

As per above it is important to understand the different types of research and how to select the most appropriate approach along with its methods.

6.3.2 Types of research and its approaches

[1, 5], Dawson (2007), Brian Paltridge, Sue Starfield, (2007) and other scholars involved in the study of research conclude that there are a few distinct methods and approaches prevalent in doing research which should be known to a researcher in any field of study so that they analyse the

problem in proper perspective, understands what methods and tools are needed and decides to choose the appropriate approaches for the research.

In order to get a clear distinction of what should be the appropriate approach towards research, the following paragraphs will detail a comparative and a contrastive description of these methods and tools according to [4]:

- **Descriptive vs. Analytical research***:* Descriptive research includes surveys and fact-finding enquiries of different kinds. The major purpose of descriptive research is description of the state of affairs, as it exists at present. The main characteristic of this method is that the researcher has no control over the variables; he can only report what has happened or what is happening. The methods of research utilized in descriptive research are survey methods of all kinds, including comparative and correlational methods. In analytical research, on the other hand, the researcher has to use facts or information already available, and analyze these to make a critical evaluation of the material.
- **Applied vs. Fundamental***:* Research can either be applied (or action) research or fundamental (to basic or pure) research. Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organisation, whereas fundamental research is mainly concerned with generalisations and with the formulation of a theory. "Gathering knowledge for knowledge's sake is termed 'pure' or 'basic' research" [6]. For example, research studies, concerning human behaviour carried on with a view to make generalisations about human behaviour, are also examples of fundamental research, but research aimed at certain conclusions (say, a solution) facing a concrete social or business problem is an example of applied research. Thus, the central aim of applied research is to discover a solution for some pressing practical problem, whereas basic research is directed towards finding information that has a broad base of applications and thus, adds to the already existing organized body of scientific knowledge.
- **Quantitative vs. Qualitative***:* Quantitative research is based on the measurement of quantity or amount. It is applicable to phenomena that can be expressed in terms of quantity. Qualitative research, on the other hand, is concerned with qualitative phenomenon, i.e., phenomena relating to or involving quality or kind. For instance, when we are interested in investigating the reasons for human behaviour (i.e., why people think or do certain things), we quite often talk of "Motivation Research", an important type of qualitative research. This type of research aims at discovering the underlying motives and desires, using in depth interviews for the purpose. Other techniques of such research are word

association tests, sentence completion tests, story completion tests and similar other projective techniques. Attitude or opinion research i.e., research designed to find out how people feel or what they think about a particular subject or institution is also qualitative research.

- **Conceptual vs. Empirical***:* Conceptual research is that related to some abstract idea(s) or theory. Philosophers and thinkers to develop new concepts or to reinterpret existing ones generally use it. On the other hand, empirical research relies on experience or observation alone, often without due regard for system and theory. It is databased research, coming up with conclusions, which are capable of being verified by observation or experiment. We can also call it as experimental type of research. In such a research it is necessary to get at facts firsthand, at their source, and actively to go about doing certain things to stimulate the production of desired information. In such a research, the researcher must first provide himself with a working hypothesis or guess as to the probable results. He then works to get enough facts (data) to prove or disprove his hypothesis. He then sets up experimental designs which he thinks will manipulate the persons or the materials concerned so as to bring forth the desired information. Such research is thus characterised by the experimenter's control over the variables under study and his deliberate manipulation of one of them to study its effects. Empirical research is appropriate when proof is sought that certain variables affect other variables in some way. Evidence gathered through experiments or empirical studies is today considered to be the most powerful support possible for a given hypothesis.

The above description of the types of research brings to light the fact that there are two basic approaches to research, viz. quantitative approach and qualitative approach. The former involves the generation of data in quantitative form, which can be subjected to rigorous quantitative analysis in a formal and rigid fashion. Qualitative approach to research is concerned with subjective assessment of attitudes, opinions and behaviour. Research in such a situation is a function of researcher's insights and impressions. Such an approach to research generates results either in non-quantitative form or in the form, which are not subjected to rigorous quantitative analysis. Generally, the techniques of focus group interviews, projective techniques and depth interviews are used.

Having given such a detailed description of the research methods and tools, it should also be mentioned that the research is cyclic and reiterative in its nature. "Research is what we call the form of disciplined inquiry that involves studying something in a planned manner and reporting it so that other inquirers can potentially replicate the process if they choose" [7].

The accumulation of information from research allows for knowledge to evolve and grow. Research, thus, leads to more research. It proceeds in stages and ends up back where it started; new questions emerge from answers to previous questions. This is a general characteristic that all types of the above-mentioned share and regardless of whether the qualitative or quantitative approach is employed, the research cycle or process consists of various steps, which repeat themselves once a new research has started. These steps involve:

- formulating the research problem;
- extensive literature survey;
- developing the hypothesis;
- preparing the research design;
- determining sample design;
- collecting the data;
- execution of the project;
- analysis of data;
- hypothesis testing;
- generalisations and interpretation; and
- preparation of the report or presentation of the results, i.e., formal write-up of conclusions reached.

Each of the stages of the research in general terms include the steps and stages that any researcher will take when preparing their doctoral thesis. The underlying principle of writing and preparing a PhD thesis is the ability to demonstrate the rationale for the research, and to describe how it fits within the wider research context.

Key tools that are available to help anyone for their research, include: internet search engines, especially ones that offer advanced search features (see http://www.google.com/ and http://scholar.google.com/); University Library Catalogues; electronic journals available; and bibliographies in any key texts about the topic under investigation.

There are also many systems that support effective data collection and retrieval. These range from card indexes and cross-referenced exercise books, through electronic tools like spread sheets, databases and bibliographic software, to discipline-specific tools. They can be used to record data accurately as they are collected, to retrieve them quickly and efficiently, to analyse and compare the collected data, and to create appropriate outputs for the dissertation such as tables and graphs, if appropriate.

The stage of research is naturally followed with the analysis of all the information and data that have been collected and later the reporting of this

research. Any researcher at this stage should be able to start with the writing of the first draft of their thesis. Nevertheless, as mentioned previously, research is not a stage that can be concluded once and forever, on the contrary it is a process, which may continue meanwhile a researcher, is writing up the thesis. As new questions may arise or issues may require further clarification, thus, it will be an outmost necessity to further research and inquire on certain issues.

The following sections will deal with the structure of a thesis and how the data collected from the research are analysed and presented in the form of findings and conclusions.

6.3.3 Organization of the thesis structure

Writing a thesis is a long and difficult process and sometimes it requires for additional work than the research process. The process of writing your thesis will include many drafts and you should start working with it from the first months of the doctorate and continue throughout the years.

It is a matter of your personal choice if you decide to start writing, leaving it aside for a certain period of time and then rewrite it again. It is advisable to provide your supervisor with drafts of your work and expect suggestions for improvement by them. You can also try to get feedback from your peers and colleagues about different issues that relate to your topic. This approach will help you in improving your research and it will perhaps offer you different and more appropriate viewpoints to your thesis.

Before writing your thesis you should make a plan about all elements it will include, decide on a schedule and ascertain that all areas are covered. Researchers need to understand that a dissertation is a long formal piece of writing on a particular subject, especially for a university degree [8]. The dissertation may serve the researcher to further develop on an existing work but it may also be an original contribution to that specific field of study. The way one researcher can organize the dissertation may contain the following elements:

- Declaration;
- Title page;
- Abstract;
- Acknowledgements;
- Table of contents;
- Introduction;
- Literature review;
- Methodology;
- Results and Discussions;

- References; and
- Appendices.

The **declaration** is required by the HE Institution but you should check in advance about the specific requirements related to what the declaration should include, how long it needs to be and the like.

The **title page** may vary from one institution to another, but it usually contains the name of the University, the title of the thesis, the author, the reason about which this thesis is being submitted, the place and date of submission. You can check out the following example (figure 6.1) but you always have to contact the respective office at your institution for clarifications on the standards set.

Figure 6.1 Title page [9]

The Abstract is essentially a brief summary of the whole dissertation whose main purpose is to give your reader a general idea of the content of the dissertation. The abstract will help a reader decide whether to read the whole text in detail. An abstract is found at the beginning of dissertations immediately after the title page. Abstracts may also appear separately from dissertations and be held in databases of dissertation abstracts [10]. An abstract is not merely an introduction in the sense of a preface, preamble, or advance organizer that prepares the reader for the thesis. In addition to that function, it must be capable of substituting for the whole thesis when there is insufficient time and space for the full text [11]. The abstract

serves the researcher to introduce the reader briefly to the aim of the dissertation, the methods used while preparing it; different findings and conclusions. The abstract should contain key terms related to the thesis and needs to be not repetitive. Regardless of the fact the position of the abstract comes at the beginning of the thesis you have to write it in the end. Since there are different fields of study, different kinds of abstracts may be required, but the researchers need to work closely with the supervisor and make sure that the abstract they have prepared contains the aim, hypothesis, research question and a short summary of the findings. Most readers will only read the abstract first so it needs to contain elements that might arouse interest.

Acknowledgments – This part of the thesis serves to thank all people who assisted the researchers in both academic and scientific matters and indirectly by providing the researcher with ideas and advice. If you worked with other colleagues for the preparation of some sections, make sure you clarify who prepared what. Since the thesis you have prepared is a formal piece of writing, you should be very careful not to share with others any negative feedback you have received while preparing it and you should refrain from what can be seen as hidden messages to the supervisor, colleagues and the university. An example of acknowledgement part of the thesis is:

ACKNOWLEDGEMENTS

I would like to express my special appreciation and thanks to my advisor Professor Dr. Reg A. Williams, you have been a tremendous mentor for me. I would like to thank you for encouraging my research and for allowing me to grow as a research scientist. Your advice on both research as well as on my career have been invaluable. I would also like to thank my committee members, professor Barbara A. Therrien, professor Jeffrey E. Evans, professor Andrzej T. Galecki for serving as my committee members even at hardship. I also want to thank you for letting my defense be an enjoyable moment, and for your brilliant comments and suggestions, thanks to you.

I would especially like to thank physicians, nurses, and nurse aids in the brain injury rehabilitation unit at University of Pittsburgh Medical Center. All of you have been there to support me when I recruited patients and collected data for my Ph.D. thesis. A special thanks to my family. Words can not express how grateful I am to my mother-in law, father-in-law, my mother, and father for all of the sacrifices that you've made on my behalf. Your prayer for me was what sustained me thus far. I would also like to thank to ii my beloved husband, Dr. Donghyun Lee and my sister, Dr. Sukyung Park. Thank you for supporting me for everything, and especially

I can't thank you enough for encouraging me throughout this experience.

To my beloved daughter Joyce Juhee Lee, I would like to express my thanks for being such a good girl always cheering me up. Finally I thank my God, my good Father, for letting me through all the difficulties. I have experienced Your guidance day by day. You are the one who let me finish my degree. I will keep on trusting You for my future. Thank you, Lord [12].

Table of contents – It shows the way chapters of the thesis have been distributed and a clear information on the subchapters it contains with their respective page numbers. You have to use Roman numerals for the first pages and then begin the introduction section with number 1 (figure 6.2).

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Figure 6.2 Table of contents

Introduction- This chapter provides the reader with explicit research hypothesis and it helps them create an overview of thesis structure. You should summarise the remaining chapters by offering an abstract of the argument you will go on to develop. It is important to consider the problem from a broader perspective and how this problem fits in the specific discipline. This part of your thesis should be informative as well as interesting since you aim at making the reader want to read your thesis. You might prepare through several drafts to make it read well and log-

ically and at the same time keeping it short. The introduction will lead to writing literature review.

Literature review – Hart defines literature review as "the use of ideas in the literature to justify the particular approach to the topic, the selection of methods, and demonstration that this research contributes something new" [13]. Webster and Watson consider an effective literature review as one that "creates a firm foundation for advancing knowledge. It facilitates theory development, closes areas where a plethora of research exists, and uncovers areas where research is needed" [14]. There are a number of questions that a researcher need to address himself and they relate to the origins of the problem, the recent developments it has gone through and also the methods used to solve it.

Nowadays there exists a wide range of information related to specific fields of study and it is the researchers' duty to distinguish research from pseudo research. As a result a researcher needs to look closely and decide on the relevance of the material and be able to separate the valid information from that which is not. This whole process of finding, reading, evaluating, and revising may be necessary until researchers are ready to write a formal research question or hypothesis. Researchers should establish the organizational scheme for this section, so the reader knows how the review is being organized. Ngai & Wat at Yair and Ellis 2006 are of the idea that "conducting an effective literature review that will yield a solid theoretical foundation should also provide a firm foundation to the selection of the methodology for the study" [15].

Methodology – The researcher should be aware that research proceeds in a careful step-by-step manner, employing an ordered system of inquiry. When you select the methodology you have to be careful not to place more importance on one type of research such as qualitative or quantitative but you should be to understand what methodologies were previously validated. Thus, a solid theoretical foundation should also provide researchers the justifications for a given methodology and enable them to provide justifications for why a given approach is optimal for their study. The researcher needs to distinguish between quantitative and qualitative research.

Quantitative research is a formal, objective, systematic process in which numerical data are used to obtain information about the world. It is used to describe variables, to examine relationships among variables and to determine cause-and-effect interactions between variables [16].

Another definition considers qualitative research as "a form of systematic empirical inquiry into meaning" [17]. Denzin and Lincoln claim that qualitative research involves an interpretive and naturalistic approach: "This means that qualitative researchers study things in their

natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them" [18].

The methodology is the philosophy that will guide your research. It is the overall approach to studying your topic and includes issues you need to think about such as the constraints, dilemmas and ethical choices within your research. Your research methodology is different to your research methods which are the tools you use to gather data, such as questionnaires or interviews.

Results and discussion - This chapter of your thesis aims at summarizing the data you have collected and conducting a deep analysis. You go back to each hypothesis you posed at the very beginning and present a detailed analysis that you carried out in order to come up with acceptance or rejection of that hypothesis. If case you did quantitative study for your dissertation, you will have to begin the results section with a description of the sample, then do some descriptive statistics. All facts related to your research need to be introduced and commented upon in this section. There are dissertations when you combine both results and conclusions in one section. This strongly depends on the length of the thesis and their importance to the subject matter. The discussion part is also important since it answers questions related to their meaning, their inclusion in the existing body of knowledge, any suggestions for new theories or viewpoints as well as new insights into the specific field of study. You should consider the importance of relating your own results to previous research or theory and point out what the limitations were in your study and note any questions that remain unanswered.

Conclusions and suggestions for further work - It was previously mentioned that the main conclusions have to appear in the abstract of your dissertation briefly. You summarize your conclusions in a more detailed and comprehensive way in this section. You can present your conclusions in the format you find appropriate for the specifics of your dissertation. This chapter should be reasonably short – a few pages perhaps. As with the introduction, it is a good idea to ask someone who is not a specialist to read this section and to comment.

References - When writing your PhD thesis it is of great importance to support information you provided in the thesis and show the sources you obtained that from. Many of the references you use will come from published sources such as books, articles, publications but you can also use websites to gather information. One issue with using websites for your citations might prove hard for other researchers to find and consult since some web pages might be updated and others no longer functioning. You have to be careful with the references you choose since they are a way to show the credibility of the dissertation.

There are different styles of citing the sources depending whether it is a research thesis or just any other piece of writing. The most common one is the American Psychological Association Style (APA). The link provided will guide you through the different ways of citing a source and an example is given below [19]. The citation can be either in text or in a footnote. In text citation includes the author and the date This means that the author's last name and the year of publication for the source should appear in the text, for example: (Jones, 1998), and a complete reference should appear in the reference list at the end of the paper. You may have to cite either an author or two or more authors, in this case the following model should be used:

- **A Work by Two Authors:** Name both authors in the signal phrase or in the parentheses each time you cite the work. Use the word "and" between the authors' names within the text and use the ampersand in the parentheses.
  Research by Wegener and Petty (1994) supports...
  (Wegener & Petty, 1994)

- **A Work by Three to Five Authors:** List all the authors in the signal phrase or in parentheses the first time you cite the source. Use the word "and" between the authors' names within the text and use the ampersand in the parentheses.
  (Kernis, Cornell, Sun, Berry, & Harlow, 1993)
  In subsequent citations, only use the first author's last name followed by "et al." in the signal phrase or in parentheses.
  (Kernis et al., 1993)

If a footnote is to be used, although APA does not recommend it, a number formatted in superscript should be used. For example:

Scientists examined-over several years[1]-the fossilized remains of the wooly-wooly yak.[2] (These have now been transferred to the Chauan Museum.[3])

If a word-processing program like Microsoft Word is used then there is footnote function, which places all footnotes at the bottom of the page on which they appear.

With regard to the reference list, it is usually placed at the end of the paper. It provides the information necessary for a reader to locate and retrieve any source cited in the body of the paper. Each source that it is cited in the paper must appear in the reference list.

The references are to be alphabetized by the fist author's last name, or (if no author is listed) the organization or title. For the websites you cite the type of medium used, and the material's availability.

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CHAPTER 7: Introduction to Academic Teaching

Armela PANAJOTI[19], Elonora HODAJ[20]

ABSTRACT: In this chapter, we provide an overview of academic teaching and what it involves, focusing particularly on teaching and learning processes especially in a university environment, on aspects of teaching and learning with an emphasis on curriculum design and development and, more importantly, on intended learning outcomes. A greater part of this chapter is devoted to supervising students as a crucial process when carrying out research for research projects and dissertations. Since it entails establishing a relationship between the supervisor and the supervisee, the importance of finding good communication modes and channels is emphasized. The last part of this chapter is devoted to research steps by focusing particularly on aspects of supervising research students and dealing with all of them from this perspective, that is, helping students when identifying research problems, formulating research questions, writing literature review, developing a research proposal, dealing with research ethics. The chapter ends with students' responsibility in the process.

KEYWORDS: academic teaching, supervising, supervisor, supervisee, research projects, dissertation.

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Contents

7.1 Introduction

The term academic teaching refers to the schooling practices provided by a teacher or scholar at a university or other institutions of higher education as places where ideas are meant to be freely explored and ideals of independent thinking and democratic liberty are enshrined.

There are three types of higher education institutions:

- Universities;
- Academies; and
- Non-university high schools.

Their duty is to transmit knowledge to new generations by serving the society as a whole. The cultural, social and economic future of the society requires considerable investment in ongoing education.

When we refer to academic teaching, we have in mind the kind of teaching that improves academic achievement, paves the way to successful study completion and sets the stage for a successful transition into productive adulthood. Aiming at preparing students for employment or further education, academic teaching is projected towards the provision of general, specific, as well as professional knowledge. Additionally, students are to acquire abilities resulting from previous scientific, technical, cultural and artistic achievements and to develop their intellectual, ethical, aesthetic and other personal skills.

The Law on Higher Education regulates the activities of universities and faculties, the functioning and work of the governing bodies and the employment of the pedagogical ones, whereas the establishment of appropriate managerial and professional bodies as well as the general organization and activities are thoroughly drafted in the statutes. Universities establish the required governing and professional bodies. All public and private higher education institutions act in accordance with the main legal acts upon which the higher education is based. According to these acts, all higher education institutions may have their own statutes as well as their rules and regulations regarding the courses of study they offer. These are legal documents that describe the organization and functions of the higher education system.

The general education principles and objectives include:

- Ensuring equal rights for the education of every citizen. The education system and the right to education are based on and defined by fundamental constitutional rights that proclaim education as a national priority in every country;

- Providing the necessary logistics and facilities for full personal development and educational opportunities according to present requirements for youth development;
- Promoting and modernizing the educational content according to the present-day social demands, including scientific achievements and information technology guidelines;
- Adapting professional education according to the guidelines for social development and alterations in the labour and production sectors;
- Providing the operating conditions for lifelong learning as an important element of higher education. Education at every age and level is an unqualified good, unassailably beneficial to the individual, the society and the world because the future is built only on knowledge-based economy and society. In this respect, lifelong learning strategies are necessary to cope with the challenges of competition and the use of new technologies and to improve social cohesion, ensure equal opportunities and quality of life, as well;
- Increasing the quality of education and its efficiency.

7.2 Understanding teaching and learning processes

The university is an autonomous institution at the heart of societies organized in different ways due to geography and historical heritage: it produces, examines, evaluates and transmits culture through research and teaching. Teaching, learning and research are inextricably linked so that teaching does not fall behind the changing social needs and the advancement of scientific knowledge. Freedom in research and training is the underlying principle of university life. In order to preserve freedom of research and teaching, the appropriate instruments to achieve this should be made available to all members of the university community. Teachers and scholars are those individuals capable of transmitting and developing their knowledge through research and innovation. Teachers' recruitment and regulation of their status are subject to the principle that research is inherent in teaching.

Teaching and learning are essentially social activities implying role relationships between teacher and learner, learner and learner. These relationships are established, maintained and evaluated through academic communication. Teachers provide adequate knowledge of their subject matter and are able to devise appropriate learning/teaching experiences. Essentially they have two major roles or functions in the classroom:

- To create the conditions under which learning can take place, i.e. the social side of teaching (managerial function).

- To impart, by a variety of means, knowledge to their learners, i.e. the task-oriented side of teaching (instructional function).

The teacher's managerial function involves:

- Teaching style (collection of the many attitudes and behaviours employed to create the best possible conditions under which learning can take place).
- Motivation by adopting a positive attitude towards learners, by maintaining discipline to the extent that a reasonable working atmosphere is established and by involving learners and giving positive feedback in different tasks.

Teaching as a practice does not cause learning as teachers cannot be in control of all of the relevant factors. Nevertheless, they are in partnership with their students in this enterprise as true managers of learning. It is the commitment to unlocking the learning potential in each student that motivates a teacher to make informed methodological choices. But teaching is not only thinking and holding certain values; it is also action, which implies experimenting with new techniques, trying them, observing the consequences, making adjustments and then trying them again.

Academic learning, on the other hand, includes several, inseparable components of powerful learning and development such as:

- Content mastery, especially in subject areas;
- Learning process skills and abilities;
- Learning enrichment skills and abilities, especially knowing where and how to get new knowledge and skills;
- Learning enhancement skills and abilities, especially the capacity to reflect on personal learning experiences and, on the basis of this reflection, to correct weaknesses and build on strengths; and
- Ability to engage in self-directed learning, including the ability to persist when challenges are present.

7.3 Planning teaching and learning

Strategic academic practices and programming are vital in higher education institutions. The main idea is to harmonize and coordinate academic learning and the conditions needed to support and reward it - in all of the places where youth learn and develop.

In order for the courses to be suited to the situation and learners and prove effective or efficient in encouraging learning, there are many issues to consider when planning to teach such as:

- Learners' present knowledge;

- Knowledge gaps;
- Resources available (including time);
- Teachers' skills; and
- Principles of teaching and learning.

In the process of course planning, these factors are considered in the three sub-processes:

- Environmental analysis (a ranked list of situational factors and a consideration of their effects on the design);
- Needs analysis (a realistic list of language ideas or skills to be achieved based on the present state of cognition, future needs and learners' wants); and
- Application of principles (selection of the most important teaching and learning principles and monitoring other applications through the whole planning process).

Having clear general goals for a course is of vital importance. This is because it is essential to decide why a course is being taught and what the learners need to obtain from it. Goals are expressed in general terms initially and are given more in detail when considering the content of the course. The items to learn and the order in which their learning occurs during the course as well as the content of their ideas ensure that learners advance in a supervised way towards balanced knowledge. Educators identify and communicate the content considered to be essential. They focus instruction on specific content and purposes (not miscellaneous topics/content). The content of higher education institutions' curricula is research-supported and in line with state and national standards.

The part of the course learners/students are most aware of is the format of the course lessons or units including the techniques and types of activities that will be used to foster learning. It is important that this part be guided by the best available principles of teaching and learning. The material in a course is to be presented and put together in a form (mainly in lessons) that will help learning. Having a set format for lessons implies several advantages such as the ease in:

- making the lessons (as each one does not have to be planned separately);
- monitoring the course; and
- learning (as learners can predict what will occur and are soon familiar with the learning procedures required by different parts of the lesson).

Nevertheless, course planning is not a linear process, the course content and sequencing can be altered in order to suit the lesson format and to reorder the list of environmental factors. The lessons may require further adjustment at other stages of the course plan.

The monitoring and assessment parts of the course represent the need to observe learning, test the result of learning, and provide feedback to the learners about their progress. The most difficult task is making sure that the learning goals of the course are met and assess to what extent these goals are achieved. The aims of course planning are to make a course efficient by offering useful and achievable goals. Assessment of goal achievement generally involves the use of achievement tests which measure what has been learned from a particular course. Achievement tests are closely related to a course and the items in the tests are based on the content and learning goals of the course. Other ways of gaining information about the progress of learners and the effectiveness of the course include observing and monitoring in discussion-based activities during seminars, having learners do research work on some course content-related topics and make presentations of these topics. Educators use multiple methods of evaluation and assessment (e.g., pre-assessments, diagnostic, standardized, curriculum-embedded, informal tests, etc.), which are both formative (during learning) and summative (after learning). Assessments measure students' abilities to answer questions acceptably and use problem-solving methods.

7.4 Curriculum design and development

7.4.1 Introduction

A well-designed curriculum is useful for students and teachers alike as it helps them interchangeably towards good teaching and learning. Having a clear understanding of what the curriculum is about, what it aims at, what will be taught, how and why it will be taught aids towards making teaching more effective, produces good and clear forms of assessment and eventually makes learning more rewarding.

Curriculum development incorporates the design and development of integrated learning plans, the modes and forms of implementation of these plans, the evaluation of these plans in terms of learning, the set of learning outcomes. The main idea behind curriculum development is to make sure students receive good learning experiences which can contribute to the student's professional, personal and intellectual growth.

Curriculum design is basically the process of finding out the best way to combine teaching and learning and develop it into some action or plan for integrating what the curriculum designer intends with what a teachers teach and what a learner expects to learn.

"When we interpret "the curriculum" in a manner that includes the processes by which we facilitate student learning, not only are we taking a more scholarly approach to planning teaching and learning; we are also making more explicit to ourselves and to our students our respective roles and responsibilities in the teaching and **learning contract**" [1].

7.4.2 Intended learning outcomes

One of the most important aspects of curriculum design, quite often overlooked or taken for granted, is the writing of learning outcomes. Programme or course learning outcomes specify what is expected from the students to achieve at the end of a programme or course. There is a growing awareness of appropriately defining learning outcomes or better of introducing a "learning outcomes" approach, which "shifts the emphasis from the duration of learning and the institution where it takes place to the actual learning and the knowledge, skills and competences that have been or should be acquired through the learning process." [2]

As it can be noted, this shift which also implies a shift in terminology, from "learning objectives" to "learning outcomes", suggests a strong focus on learning rather than teaching, that is, on what a learner does and achieves rather than what a teacher does or intends to do. Nevertheless, focusing exclusively on student achievement without taking note of other outcomes should not be the main purpose when designing a curriculum. After all, learning outcomes are inherently connected with the programme, which is a product of what a teacher intends and aspires to teach, on the topics proposed for teaching, on the present-day social and educational requirements and demands and on the students' expectations from the programme/course.

Thus when designing and developing a programme, several factors, internal and external, should be taken into consideration. These include wider and specific priorities at the national and local levels, university priorities and strategy of development, market demands, and requirements set out by the approving and accrediting bodies, stakeholders' expectations. When defining the programme learning outcomes, it should be remembered that since programmes consist of courses, their learning outcomes should be integrally related to the programme outcomes.

Programme learning outcomes define the minimum level of achievement required from a student to obtain a degree. As such, they:

- Describe the essential knowledge, skills and attitudes required by graduates of the program;
- Focus on the targeted aim of the programme;

- Are formulated generally and comprehensively for present and prospective students to understand;
- Are achievable, realistic and measurable within the context and duration defined in the programme;
- Are to be achieved through the programme courses within the indicated period of time; and
- Are demonstrated through course assessment.

Course learning outcomes define the minimum level of achievement required from a student to demonstrate to be considered successful in that course. As such, they:

- Should be linked to the programme learning outcomes;
- Should be stated as comprehensively as possible so that students can understand them;
- Define the scope of the course;
- Are achievable, realistic and measurable within the context and duration defined in the course programme;
- State expectations clearly, that is, what the students will need to demonstrate as achievement upon completion of the course;
- Are demonstrated through assessment; and
- Are tangible through teaching and learning activities.

The best way to demonstrate how learning outcomes work in connection with assessment and teaching and learning activities is to refer to the concept of constructive alignment upon which an outcomes-based curriculum is built:

"Constructive alignment is a design for teaching in which what it is intended students should learn and how they should express their learning is clearly stated before teaching takes place. Teaching is then designed to engage students in learning activities that optimise their chances of achieving those outcomes, and assessment tasks are designed to enable clear judgments as to how well those outcomes have been attained" [3].

7.4.3 Aligning assessment with intended course learning outcomes

Valid assessment requires that intended learning outcomes be aligned with a good assessment plan, which will show how students are expected to demonstrate their learning. Planning assessment involves detailing each assessment task at the beginning of the course against the course timeframe and the course learning outcomes.

Doing so is beneficial but also challenging. On the one hand, it allows students to recognize what is important to learn during the course and also stay more focused on their learning and how to demonstrate it during assessment. It likewise helps teachers to target assessment tasks and activities as measuring how particular learning outcomes have been achieved. Overall, it also aids them to reflect on their own teaching and also indirectly make students participants in the process of assessing assessment. However, this process can be challenging because it requires aligning each learning outcome to particular assessment tasks, which cannot always be the case. What is more, "Learning outcomes can be seen as statements of threshold learning in that they prescribe to students the minimum standard needed to achieve a pass. Determine at the outset whether all the course outcomes must be achieved at the threshold level, or whether higher achievement on some will compensate for failure on others" [4].

It might be handy for teachers to plan assessment by using some visual representation, a table or some other effective visual aid, which can clearly point to the alignment of assessment tasks, learning activities with the learning outcomes. Below, is shown table 7.1 adopted from [5], which shows how learning outcomes can be aligned with class discussion activities and assessment tasks:

Table 7.1 Alignment of learning outcomes, learning activities, and assessment tasks [5]

	COURSE LEARNING OUTCOMES				
DISCUSSION POINTS (entire class)	Discuss, critically analyse and place into context a wide range of interactive works	Demonstrate an understanding of the essential nature, ideas and language of interactivity	Use an iterative creative process to develop interactive projects	Work individually and collaboratively with peers to create works of interactive art or design	Propose prototype and produce an engaging and successful interactive experience
TALKING POINT 1 Cognitive aspects of interactivity	x	x			

Table 7.1 continued

	COURSE LEARNING OUTCOMES				
DISCUSSION POINTS (entire class)	Discuss, critically analyse and place into context a wide range of interactive works	Demonstrate an understanding of the essential nature, ideas and language of interactivity	Use an iterative creative process to develop interactive projects	Work individually and collaboratively with peers to create works of interactive art or design	Propose prototype and produce an engaging and successful interactive experience
TALKING POINT 2 Affordances, function vs emotion	x	x			
TALKING POINT 3 Can play be a useful interactive tool?	x	x			
TALKING POINT 4 How can complexity be managed	x	x			
TALKING POINT 5 How to apply collaborative practice to current project	x	x			

Table 7.1 continued

	COURSE LEARNING OUTCOMES				
PROJECTS (Individual and group)	Discuss, critically analyse and place into context a wide range of interactive works	Demonstrate an understanding of the essential nature, ideas and language of interactivity	Use an iterative creative process to develop interactive projects	Work individually and collaboratively with peers to create works of interactive art or design	Propose prototype and produce an engaging and successful interactive experience
PROJECT 1 - PART A Discovering the Principles of Interactivity (Individual)	x	x		x	
PROJECT 1 - PART B Discovering the Principles of Interactivity (Group)		x	x	x	
PROJECT 2 - PART A Designing an interactive Prototype (Individual)		x		x	
PROJECT 2 - PART B Designing an interactive Prototype (Group)	x	x	x	x	x

Some of the most commonly used assessment techniques used in Higher Education include: paper/thesis, project, product development,

performance, exhibition, case study, clinical evaluation, oral exam, interview, research assignment, portfolio.

Check questions are advisable to ask in order to see how well your assessment plan is working. These involve:

- What outcomes (level of understanding/ performance) are assessed?
- How authentic is the task?
- What kind of learning is promoted?

Overall, the steps involved in aligning learning outcomes with teaching, learning and assessment activities are:

- Providing well-defined learning outcomes;
- Selecting teaching and learning approaches, methods and techniques that promise the achievement of learning outcomes;
- Selecting appropriate technique(s) to assess the achievement of learning outcomes; and
- Assessing learning outcomes against what was intended.

7.5 Supervising students' projects and dissertations

In this part of the chapter, we will try to provide an outline of the process of supervising students' projects and dissertations. We will begin with a definition of each and with emphasizing the importance both have in the teaching and learning processes and, above all, in empowering students with research skills. We will then move on to some key aspects of the process and try to make some useful suggestions as to how to make the process more engaging for both student and supervisor.

7.5.1 Definitions

A dissertation is an extended written work on a particular topic in a specific subject area, which is usually submitted for qualifying for a doctor of philosophy degree (PhD). As such, it is intended to demonstrate the student's ability to handle the argument coherently, logically and convincingly, to bring evidence and apply relevant theoretical tools and methods, assess both against personal arguments and theories.

While a project is also an extended written work on a particular topic, it is more oriented towards field work, data collection through experimental work or any other ways of primary investigation. In addition to the abilities listed above, when doing a project, a student has also to demonstrate the ability to identify a research problem, define it appropriately, develop a good methodological plan for data collection, analyse data and interpret results. As such, it should demonstrate similar abilities to those listed for a

dissertation and in addition the ability to plan experiments or data collection and interpret and analyse data. What is more, unlike dissertations which are individual works, projects can also be group work.

7.5.2 Why are they important?

Both projects and dissertations mark an important step in students' education. As part of the requirements for completing a course or a degree programme, they are well-weighed progress indicators marking the advancement of their academic achievement, demonstrating their ability to put knowledge into practice, to think and behave critically and scientifically, to develop new theories, to deal with a research problem arguably, systematically and convincingly. The process leading to their finalization is normally long and requires good organization of procedures from the beginning to the very end of the process. Nevertheless, the completion of the dissertation or of a research project should not be seen as an end product per se, but as the beginning of a new process, that of being ready for a knowledge-based economy in which high-profiled individuals with high qualifications are on demand. Therefore, one of the most important aspects of the process is supervision, as the way that leads to success in this ongoing process. In this chapter we will focus on the importance of supervision and some key related issues.

7.5.3 Supervision - why it matters

Like any other difficult process that needs some guide to be performed successfully and in a less painful and complicated way, writing projects and dissertations also need some guiding. Despite the several definitions that might be formulated to define supervision and the ongoing debate as to the amount of work it means for a supervisor, supervision is basically the process of aiding, advising and guiding PhD students, of providing all necessary support, professional and social towards the completion of the project and dissertation, which is why very often the supervisor is a senior member of the staff. Quite often a good project or dissertation is credited to good supervision because it not only enables students to discover and maximize their own potential, but also enhances the institution's research profile.

Supervision is a very engaging and rewarding process for both the student and the supervisor at the professional and social levels, but at the same time very time-consuming and quite often even stressful. To sum it up, it is simultaneously a relationship and intervention that extends over time. The question is what can be done to facilitate this process, to make it easier and less stressful for both students and supervisors? To put it very

simply and straightforwardly, what constitutes good supervising? To answer this question and get a thorough understanding of the process, it is relevant to take into account two perspectives, the supervisor's and the student's.

Below we quote from a summary of the results obtained from interviews [6] had with students and supervisors. Next, we will try to identify the common views student and supervisor share and work along them to find some common ground where both student and supervisor can feel more at ease with each other.

7.5.3.1 Student Perspective

Students described positive supervisory relationships as based on a shared passion for the topic, clear expectations and open communication. "Good" supervision meetings occurred within a relaxed space where the student felt they were listened to, their concerns were not dismissed and they received support, guidance and reassurance. In some circumstances, the synergy of ideas resulted in better research. Students described supervisors' contribution to positive supervisory experiences in terms of their approachability and availability, support, interest in the student as a person and sensitivity to the student's emotions. Students described their own contributions as coming to meetings prepared, taking ownership of the research project, and in some cases managing the supervision process. Where supervision meetings went well, students reported feeling remotivated, with increased focus and clarity about the project. They knew what they had to go on and do next, and felt less stressed [6].

7.5.3.2 Supervisor Perspective

Supervisors described positive supervisory relationships in terms of shared passion for the topic, clear expectations and a positive group dynamic or dyadic relationship. Good supervision meetings were characterised by discussion, guidance, clarification and positive feedback. Supervisors described their own contribution to good supervision in terms of providing structure and research knowledge, being about to explain concepts in everyday terms the students could understand and being supportive. Students were viewed by supervisors as contributing to positive supervisory experiences through being interested in the topic and taking ownership of the project. The outcomes of good supervisory meetings were described in terms of seeing the personal growth andskill development of students, and student satisfaction [6].

Both perspectives are brought to attention in order to identify the views both student and supervisor share and attempt to find some common

ground towards making supervision a most rewarding experience socially and academically for both student and supervisor. That supervision involves a relationship goes without saying. Let us see below how this relationship can be improved to mutual benefit.

7.5.4 Positive supervisory relationships

The social and human aspect of this relationship is very important for both student and supervisor. It appears that both student and supervisor agree that shared passion for the topic and clear expectations are important. In this regard, it is essential that both student and supervisor work closely together to select a topic they both love investigating and that promises good collaboration between them. While the student places the emphasis on good communication, the supervisor sees supervision as a dyadic relationship, which implies that both lay their emphasis on the expectations from each other. The student needs some form of social comfort stemming from good communication, while the supervisor implies that the student should also acquire some form of independence.

Building a mutually constructive and supportive relationship is crucial because it will help students and young researchers communicate freely, express ideas and fears more explicitly, increase their level of confidence, take ownership of their work more quickly. Nevertheless, it should be taken into consideration that students are different and their passage to ownership might follow different paces. But, "[t]he key to establishing a working supervisory relationship is to understand each other's expectations and agree upon roles and responsibilities accordingly"[6].

7.5.5 Meetings

Supervision meetings are very important in the process because they establish the course of communication between student/young researcher and supervisor. To make the most of these meetings, both student and supervisor should play their part. It is important that both student and supervisor go to these meetings prepared. One of the first things students expect from the supervisor is information about the programme of study and especially about the formal procedures leading to the dissertation defence. Therefore, some preparation is needed. The supervisor should make sure that he/she is familiar with the formal procedures and requirements for supervision, with the requirements and guidelines for writing a good dissertation and especially be familiar with the roles and responsibilities of the supervisor as outlined in the programme. Using a checklist of activities to undertake for supervision would be a good idea [6]. The checklist helps the supervisor not only to cross out the activities to

be carried out but also to add others that are not on the list. Some of these activities might include:

- Documentation to consult,
- Supervision regulation (role and responsibilities of the supervisor, possible restrictions, workload, important dates, possibility of co-supervision etc.);
- Looking for good practices (previous projects or dissertations); and
- Information about mentoring/counselling opportunities.

The first meeting should serve to reach an agreement on communication issues primarily since communication singles out as very important for students. Thus, defining the forms of communication that are acceptable (email, online tools, communication apps, phone calls) and the frequency of meetings are two important things that need to be settled from the very beginning.

Students vary in their need for assistance, degree of dependence/independence, level of interest. Some are hesitant to get into contact with the supervisor, others need frequent contact with the supervisor in order to be confident about the progress they are making. When working with group projects, some communication modes and patterns should be agreed upon like copying all the group contacts in the email when communicating. It is recommended that a summary of what was discussed and agreed upon during the meeting follows up the meeting. This will help both students and supervisor check what has been obtained during the meeting, what progress has so far been made but also agree upon the next steps to take and set deadlines about the completion of tasks following the next stages.

Although student and supervisor can be constantly in touch together through other means of communication, face-to-face meetings are important because they give the student the chance to discuss, clarify unclear items, receive feedback, be listened to, and feel relaxed, reassured and supported. To ensure this sort of atmosphere the student needs, the supervisor should not simply review the progress done but should also encourage the student(s) to ask questions about unclear things, to express their own opinion about what they have done so far, to ask them to report how they feel in relation to the work done so far, provide constant guidance and reassurance.

Finally, supervisors should bear in mind that most often it is the emotional aspect of the relationship they should pay more attention to, which regards aspects not pertinent to research, such as body language, voice pitch, degree of attachment, intercultural communication skills

(when dealing with international students) but that account more than all other preparations done for research.

7.5.6 Supervisor's feedback

One important aspect of supervision is feedback. The supervisor's opinion and the feedback on what has so far been done is very important for the student. When provided, it makes them more motivated to go ahead, think more critically about their work, improve it and keep to the deadlines set. When poorly provided, students feel frustrated, helpless and less motivated. Feedback can be formal and informal. It is of good use to students to receive feedback before the next supervision meeting takes place so that it can be discussed in the next meetings and allow for identifying areas for improvement. To ensure that students receive feedback, it can be recommended that this be formalized into feedback templates that include the areas/headings for providing different kinds of feedback at different stages of supervision. So, if the student is in the process of writing the dissertation/project report, the feedback will concern the dissertation/report drafts and will be about the content, formatting, citation, language used, text coherence, structure of the work.

7.6 Research steps

7.6.1 Supervising research students

7.6.1.1 From the problem to the question

All research stems from a problem, from a situation or any other thing that is observed but that needs to be solved or answered in some way or another. This problem later becomes a research topic that needs investigation.

In order to help students identify a research topic to work on, a supervisor should encourage them to think about their work-related context and ask them to observe carefully if there is something unsatisfactory or unsettling they would like to solve or ask them to look more closely at the literature for consultation and try to identify a problem to be solved or look into their experience. By doing so, the supervisor will help them take their first step towards taking ownership of their project or dissertation. Supervisors should make sure that the students realize what constitutes a good research question: significance, clarity, feasibility and investigation of relationships. Emphasis should be laid to the fact that formulating

research questions as precisely as possible is the key to the following steps in research, that is, research methodology and design, sampling, instrumentation and so on. Therefore, guiding this stage as closely as possible is crucial for the next steps in research. As mentioned earlier, one of the sources for locating research problems and topics is literature review. Literature review helps students not only track down what other researchers have already looked into and found out, but also and above all, what has not so far. These undiscussed issues, commonly referred to as gaps in literature, will be of use to students for identifying their own research topic.

7.6.1.2 Literature review

Quite commonly students stumble on literature before beginning their research work. Two are the most commonly reported difficulties:

- Where to locate literature?
- What sources to consult?

The key to success is to equip students with good searching skills. Therefore, it is necessary to teach them the steps involved in literature review:

- Define the research problem as precisely as possible;
- Look at relevant secondary sources;
- Select one or two appropriate general reference works;
- Formulate search terms pertinent to the problem;
- Search the general references for relevant primary sources; and
- Obtain and read relevant primary sources; note and summarize key points in the sources.

Doing literature review is far easier nowadays given the availability of so many sources and databases. The next thing is to emphasize the importance of key words. Advising students to identify key terms/descriptors as precisely as possible is essential to identify primary and secondary sources. It will provide more useful results pertinent to the research topic.

It is important that students document their search, which implies recording all basic information about the sources searched for and read. The best way to record this information is to use word document templates. There are a lot of them available online. Below, in a table 7.2, is shown a very simple template.

Table 7.2 Literature search template [7]

My research question:				
Places to search for information:				
List of sources searched:	Date of search	Search strategy used, including any limits	Total number of results found	Comments

It is very helpful to them, is they are informed them about the most available indexes or databases and about how to differentiate between primary sources and secondary sources. The supervisor should help them to identify the most useful databases and indexes for their own field of research, to develop some strategies for locating literature, to recognize literature that is useful for their own research. The importance of abstracts in identifying literature that is of use for their research should also be highlighted. It should be pointed out that besides searching for sources should go alongside organizing the material and students need to be advised to do so. To sum up, advise them to:

- Select citations that are relevant to their topic;
- Record all basic information as they read each source;
- Organize and edit materials; and
- Identify strategies for obtaining additional sources not available in library.

Students and young researchers should be encouraged to evaluate the literature collected and prepared to write the literature review report. This could be done by using worksheets for evaluating literature review alongside the templates for recording them or by encouraging them to reflect on literature by trying to answer some questions.

The next step would be the writing of literature review report, which consists of:

- Introduction;
- Body of the review;
- Summary;
- Researcher's conclusion; and
- Bibliography.

7.6.2 Developing a research proposal

Once students have done most of their literature search, they are now ready to move towards the next step, which involves planning their research. Writing a research proposal is the best way to plan research and frame most elements of research. A research proposal is important basically because it:

- Provides a detailed outline of what the researcher intends to do;
- Informs others about the intended research and allows them to offer suggestions for improving the study; and
- Helps the researcher clarify what needs to be done and to avoid unintentional problems.

But not all students or novice researchers know how to plan or write it, therefore, it is important that supervisors inform students about the importance of writing a research proposal (being also an important part of the evaluation of their research topic), teach them how to do it and assist them while writing it, but in no way write it out for them. It is important that supervisors encourage students to take ownership of their own project/dissertation/research. In this regard, the many templates available online would come in handy to young researchers, although these are often provided within the framework of the study programmes themselves. Despite the differences across disciplines and research methodologies, all research proposals contain four major sections:

- The purpose of the study, which is a concise statement about the purpose of what the researcher proposes to investigate. It provides a framework to which details are added later. The field of interest can also be clarified here;
- The justification for the study. The importance of the study should be pointed out in this section. The researcher must present an argument for the study and also any specific implications that follow if relationships are identified should also be include, like for instance the inadequacy of the current methods applied should be made explicit;

- The research question/hypothesis, including variables to be investigated. The particular question to be investigated should be stated here. For quantitative research, stating hypotheses will help clarify and become a strategy point. They should be formulated as concisely and precisely as possible;
- The definition of terms. All key terms should be defined as clearly as possible so as to avoid any likelihood for ambiguity. Sometimes, terms will have to be modified to fit the present study.

One-page Research Proposal Summary is given in table 7.3, which students might find useful when drafting their research proposal.

Table 7.3 One-page Research Proposal Summary [6]

One-page Research Proposal Summary	
Title An exploration of...	Focus, location, participants, processes, goals.
Purpose of Study This study will...do what and produce what	
Justification Why spend the time - what is the need and value? Why I can complete it - my knowledge and network.	
Academic Objective The study will contribute to what field of study? What are key theories and concepts in the field?	
Practical Objective This study will contribute to...What problem	
Research Questions/Hypotheses What is happening? What is the impact? What is working?	
Research Design What research approach - why? What sample? What is the unit of analysis?	
Research Method Collect what from who how when and where?	Case study - survey - record scan -observation - focus groups - interviews - secondary data

Two things should be born in mind:

- Students should be helped to become independent in the process and take ownership of their work. This can be done by reviewing the drafts of their proposal and discussing them during the meetings and encouraging them to use the feedback provided;
- They should not expect their research to be perfect. All sorts of difficulties can arise during research. Ideal conditions for carrying out research are difficult to obtain. Therefore, it is comforting to let them know that "'there is no such thing as a perfect research proposal (or dissertation)' […] and that your shared goal is the development of a research proposal that sets out a program of research that is achievable within the program constraints" [6].

7.6.3 Research ethics and scientific integrity

Both research ethics, which refers basically to adopting ethical procedures that do not cause any harm whatsoever to participants involved in the study during data collection, to respecting them as well as to reporting the research fully and honestly, and scientific integrity, which regards mainly lack of instances of academic dishonesty and plagiarism, are very sensitive issues among the research community and the academia. As such, supervisors should inform their supervisees about what constitutes a breach of ethical behaviour and procedures, the measures against unethical behaviour or plagiarism and highlight the importance of ethics in research, make students aware of copyright and plagiarism issues. Some guidance on copyright and intellectual property right issues regarding the submission of e-theses should also be provided.

7.6.4 Responsibilities of students

As mentioned earlier, supervisors describe supervision as a dyadic relationship, which implies that, besides providing guidance, reassurance and positive feedback to the supervisees, they also expect from them a high level of commitment that would eventually help them grow more independent and take ownership of their research. Below is a suggested list of things students should feel are their responsibility in order to carry out research in a less stressful and painful way and obviously in a successful way. Students should:

- discuss their proposed research topic with their supervisors and plan the timetable for the research together;
- agree on the meetings schedule together with the supervisor.
- Discuss feedback with the supervisor;

- Keep track of the progress done from the first meeting to the later ones;
- Follow the supervisor's advice and suggestions closely and ask questions if anything unclear appears;
- Respond to the supervisor's comments and feedback;
- Get informed about the formal procedures, legal issues and regulations regarding research, ethics in research, scientific integrity issues, copyright issues, data protection issues and any other unethical practices that might arise during research;
- Get informed about the formal requirements leading to the finalization of the dissertation defence and of obtaining a degree;
- Work systematically and in accordance with the deadlines set together with the supervisor.

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CHAPTER 8: Research Projects Planning and Managing

-State of Art-

Dejan BOKONJIĆ[21], Sinisa BERJAN[22], Nenad MARKOVIĆ[23]

ABSTRACT: There are different definitions about what is the project. According to EU Project Cycle Management Guidelines (EC, 2004) "*a project is a series of activities aimed at bringing about clearly specified objectives within a defined time-period and with a defined budget*". Project can be a group of different activities constrained by time, cost and scope designed to deliver and create unique purpose. Project has a clear and specific objective, it is someone's responsibility and it is any sort of planned undertaking which is finite and bounded.

This chapter focuses on project planning and management. After a brief introduction of project life cycle, the following section deals with project formulation and project proposal preparation. Then a section is dedicated to project management and monitoring. It should be highlighted that many issues regarding project management are decided in advance while preparing the project proposal for that they are addressed in the section dealing with project formulation.

KEYWORDS: Project, project management, project planing

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8.1 Project life cycle

The Project Life Cycle (figure 8.1) refers to the series of activities necessary to fulfillment of the project goals or objectives. Certain phases of development are present in every project. Although projects may vary in size and complexity, all projects can be mapped to the following life cycle structure no matter how large or small they are [1]:

- Starting the project;
- Organizing and preparing;
- Carrying out project work; and
- Closing the project.

Clear and proper understanding of these phases allows managers and executives to maintain control of the project more efficiently. By definition, a project has the beginning and the end and goes through several phases of development known as life cycle phases. These phases can vary depending on the industry involved but all of them follow the same basic steps. It is important to realize that the project life cycle for each project may differ in both the number of phases it may have and the details within each of these phases.

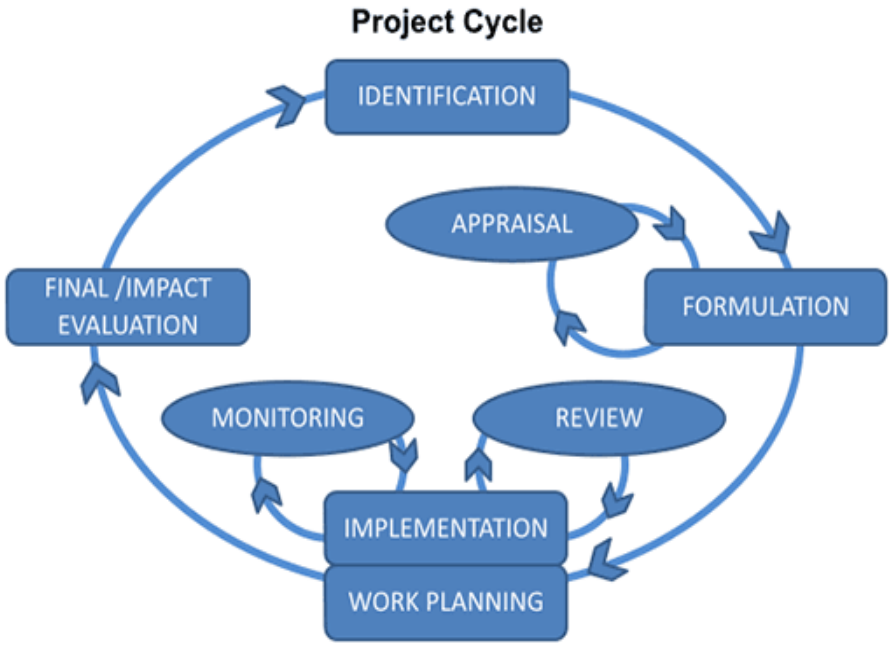

Figure 8.1 Example of Project life cycle [2]

In order to have a successful project, the project team must [3]:

- Select the appropriate processes and persons to meet project goals and objectives;
- Use a defined approach focused on meeting the requirements of the project;
- Clearly define and agree upon stakeholder/customer needs and expectations;
- Balance the competing demands of scope, time, cost, quality, resources, and risk to produce the specified product, service, or result.

8.2 Lifecycle of research projects

For realization of research ideas it is very important to develop project and understand the whole concept. Research is always starting with research idea. After developing of the draft project idea consultation process should be organized, also good review of the literature and peer review should be organized. Team who is developing project should come together and discuss once again project proposal. When research idea is finalized and all partners agree, next stage in preparation of the project is coming and that is finding good opportunities and donors to which you can submit such idea. After finding donors somebody should start preparing project proposal. During preparation of proposal it is very important to organize ethics review process and that should be also must criteria.

If application is awarded to be granted research can start. Operational approval must be done. Equipment should be purchased, if it is predicted to be bought, staff prepared and research started on systematic way. During project life time it is necessary to introduce quality control measures and also regular monitoring process. Intermediate reports should be regularly submitted to donor. In the end final report should be submitted in order to prove that grant was used properly and that all predicted activities were performed on time and according to plan.

8.3 Project formulation: Preparation of a project proposal

8.3.1 Some insights about research proposals preparation

Writing of project proposal, both concept note and full proposal, is state of art. It is a very demanding, creative and hard job but to possess this skill is must criteria in current world. There are many different guidelines,

approaches, and numerous of recommendations, which somebody could find about preparation of project proposals. Those information can be found on internet, in electronic and hard version books, different articles and etc.

A successful proposal is one that gets the money!

A successful proposal for EU funding has to overcome many challenges to get the money.

So, getting a successful proposal needs the right philosophy!

It is important to have the necessary philosophy to understand what is needed and the way the EU programme managers and proposal evaluators will assess your project proposal. This guide to writing project proposals tries to get you into the right frame of mind to know what to write and how to write it [4].

In the beginning when somebody decides to go into this story he/she needs first of all to have a good idea. The objective in writing the project proposal is not just merely the description of what you want to do, but to persuade the funding source to give you the money! Also, important question is: "Why should they decide to give the money to you when there will be lots of other good proposals they could select instead of yours?" So, it is important to learn how to be competitive! For instance, for H2020 project proposals, because of the very strong competition, you need to be very competitive, targeting your proposal to be the best that the evaluators read. Because of the popularity of some H2020 schemes, so far success rates have even been below 4% and average H2020 success rate is only around 12% - which means 88% failure! Idea is crucial and the main precondition for starting the whole process. Generally, idea has to be creative, attractive and must be in accordance with priorities and recommendations which can be found in application call. To be successful, your proposal will need to have something really special about it, so avoid saying the same things that everyone else will say! [4].

Project idea has to give answer on several questions. First of all what is important and to whom is important such idea. We need to find common problem for all those who will participate in the project. This has to be "hot topic" and usually should be in accordance with good practice of those institutions or organizations with whom we are comparing. For example usual situation in high education and research area is transferring of some good practice from those institutions, which already introduced such idea to those who would like to introduce new processes, procedures or good practice. During defining project idea somebody has to emphasize what problem this project is going to solve. Again, this problem has to be unique or specific, but only in situation when its implementation is going to bring big progress for institutions itself. Next important question is

proving that different other institutions or organizations by using such project idea have solved some problems or improve their organizations. Of course, project ideas can be completely and brand new, as the new approach for example in leading High Education institutions or introducing some new processes and procedures but this is not very often common. So, transferring of good practice from better institutions to our institutions in particular field is very common and useful methodology in High education and research area today. Examples of good practice are very popular for new projects. When somebody is starting with preparation of project proposal they should read a lot of literature and to find and analyze idea and topic for new project proposal in details. Approach at least has to be unique and adopted to current situation in particular country or on particular universities. Proves that idea can work is experience of other institutions who implemented such things before those who are applying.

Challenges to overcome: According to [4] philosophy for success includes knowing how to avoid or overcome four major challenges:

- to follow all the instructions, meaning to read and implement them;
- to be persuasive making statements with enough supporting evidence to convince evaluators;
- to provide sufficient details of activities that will be carried out in order to convince evaluators of the activities' impact;
- to be consistent in what you write in different parts of your proposal, to avoid evaluators getting confused.

So, bear these four challenges constantly in mind while you write your proposal.

8.3.2 Preparation of a project concept note

A concept note is the first and the most important document that introduces your project idea to the potential funding agency. Actually, that is a laconic summary of a project describing the project idea and objectives to be followed. Some funding agencies require to send them a concept note first, and when it is approved you can submit your full proposal. Writing a concept note try to be very concise and precise. It should be a brief outline of your proposed project. The purpose of a concept paper, is to help work out more competitive proposals and to save time by filtering proposals that are not appropriate to be funded. The applicant’s goal in developing a concept paper is to grab the attention of the potential funding agency and convince it that the proposed idea is worthy of further consideration. Therefore, the first sentences of a concept paper are crucial. You want the

funding body to continue reading! [5]. Tips for the Development of your successful Concept Note are:

- Do not overload the reader with details, but avoid sounding vague or unsure about what you want to accomplish [5].
- Be positive and definite. Instead of saying an objective "may be accomplished," indicate that the objective "will be accomplished" by a certain time [5].
- Consider your audience. In most cases, you will have to create different concept notes for different funding agencies for the same matter. Only when your concept note matches with the interests of the agency, your request will have a chance. Find out as many details as possible on objectives, "hot topics" and interests of the organization you are sending the concept note to.
- Consider your language. If your concept paper is going to be reviewed by experts in your field, scientific terms and technical jargon may be acceptable. However, if your proposal is being reviewed by generalists or lay persons, this type of language will not communicate your ideas effectively.
- Only include budgetary information if it is specifically requested.
- Appearance is important. This concept paper represents you! The type size should be large enough to read easily, and margins should be standard. Check for grammar, spelling, math and other errors before submission. Attention to details is important. Number all pages. Place your name and date in the header. Include your contact information with the concept paper [5].
- Identify a door opener if you are not writing your concept note for an announced call from the organization. Sending random concept notes to the general address of an organization is rarely successful. If you do not know anybody who could introduce you to somebody of the targeted organization, it's a good idea to establish personal contact by phone or in a meeting. Only once you have convinced somebody who supports your concept idea within the funding agency, you will have a real chance with a "wild" concept note submission.

Writing a successful concept note takes much time, so you have to think and schedule the action carefully. How well you plan the action will largely influence how good the actual results are. The planning is perhaps the most critical stage of a project [6].

The funding agency usually specify the length and the format for a

concept note. Most funding agencies require a minimum of three pages to a maximum of five pages.

A concept note should include the following information [7]**:**

- Title: should be informative, distinctive and capture the readers' attention;
- Background: should follow two major questions: Why it is crucial to address the problem identified? and What has already been done to solve the problem?;
- Objectives: briefly specified;
- Methodology: describe your methodology, e.g. how the project will be implemented and mention any innovative approaches, techniques, or processes that will be applied;
- Outputs: should be directly related to the project objectives. They are typically tangible items, such as a newly constructed technical facility, the publication of information materials, or events, such as workshops or stakeholder meetings. Depending on the project in question, intangible items might also be mentioned, such as a rise in awareness;
- Activities and duration: a summary of the planned activities to achieve the project objectives. Include general timelines by what you hope to accomplish each step;
- Beneficiaries and impacts: this section is important for getting "buy-in" from the funding agency. Describe the expected benefits (both in quantitative and qualitative terms) and who will benefit. Consider who and how will assess the impacts;
- Project management (includes monitoring and evaluation): this section should explain how the objectives will be achieved and how the project will be managed and evaluated. It should become clear who will lead the project and what roles and responsibilities the various people in charge of tasks such as financial management, monitoring and evaluation will have;
- Budget (only include budgetary information if requested by the donor agency): before drawing up the budget, it is necessary to get an overview of the inputs needed to achieve the objectives. These may be, for example: people, travel costs, vehicles, equipment, supplies, services, works, facilities and overheads.

8.3.3 Developing project full proposal and work plan

When project idea is ready and accepted by all partners and when it is fit into priorities of some application call, it is time to start with developing project plan.

Whenever one project is planned it is absolutely vital to have a project plan and will ultimately save you a good deal of time. There is a lot of information required in a project plan. What can be found in the project plan depends and will be strongly influenced by the type of the project; so it is a good idea to start off by defining the type of the project. You also need to identify all the 'stakeholders' in the project. This task sounds far easier than it is because a stakeholder is anyone who will be affected by the project, so identifying them can take some time. Once you have identified all the stakeholders, you need to engage with them to ascertain what they want and need from this project. When having clear situation, you will need to start to draw up a list of project goals.

Project plan is consisted of different parts. It depends of the project application and donor and also of the amount of the budget allocated for particular call and possibly for particular project.

Usually project is starting with clear description of the project background. So, it is very important to describe current situation in the country and region where project will be applied. Also, it is necessary to describe current situation on the applying institution/organization. In the same time those who are applying for the project has to describe current situation about particular field which is topic of the project.

Next part of the project application usually is devoted to the description of the project partner institutions/organizations. It is very important to clearly describe roles of each partner in the project, their clear tasks and responsibilities. Background of each institution/organization should be described, their expertise and what can be their contribution to the project. In the project proposal it should be clearly described why this particular partner is selected.

Each partner institution should propose key experts who are going to be involved in the project realization.

After setting up consortium we have to define project rationale. First of all from the project proposal it should be clearly seen that projects fits into defined priorities and second why project is important for development of high education process or research. Also, it should be emphasized how project fits into strategies for development of research and high education process. So, detailed information about current situation in that particular field should be logically continued with information about what project is about and in which aspects it will bring changes.

After all these steps it is perfect time to develop project proposal. First, wider project objective should be defined and after this step specific project objectives should be also defined. Specific objectives should be derived from wider objective. List of specific objectives should not be too long. During development of project proposal it is very important to

address the following points like involvement of different groups into the project, activities leading to the expected outcomes, being consistent with the wider and specific objectives, quality assurance measures and etc. The description must indicate the working methodologies to be used with a clear monitoring, quality and management plan including measures for conflict resolution.

Tasks and responsibilities are all very important, because there has to be a clear strategy what should be done and who is responsible for doing what and when these things will be done. It is really important that these are identified very early on in the process. Often these duties and tasks are contained in a logical framework matrix (LFM) and work-plan that lists duties and shows responsibility for delivering these duties against the agreed timeframe. The beauty of these two documents is that it shows the evolution of the project and how each duty and task flows into the completion process.

LFM is very important part of the project. LFM follows vertical and horizontal logic. In vertical way it is starting with wider objectives. From wider objectives specific project objectives are derived. Tangible and intangible outcomes are defined based on specific project objectives and finally precise activities are planned. In horizontal way from objectives to activities all of them must be explained by using indicators of progress, tools how indicators will be measured and assumption and risks. Finally in the end, each LFM contains very detailed described inputs necessary for implementation of the project activities.

Turning concepts into a working plan is very important for successful running of each program. Work-plan is used for careful planning of project activities and preparation of clear deadlines. The working plan needs to include more details than is needed in a proposal, in order to have all the strands of activities brought together. It is important to know that the features recognized in the proposal may not represent the whole project, since there may be dependencies on, for example, external facilities which scheduling is not under the control of the project. Further, the goals may have to be scaled back depending on available funding. The working plan should build on the information developed for the proposal, particularly for such issues as the way how different components of the project interact, and where bottlenecks may occur. Critical path analysis can help to recognize such features, and suggest ways how to overcome them [8].

8.3.3.1 Project dissemination and sustainability strategy

For approving one project proposal evaluators and donors usually asked for clear dissemination and sustainability strategy.

Dissemination is an important project outcome that starts from the beginning of the project. The project coordinator and the project management team will be in charge for dissemination of project results. Different dissemination tools should be developed. As a part of the dissemination strategy a project website should be created for dissemination of information. So, information will be available to all project partners involved, other target groups, stakeholders and a broader public including political stakeholders – different ministries and etc. Project website will be linked to website of all consortium members. All project partners will disseminate project results internally in their own organization. Newsletter and other applications are important for disseminating the milestones in the realization of the project outcomes. Very important is also the project dissemination conferences. We think that for successful implementation of the project is necessary to organize info days for different stakeholders. The systematic dissemination of the projects results is a key prerequisite for the exploitation of the project's results and the overall success of the project. All dissemination actions in the projects should be properly planned and focused on the achievements and impact of the action. In order to maximize the impact of communication efforts:

- Activities need to be timely;
- Activities should be co-ordinated closely with all project partners;
- The right groups should be targeted;
- Activities should be appropriate in terms of resources spent and expected impact.

General objective of the dissemination plan is governed by the need to support the project sustainability and shall be focused on the following things:

- Spreading the information about the project to different target groups not directly involved in the project in order to share results, best practices and lessons learned;
- Gaining support from main stakeholders and politics in order to generate positive decisions concerning project sustainability;
- Gaining interest from direct users.

The dissemination strategy explains how the project outcomes are shared with stakeholders, relevant organizations, and individuals. Thus, the approach for dissemination is addressed to fulfill the project expectations and to ensure its post-implementation sustainability.

- The dissemination strategy defines the main action lines to be followed for designing and implementing an efficient dissemination plan. These actions include: Design of Project brand (logo, colour scheme, style sheet, etc.);

- Production and distribution of promotion materials (flyers, posters, brochures, etc.);
- Organization and participation in relevant events (workshops, exhibitions, meetings, etc.);
- Exploitation of media resources (newspapers, TV, web portals etc.);
- Ensure communication and involvement of all project partners in dissemination activities;
- Establish synergies with other relevant projects to extent the scope of dissemination results;
- Monitor the implementation of the dissemination plan, assess the dissemination activities results and adjust the Dissemination Plan as needed.

In addition to this dissemination strategy outlines, the dissemination plan shall consider the sustainability strategy outlining what dissemination activities could contribute to the sustainability, exploitation and spreading of project results.

Regarding sustainability, project consortium should clearly prove in project application that a results of the project will be sustainable. There are different types of sustainability. Academic sustainability means that results will be accepted by all partners and authorities and fully implemented after finishing of the project. Financial sustainability can be ensured by financial support of all Ministries and the State itself. Acceptance of final project results and incorporation of those results into different strategies and documents on high education institutions or process as whole will provide final sustainability of project results.

8.3.4 Getting project funded: finding a donor

Projects can vary significantly regarding their objectives, scope and scale. In this sense, smaller projects might involve modest financial resources and last only a few months, while large projects might involve many millions of Euro and last for many years [9].

When project idea is developed it is proper time to send it to other potential partners for getting opinion and support. So, after acceptance of idea from possible project consortium it is time to find donor.

In the same time during defining good project idea is very important to look at possible donors and those who are going to approve such proposals. Usually, donors during submitting project call are giving precise description of call with all priorities and topics which should be met by all those who would like to submit proposal (e.g. European Commission inside Erasmus + Capacity building action and Horizon 2020 has clearly defined priorities for each country and regions with all topics which can be

eligible for granting). Your starting point, having identified a suitable funding source to develop your idea, is to read carefully the funding scheme's relevant background documentation on programme objectives, objectives of the call (or topics) and the Guide for Applicants [4].

Apart from this, usually serious donors are offering results or abstracts of all previous granted proposals, so those who would like to apply for grant in the future can check what was submitted and granted in the past.

8.3.4.1 Research and development projects funded by the European Union

The EU provides funding for a broad range of projects and programms covering areas such as:

- regional & urban development;
- employment & social inclusion;
- agriculture & rural development;
- maritime & fisheries policies;
- research & innovation; and
- humanitarian aid.

Horizon 2020 is project the financial instrument implementing the Innovation Union and Europe 2020 with the main aim to rise Europe's global competitiveness.

This project should drive economic growth and create jobs. EU agreed that research is an investment in our future and so put it at the heart of the EU’s blueprint for smart, sustainable and inclusive growth and jobs.

By coupling research and innovation, Horizon 2020 is focusing to achieve this with its emphasis on three main priorities: excellent science, industrial leadership and tackling societal challenges.

The goal is to ensure growth of good science in Europe, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering innovation.

Horizon 2020 is open to everyone, with a simple structure. This approach makes sure new projects get off the ground quickly – and achieve results faster.

The EU Framework Programme for Research and Innovation will be complemented by further measures to complete and further develop the European Research Area. These measures will aim at breaking down barriers to create a genuine single market for knowledge, research and innovation.

Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020). This programme brings ideas from the lab to the market and on that way connecting high education institutions with market.

Most of the EU grants is managed in cooperation with national and regional authorities through the following structure:

- the Structural & Investment Funds. Collectively, these help to implement the Europe 2020 strategy.
- European Regional Development Fund (ERDF) – regional and urban development
- European Social Fund (ESF) – social inclusion and good governance
- Cohesion Fund (CF) – economic convergence by less-developed regions
- European Agricultural Fund for Rural Development (EAFRD)
- European Maritime and Fisheries Fund (EMFF)

Other funds are managed directly by the EU through Grants for specific projects in relation to EU policies, usually following a public announcement known as a 'call for proposals'. Part of the funding comes from the EU, part from other sources.

8.3.4.2 Research projects funded by companies

Key funds in research today are coming from industry and market as whole. To attract investitures it is very important to prepare good and inspiring research proposal. A research proposal is a concise and coherent summary of your proposed research. This proposal contains questions that you intend to address. It presents area of study within which your research covers, referring to the current state of knowledge and any recent discussions on the topic. It is very important to emphasize originality of proposed research.

The proposal is the crucial document that you submit as part of the application process. Through proposal somebody should see that you have the capability to set up research and implement all research phases by demonstrating that you have the ability to communicate ideas clearly, and critically. The proposal also helps us to match your research interest with companies, who supposed to finance research.

Research proposal should normally include the following information:

- Title - This is just a working version title for your planned research. Title can be revised during the research depending of the preliminary results and proposals coming by investiture;
- Abstract - The proposal should include a concise statement of your intended research of no more than 250 words. This may be a couple of sentences setting out the problem that you want to examine or the central question that you wish to address;
- Research background - It should be explained the background of the problem against which you will conduct your research. Also a brief overview of the general area of study within which your proposed research

covers summarizing the current state of knowledge and recent discussions on the topic. This will allow you to demonstrate a familiarity with the relevant field as well as the ability to communicate clearly;

- Research Questions - The proposal should present main aims and questions that will guide research. Key questions and dilemmas should be discussed before writing proposal. Research proposals should not be broad, so reflecting on key research questions is a good way to make sure that project is sufficiently feasible. Very important is to define research hypothesis and research goals from which you can derive many research questions. The proposal should also explain your intended approach to answering the question through study;
- Research Methods - The proposal should outline research methods, explaining how research is going to be conducted. Methods may include searching different libraries or archives, field work or interviews. Most research is library-based. If proposed research is library-based, it should be explained where your key resources are located. If there is a plan to conduct field work it should be provided details about how is going to be organized. This section should also explain how analysis of research findings is going to be organized;
- Significance of Research - The proposal should demonstrate the originality of your intended research. You should therefore explain why your research is important (for example, by explaining how your research builds on and adds to the current state of knowledge in the field or by setting out reasons why it is timely to research your proposed topic);
- Bibliography - The proposal should include a short bibliography identifying the most relevant works for your topic.

During preparation of project proposal it is very important to contact different member of staff, key stakeholders, representatives of the work-field who can help with their expertise.

If there is a good fit between proposed research and research directions of the company, who can be a possible donor, there is a good opportunity that particular research will be funded.

8.4 Project management and monitoring

8.4.1 Fundamentals of project management

Knowing some basic aspects of project management is crucial precondition for starting preparation of project proposals. It is very important to define some objectives for project management. Building common principles and methodologies of project management is very

important. Connection between project managers should be established and best practice must be shared inside network.

On the other hand project management means set of coordinated and controlled activities for realization of some objectives in defined time with defined resources. For project management in general is very important to have defined coordinated and controlled activities, time and cost constrained operations and through project it will be introduced different knowledge, skills and techniques. For one project it is very important to have clearly defined project idea which has to be innovative and desiring. Each project is facing with some challenges like: objectives are not well defined, resources are planned on insufficient way, project plans are unrealistic, communication is missing, team is not adequately selected, risk analysis is not predicted, control process is weak, etc. Project management can help institutions to meet their strategic goals, by reducing risks and efforts.

During defining project it is very important to consider project within broader context and projects must be influenced by internal and external environment. Internal environment means condition, which one institution has established for project work and also means general organizational culture.

Institution can influence internal surrounding but external environment institution has no influence to change. External environment includes donor requirements, different regulations, infrastructure, etc.

Every project is depending upon people, process and tools. Process means way how the project will accomplished. Human resource management is usually crucial. For project realization it is necessary to have skilled and good educated staff. Finally, one organization needs to pose adequate techniques for successful project management.

Project has to manage four key constraints: scope (project frame), schedule (time to finish project), budget (available funds) and quality (achieving expectations of donors). During preparation of project proposal, project coordinator has to be aware of project constrains.

Project management consists of six phases:

- Initiation;
- Planning;
- Implementation;
- Monitoring;
- Adapting; and
- Finishing.

In initiation phase project concept should be prepared. Draft proposal should be defined. Proposal should be brainstormed and finalized. Through

other phases project proposal should be developed, implemented and controlled.

Project Management (PM) is conceptually very simple but a lot more difficult to put into practise. PM process means group of structured activities that produce a specific result. Most important management processes are: schedule management, team management, risk management, quality management, scope management, etc. The whole project management process is starting with inputs necessary for definition of project plan and for implementation of the project. The whole process should be regularly checked and adopted according to needs. From the process different outcomes are coming. All project management processes can be organized into core and supporting processes.

For successful running of the project is very important to have good project manager, who should be good integrator, communicator and leader.

For good project it is also very important to plan very clear and strong project management structure. Good project management is essential for a successful implementation of the project results. One partner is always acting as coordinator and is responsible for all communication with partners, with donors and for delivering all reports in time and for the financial management of the project. Although coordinator is in charge of the full project implementation, the practical implementation of all project activities should be taken by all partners. All partners agreed on that division of tasks.

Furthermore each other project partner should indicate a responsible staff member in charge of project management for his or her institution. They will have to deliver in time all requested financial and administrative documents to the coordinator. They also have to take care that all academic staff members deliver all project deliverables in time and respect the agreed deadlines. All indicated project managers should act as a consortium for project management. It is obvious for successful project is necessary that all decisions have to be taken only in common agreement with all partners. The consortium should meet regularly in order to see the progress of the project activities. Reports to the external donor will be prepared, finances will be controlled, timetables and activity plans will be adapted if necessary. In between the meetings there will be regular communication between all partners via e-mail and telephone. Coordinator should assure a smooth financial follow-up of all activities according to the articles of the partner agreement.

8.4.2 Project management tools

It is often feasible to get a good idea of the important aspects of a project without explicit use of project management tools. However, the use of such tools provides a very close inspection of what is required, and what is available. The work on the project plan development can reveal unexpected issues. Management tools provide tracking of progress, based on assignment of tasks, staff and resources. In all cases, effective use of the tools depends on a good understanding of the project specifics [8].

Quality management is very important for successful running of the project. The most important tool is Shewhart cycle consisted of four steps: plan, do, check and act. This cycle is commonly abbreviated as PDCA.

There are many tools (e.g. Mind Map, Drill Down, Gantt Charts, Risk Analysis, PERT chart, etc.) commonly used in project management – this is a key transferable skill and therefore being able to demonstrate the application of these techniques will be helpful when job hunting etc.

Mind Map: represents a powerful graphic technique providing a universal key to unlock the potential of the brain and tool useful at the earliest stage of a project. It sets out all possibilities and issues, helps in giving structure to project and makes linkages more evident. The number of thoughts, ideas and connections that your brain can make is limitless, which means that there are no limits to the different ways you can use Mind Maps to help you [10].

Drill Down: One approach to problem solving is known as the Drill Down Technique (Newton, 2016). In order to plan a project in detail - essential when you need to allocate funding or resources – it is needed to analyse it in detail. This technique helps to identify all tasks associated with a project (figure 8.2). Steps include: start on the LHS with the project objective, identify obvious tasks, break them down into smallest parts and list questions or points to clarify. Once you have reached what is considered to be the bottom of your chart, you will be finished and you can begin to look for solutions among what you have created. This process lasts until you simply cannot drill down any farther (Newton, 2016).

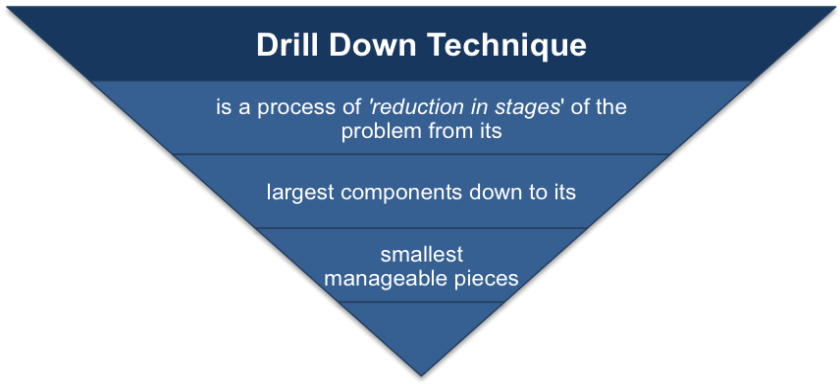

Figure 8.2 Drill down technique Newton (2016)

This technique is useful for identifying all the involved tasks, but one of the most difficult elements of project planning is the allocation of time to each task. It is important to get time estimates right for two main reasons: Time estimates drive the setting of deadlines for delivery of projects, and hence peoples' assessments of your reliability This is important in determining the allocation of resources and hence their efficiency. Usually people vastly underestimate the amount of time needed to implement projects. This is particularly true when they are not familiar with the task to be carried out. They forget to take into consideration unexpected events or unscheduled high priority work. People also often simply fail to comprehend the full complexity involved with a job.

Gantt chart: This is a very important tool in project management. It provides an overview of a project in the form of a calendar view allowing the sequence and duration of the different tasks to be appreciated. In fact, this toll lays out the tasks that need to be completed, shows when these tasks should be carried out, assists the allocation of resources, helps you to work out the critical path - the sequence of tasks in project which must be completed by a particular date to meet the final deadline.

This is the good tool to work out and show the minimum time required for a project, stating which tasks need to be completed before other tasks can start.

The Gantt chart (figure 8.3) provides an easy-to-read representation of the project at any point and can be used to monitor progress against the plan. In particular the chart enables one to see how project milestones are linked to the project components. However, if there is a need for change, it can be difficult to assess from a static chart the impact of what happens in one area on the rest of the project. Most Gantt charts are now produced using computer software and so it is possible to adjust the parameters and

see what happens [8]. It is, of course, desirable to work on a copy rather than overwrite the main description of a project! There is a possibility to have Gantt Chart organized differently.

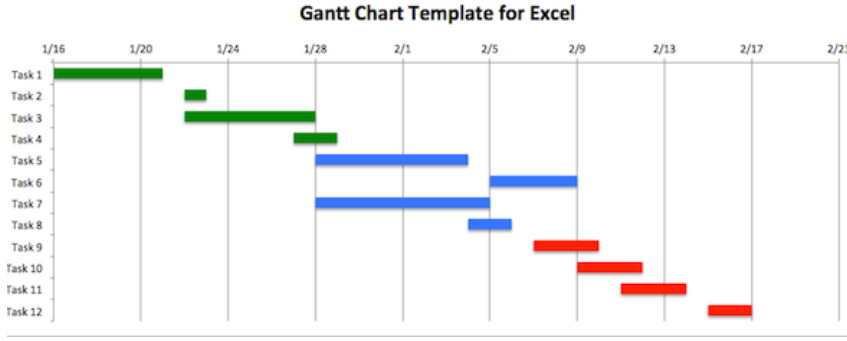

Figure 8.3 Gantt Chart in Excel [11]

PERT chart: This is a project management tool that provides an alternative way to represent the dependencies and interactions of more complex projects as graphical representation of a project's timeline. This chart includes the information on start and end dates for each component, and the way that these feed into each other. PERT (Program Evaluation and Review Technique) allows the tasks in a particular project to be analyzed. Although PERT charts are preferable to Gantt charts because they more clearly identify task dependencies, PERT charts are often more difficult to interpret.

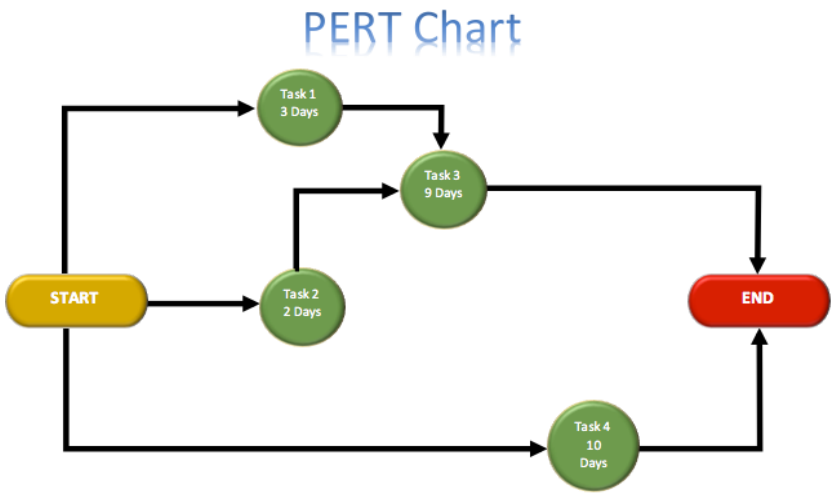

Figure 8.4 PERT Chart Template [12]

Behind schedule, if you discover or anticipate a delay it is essential to take action:

- Report the implications of delays - other projects or work may be depending on the outcome of your project so give people time to react;
- Discuss changes in plans - involve others so they can make suggestions;
- Direct resources - use the CPA to see what tasks need to be completed;
- Avoid persecution - if someone else is telling you about problems, be constructive - or next time they may not tell you until it is too late;
- Respond early - so there is time to get back on track or re-think;
- Be flexible - use your project plans to find alternatives;
- Involve the client and stakeholders - they may have ideas or be prepared to be flexible too.

Generally, project management is developing the project plans that will secure actions to implement the project; coordinate the work to use optimum resources; leading and motivating team; controlling and monitoring progress against plans.

8.4.3 Managing cost, time and quality in research projects

For successful project management and for effective and successful completion of any project famous, “Triple Constraint” (cost, time and quality) must be followed.

- **Time** – time necessary for delivering or finishing project activity. So this is time necessary to realize project activities. The amount of time required to finish activity will be directly related to the amount of requirements and the amount of resources allocated to the project;
- **Cost** – This is the estimation of the amount of grant that will be required to complete the project. Cost includes different things like: resources, labor rates for contractors, risk estimates and etc;
- **Scope** – These are the functional elements that, when completed, make up the end deliverable for the project.

The main massage from Triple Constraint is that one cannot adjust one side of it without in effect, altering the other sides. So if there is a scope change during execution of the project, the cost and time will be affected in some manner. If the schedule appears to be tight and the project coordinators predict that the scoped requirements cannot be accomplished within the allotted time, both cost and time are affected.

8.4.3.1 Understand the Triple Constraint

For starters, the project manager must be fully cognizant of the fact that scope, time and cost are fully inter-related and that the triple constraint dic-

tates any adjustment to any of those items must affect the other. Denial of the potential repercussions of adjustments to the scope, time or cost of a project are only going to lead to issues down the road and may also cause the project to fail.

8.4.3.2 Convey the Triple Constraint

Along with recognizing how the triple constraint functions, it is very important that the project coordinator transfer that information to the project stakeholders. Making sure everyone who is involved with the project recognizes the importance of the constraint will make discussions regarding the scope, time and cost far easier. Note that conveyance of the triple constraint to the stakeholders is best performed at the outset, likely during the formation of the initial project plan.

8.4.3.3 Monitor the Triple Constraint

Project coordinator should be sure that you stay on top of all the key attributes of the triple constraint. That will make your project more successful. Everyone should be aware of any fluctuations to the key attributes. Never assume that other attributes can be left un-changed if one attribute is known to be changing or fluctuating. As noted earlier, one cannot simply dismiss a change to one without being fully aware of the fact that it will affect the other two.

A particular attention should be paid to funds management. In fact, funding must be managed according to strict rules to ensure there is tight control over how funds are used and that the money is spent in a transparent, accountable manner.

8.4.4 Risk management

Risk is defined as the possibility of the occurrence of an event associated with a damaging impact on the project.

The risk is measured by two factors: the probability of the event to occur and the intensity of the damage to the project in case the event actually occur.

The process of risk management starts at the planning stage and follows the project throughout its lifecycle.

Three tasks are included in the planning process: the identification, the assessment and the response planning. Risk control is a process that follows the project until its completion.

The risk management methodology as presented by the PMBOK (Project management Body of Knowledge [13]) includes four main phases:

- Identification – detect the events that may impair the success of the project. The occurrence of these events might be estimated and identified by brainstorming, questionnaires, professional checklists, and analysis of related literature and articles or by evaluating the experience of the project coordinator and other members of the team.
- Assessment – evaluation should be performed using quantitative procedures and qualitative methods in order to define a scale for the magnitude of the risk. Every risk event is assessed by two parameters: its probability to happen and the impact of its occurrence to the project. The risk scale is based on a weighted procedure of these two parameters.
- Response Plan – the risk management team, in cooperation with the relevant parties, initiates a program for response that includes responsibility assignment, strategy of response and the time for implementation.
- Control – during the lifecycle of the project, a predefined monitoring system must be implemented, in order to maintain full control over the development of the risk events. Since there might be risk events that were not identified during the planning process, the procedures of identification and assessment should be re-initiated.

Risk has to be identified. Measures to ameliorate defined risk must be defined. Risk assessment is normally performed by the use of tools such as: team brainstorming, distribution of questionnaires, analysis of historical data and professional consulting services. In the current project we used for the preliminary assessment phase several tools.

Qualitative risk method is applied in order to present the Risk Index (RI) values that can be calculated and arranged in a prioritized list.

The value of the risk index is calculated by multiplying the probability (P) value by the Impact (I) value:

*Risk Index = Probability * Impact*

Probability (P). The possibility of an event occurrence is defined by an ordinal scale method, ranging from very low (1) to very high (5).

The method of evaluation is based on three steps: an evaluation of the probability of the event to occur, an assessment of the impact, and an arithmetical calculation of the risk index values.

The risk management team prepares a plan to avoid significant project performance deficiencies due to risk occurrences. The team monitors each of the high-risk index events and the medium-risk index events.

During internal and external controls special attention will be dedicated to impact of risks and their avoidance for all project activities.

The risks connected with a project have to be judged in context [8]. Formal risk analysis is now common for large projects. Risk analysis is an essential tool and proven way to identify and assess factors that may negatively affect the success of a project/business or achieving a goal. In risk analysis, it is important to:

- Identify sources of risk;
- Assess likelihood of risk;
- Assess magnitude of risk;
- Develop response.

Recognising the existence of risk helps towards the mitigation of its consequences.

The main types of risk relevant to research programs [8]:

- **Technical risks:**
  - Is approach appropriate?
  - Is necessary expertise available?
  - Is the timeline feasible?
- **Infrastructure risks:**
  - Dependencies on particular pieces of equipment
  - Contingencies in event of critical failure
- **Financial risks:**
  - Is costing realistic?
  - delivery timing?
  - foreign exchange risks?
  - withdrawal of support (what are the full range of commitments you are obliged to meet?)
  - are there reserves?
- **Information risks:**
  - availability of critical information
  - intellectual property issues
  - management of data and metadata
- **Reputational risks:**
  - what constitutes failure in the project?
  - is the institutional reputation likely to be affected by such failure?

8.4.5 Quality control and project monitoring

During whole project very important issue is to prepare good quality plan and to plan clear monitoring activities.

Quality control and project monitoring can be organized through annual external expert quality control and internal control during project life time.

Somebody inside consortium has to be in charge to write and submit an annual quality report during project life time. This report will evaluate activities fulfilled in the previous period. Sometimes it is good approach to select external experts for monitoring. Experts will submit reports according to plan to the coordinator of the project, who will further analyze the report and discuss the project progress with all members of project consortium. Experts will put special emphasis on the state of the art of the implementation of the project goals and outcomes.

Experts will also take into account the sustainability of project results. Therefore the final report will also include the following chapters:

- Clear results of changes achieved during the project;
- Opinion of relevant stakeholders if they are involved in the project;
- Opinion of University management about introduced changes.

Also during project it is very good to plan internal control of project results which is often done by using satisfactory questionnaires after each activity. In figure 8.4 is given plan of monitoring project progress.

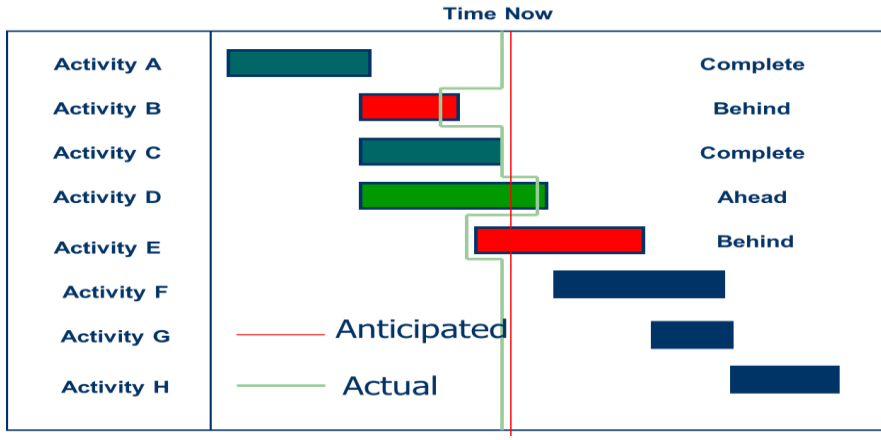

Figure 8.4 Monitoring project progress

8.4.5.1 R&D project quality

The main concepts in the R&D project quality are [14]:

- Project Quality Management [Knowledge Area]. A subset of project management that includes the processes required to ensure that the project will satisfy the needs for which it was undertaken. It consists of quality planning, quality assurance, and quality control.

- Quality Assurance (QA). All those planned and systematic actions necessary to provide adequate confidence that a product or service will satisfy given requirements for quality.
- Quality Assurance (QA) [Process]. The process of applying the planned, systematic quality activities (such as audits or peer reviews) to ensure that the project employs all processes needed to meet requirements.
- Quality Control (QC) [Process] The process of monitoring specific project results to determine whether they comply with relevant quality standards, and identifying ways to eliminate causes of unsatisfactory performance.
- Quality Management Plan [Output/Input]. The quality management plan describes how the project management team will implement the performing organization's quality policy. The quality management plan is a component or a subsidiary plan of the project management plan. The quality management plan may be formal or informal, highly detailed, or broadly framed, based on the requirements of the project.

8.4.5.2 The concept of project quality

Four main criteria are important while discussing quality [15]:

- The maximum satisfaction of stakeholders and other project output users. The tasks and activities and the project results afterwards should be oriented to meet the requirements of end users and stakeholders. That is why the project team and the contractor pay considerable attention and efforts to understand the needs of stakeholders and end-users in advance. It is important to ensure that a proper communication system is established during all project development and implementation phases.
- The completion of all planned activities are properly implemented and finished. The management process is under control and all functions, such as planning, coordination, resource management and material supply, monitoring and control are accomplished.
- The quality of products and process is achieved. The quality of project process and the quality of the final output of project are interrelated subjects. This could be achieved in case the monitoring and control system is loaded and operated properly. A monitoring system is based on the criteria settled by end users. According to those criteria, the quality of final output will be evaluated.
- The project management system ensures the supportive environment to reach the adequate quality of project output. In order to ensure the appropriate quality of R&D project output, a quality target needs to be established. Measurable quality goals go hand in hand with a flexible

and clear organizational structure, quality evaluation system and criteria, supportive and dedicated project team with adequate competencies and motivation to reach the qualitative output within the available system.

8.4.5.3 Standardisation for R&D projects

The following aspects become the target points for standardization within R&D project management [16]:

- Management limits;
- Quality system, documentation, control feedback;
- Contract review and control;
- Purchases;
- Process control;
- Infrastructure and equipment maintenance, testing and checking;
- Internal quality audit;
- Preventing performance and corrections;
- Training;
- Statistical checking and validation.

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CIP - Каталогизација у публикацији - Народна библиотека Србије, Београд

001.891-057.875(035)

ACADEMIC Guidebook for Young Researchers / [authors Marko Škorić ...
[et al.] ; chief editor Dragana Cvetković Ilić]. - Niš : University, 2018
(Niš : Unigraf-x-copy). - 254 str. : graf. prikazi ; 50 cm

"This work is part of the project Enhancement of HE Research Potential
Contributing to Further Growth of the WB Region Re@WBC ... " --> Foreword.
- "This book has been published with the support of the Erasmus + programme
KA 2 Capacity Building in Higher Education." --> Foreword. - Tiraž 2.700. -
Bibliografija uz svaki rad.

ISBN 978-86-7181-103-3
1. Škorić, Marko, 1976- [аутор]
a) Научно истраживање - Млади - Приручници
COBISS.SR-ID 258111756