Science and Technology Center in Ukraine

Project Notebook
Principles and Guidelines

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I. Guiding Principles

I.A. Philosophy and Context

As part of its mission to support former weapons scientists and their projects in a broad effort to convert the military know-how into peaceful civilian applications, the STCU is also keenly interested in assisting Ukraine and other Center member states to introduce project accountability as well as measures that will promote the growth of intellectual property rights (IPR) protection.

One of the most effective means by which to achieve such a goal is to provide guidelines on how scientists and support staff should keep a record of their research and administrative activities in the form of a project notebook—something that the West regards as a significant legal document. Using a project notebook to record ideas, inventions, experimental records, observations, and all work details is a vital part of any laboratory process. To this end, the STCU upholds three guiding principles for project notebooks, which are expanded upon in sections I.B through I.D below:

- Intellectual Property Rights (IPR) Protection
- Scientific Repeatability
- Project Accountability

Moreover, there are several important benefits of keeping a thorough project (laboratory or administrative) notebook:

- A detailed laboratory notebook is the best, most-direct evidence of the work performed:
  1. Exact details and dates of conception, experimental observations and results, and a chronological record of a scientist's work are an essential part of the written record;
  2. The project notebook provides monitors and auditors the means by which to assure funding governments and business partners that their support is being effectively utilized in obtaining results and meeting STCU goals;
  3. It is an essential piece of evidence for patent applications.

- It provides a means by which a scientist may more effectively organize and plan work:
    1. It permits a quick retrieval of experimental concepts, designs, data, and interpretations;
    2. It keeps relevant information in one place, or if this is not possible, it keeps all references to over-sized results (technical drawings, maps, long computer programs, photographs, graphical plots, etc.) in one location;
    3. Since the notebook contains the only firsthand record of the work performed and results obtained in a laboratory setting, it assists the scientist at any time in the future to summarize the results obtained into reports or articles.
- It provides project managers and group leaders a transparent record of and means by which to manage the work of their scientists and support staff:
    1. The time dedicated to project work may be recorded in the notebook;
    2. Printed tasks and assignments may be pasted into the notebooks;
    3. Completed work may be verified and signed.
    4. Based on the content of the notebook, a manager should be able to request another scientist to repeat the work performed (for verification) using only the notebook as a guide, or to assign another scientist to the work if the first should be removed from the project for whatever reason.

I.B. IPR Protection

The serious research and development work undertaken by scientists and engineers is also a creative effort. Such efforts fairly frequently yield new scientific findings, technical innovations, fresh insights and improved methodologies that enrich the scientific community and society at large. Clearly, not only the scientists but their respective organizations and government are acutely aware of the value scientific research may provide (commercial or otherwise), and therefore understand the necessity of protecting the results of such work. The laboratory notebook is the base document upon which a scientist's intellectual property rights may be protected. For example, it is one of the more significant documents upon which patent applications are based.

The STCU recognizes that Ukraine and other member states of the FSU may currently not have as robust an IPR legislative basis by which the work of scientists may be protected. Nevertheless, it is important to work toward supporting such a protective regime, and strong institutionalized practices in managing one's scientific research by way of laboratory notebooks will go a long way in developing and strengthening robust IPR protections. The art in establishing such an environment is to properly intertwine two somewhat competing goals: on the one hand to provide scientists the ability to freely and creatively carry out their work without imposing undue bureaucratic requirements; on the other to institute a research recording procedure that adequately preserves and protects the scientific work carried out.

I.C. Scientific Reproducibility

It is essentially axiomatic that the results of scientific work should be reproducible. To this end, keeping a meticulously-organized notebook is central to verifying such results. In an important sense, one may consider a laboratory notebook as a history of the development of a scientist's thoughts as he progresses in uncovering findings in his or her field. Irrespective of whether one is a theoretician or an experimentalist, the thoughts that lead to new scientific discoveries and technical innovations are important in their own right for they form the basis of a written record of the work as well as the basis for published articles or books. These results may then be reviewed by a scientist's peers, and, of course, can form the basis for further research and development.

I.D. Project Accountability

Projects supported by the STCU are subject to regular monitoring by project coordinators and financial officers, as well as by western auditors. For governments (through regular projects) and private businesses (through partner projects), such reviews are one of the most attractive aspects of conducting scientific work through the STCU with Ukrainian entities. Simply put: financing parties need to have assurances that their investments are being effectively and wisely utilized. Transparency and financial accountability are highly valued requirements for projects of any type of serious work in the West. But irrespective of these requirements, such an approach also provides a valuable tool for the scientists and their managers to organize their work, to establish goods recording habits, and to help the project manager in managing the progress of work.

I.E. Summary of the STCU's Vision

The STCU is not interested in imposing upon scientists and their managers a bureaucratic burden by interfering in the day-to-day details of project implementation. The STCU does not demand strict adherence to specific project notebook instructions—it is the philosophy and fundamentals that the STCU believes are important. Scientists engaged in STCU projects are highly-trained, highly-competent professionals that are well able to manage their own work. Moreover, there is a wide spectrum of scientists operating in various scientific disciplines—each discipline with its own research methodologies—from theoreticians to experimentalists, from computer programmers to chemical synthesizers, from mathematicians to equipment technicians. In this sense, to broadly impose strict "rules" across all areas of science would be to inhibit the exploratory spirit of scientific research. Science must be able to "breath" in order to grow.

Nevertheless, the STCU emphasizes the importance and necessity of keeping a meticulous laboratory or administrative notebook as part of any STCU-supported project. To summarize, the project notebook is a complete record of what was accomplished in the laboratory or other scientific work-setting. Reproducibility—even many years later—is crucial because the project notebook should be viewed as a legal document to help verify scientific findings and to support possible commercialization of work. The project notebook provides evidence to western funding partners that new work was carried out (as opposed to old work that was repeated), that former weapons scientists are involved in civilian-related scientific activities, and that these activities are being effectively carried out.

The general instructions below are provided as guidelines to assist scientists in keeping efficient and accurate project notebook entries. It is hoped that the proposed practices will extend to scientific work beyond STCU-supported projects.

II. Guidelines for Keeping a Project Notebook

II.A. General Instructions

The STCU is able to provide high-quality, pre-printed project notebooks—available at the request of the project manager. Instructions for keeping notebooks in support of STCU projects are outlined below, and may be divided into two categories: administrative journals and laboratory notebooks. While each of these has its own distinct requirements, there are nonetheless a set of instructions that apply to both, i.e., ALL notebooks should observe the following guidelines:

1. Project notebooks should be a bound with non-removable pages. High-quality paper (acid-free) should be used to ensure durability and prolong its life.

2. All hand-written entries should be neatly made in blue or black ink. Mistakes are to be clearly crossed out but left in a legible manner. The reason for any correction should be noted.

3. Pages should be pre-printed with consecutive numbers. Or, if pages numbers are not pre-printed, ALL pages should be clearly, legibly numbered prior to using the notebook. NEVER, under any circumstances, should pages be removed from a project notebook.

4. Writing may occur on both sides of a page. However, blank pages or significant blank spaces should not occur. Do not skip pages in the notebook to allow space for the anticipated completion of an incomplete work. Such situations may be adequately handled through the table of contents (point 6 below) and by making reference on the pages involved, such as "continued from page XX" or "continued on page YY." If, for some reason, a page is accidentally skipped and left blank, one may simply cross out the entire page, and sign and date that page.

5. The cover page should contain the project title and number, name of the person tom whom the notebook belongs, date of start of notebook entries, end date for notebook entries, and, if applicable, number of the notebook if more than one is used.

6. A table of contents should be kept on the first 2-3 pages of the notebook that clearly reflects page numbers for work, project phases, etc., contained in the notebook, and the table of contents should be kept up-to-date.

7. For each day during which project work is performed and recorded, the date and the actual number of hours worked should be recorded.

8. Specific tasks assigned by managers or group leaders should be printed and pasted into the notebook. Notebook entries should be reviewed and signed off on by the manager or group leader.

II.B. Administrative Notebooks

An administrative notebook is a document that applies primarily to non-technical staff such as secretaries and financial officers who support project implementation. All general instructions noted above apply with the addition of the following considerations:

a. Computer files containing financial information, correspondences other than e-mail (such as official letters and memos), important e-mails, etc. should be referenced in administrative notebooks.

b. Project-related business trips, redirection letters, computer files containing quarterly and technical reports, etc. should also be referenced in the administrative notebook.

c. If an administrative assistant is requested to perform literature searches for scientists, a record of this work should also be kept.

d. Entries do not have to be lengthy, but should nevertheless clearly indicate what work was performed and what documents were prepared or used.

II.C. Laboratory Notebooks

A laboratory notebook is a document that applies primarily to scientists, but may also relate to the work of technical support staff such as technical blueprint drafters, machinists, and other technical support staff. All general instructions noted above apply with the addition of the following:

a. Most laboratory time should be devoted to experimental, theoretical, or analytical work. However, it is useless to do the work unless it is properly recorded for later use and reflection. Not only should essential measurements and precise procedures be recorded, but also all conceivably pertinent observations. A slight change in procedure, a seemingly insignificant observation, etc. is often a crucial matter in the final analysis. Collect results and organize them so that they can be easily assimilated and compared.

b. Each new phase of work or each new task or each new experiment should be clearly labeled at the start of such work. In addition, a brief explanatory note (theory if applicable) and relevant literature references (if applicable) should be provided at the start of such work. Answer what you are trying to accomplish, e.g., verify a law, measure a fundamental constant, correlate readings, etc.

c. NEVER use intermediate scratch sheets: a good journal reflects the development of thoughts, hypotheses, and results. All data and descriptions should be entered directly into the notebook. If "thinking out loud" is done in a group setting (seminars, meetings, etc.), the project manager should assign someone to take notes in their journal—with other members of the team receiving copies of such notes.

d. While it is not required to enter volumes of detail in most cases, the general idea guiding Laboratory Notebook entries should be the following: a neat, orderly notebook should make it relatively simple for a competent and trained specialist to take the notebook either now or months later to be able to read it, follow it, understand it, and recreate results obtained earlier.

e. Plenty of space should be left for relevant intermediate results such as photographs, plots, short computer programs, drawings or schematics, etc. All such supporting materials should be clearly labeled. All such entries must be permanently affixed onto a page in its proper chronological and logical location.

f. If work-related materials are produced during project implementation that are physically too large to incorporate readily into the notebook (such as blueprints, long computer programs, large drawings, etc.), then clear references should be provided for where such materials may be readily located.

g. Computer programmers and theoreticians should develop their ideas in the notebook—recording relevant guiding equations, sub-routines, etc.—so that the thinking behind printed computer programs or articles can be clearly followed.

h. Never let anyone other than yourself write in your notebook—excluding witness or manager's signatures. Delicate and difficult-to-repeat experiments should be clearly described in detail, and a witness to such an experiment should sign off on the results recorded.

i. Never erase or remove material already added. Simply draw lines through irrelevant entires at the time entries are being made. Do not erase errors. Just draw a single line through any erroneous entry, and then initial this alteration.

j. A number by itself is meaningless. Therefore, units, corrections, and information which make a number's or set of numbers' interpretation meaningful should be carefully noted. There should be sufficient information about experimental conditions, reagents, and equipment (if applicable) so that the experiment can be reproduced if necessary.

k. Experimental procedures should be carefully and clearly described once, and the referenced in subsequent experiments. Describe technique used for measurements and sketch experimental set-ups if applicable.

l. Illustrate all computations by writing the appropriate formula or equation, substituting a sample set of data (with units) and recording the output. Calculations should be performed in the notebook. However, for highly repetitive calculations one can provide a representative calculation and then simply tabulate the remaining input data and results.

m. Propagation of Errors: Use standard propagation of error methods to assign uncertainties to all your results. If you are reporting a number, it MUST have an error!!

n. Literature Comparison: Whenever possible your experimental result should be compared with accepted or typical literature values. Record the source in your notebook for use in your lab report. Comparisons should include notations of significantly different experimental conditions or procedures. Both absolute and relative differences should be included after the data have been adjusted to the same temperature, pressure, etc.

o. Commentary and Conclusions: Briefly and quantitatively assess the accuracy and precision of your work in light of the uncertainty in the measurements which you have made. If there is a circumstance (duly noted as a comment in your notebook) which would explain good or bad results, describe it and give an estimate of its magnitude and effect. State whether or not objectives were met (based upon recorded results). Avoid personal editorial comments.