

# Dr. Norbert Cheung's Lecture Series

Level 5      Topic no: 40

## Project Execution and Management

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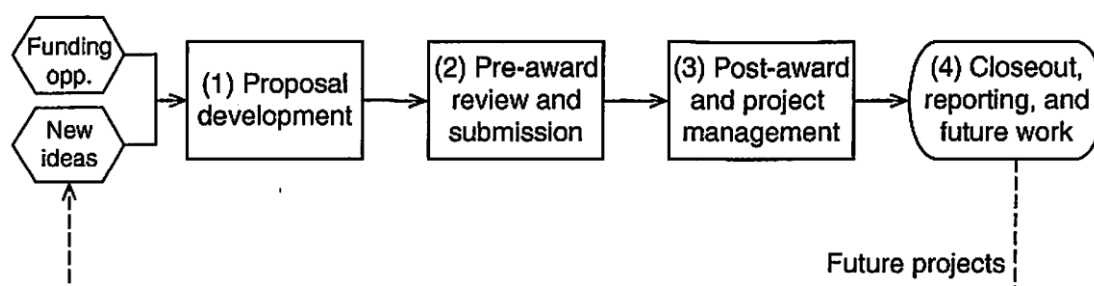
### **Reference**

Engineering Research: Design Methods and Publication, Herman Tang, Wiley, 2021.

## **1. Basics of Project Management**

### Life Cycle of Research Project

Research life cycle is the entire process and life of a project, from inception to completion. There are four phases for a research project from a viewpoint of researchers and their organization. Figure 7.1 shows the four phases and Table 7.1 lists the main tasks of the phases for large projects.



**Figure 7.1** Four phases in research project life cycle.

For a funded research project, the PI is the project director. In the entire course of research work, PI is responsible and takes care of six main aspects of a research project (Figure 7.2) on a routine basis.

Among these six aspects, project timing, cost control (budget and expenditures), and team management of research project management are similar to those of general project management. For a research project, the quality of deliveries or innovation, instead of quantity, is often more important than that of a general project. In addition, we should work closely with all internal and external stakeholders for the existing project and future opportunities.

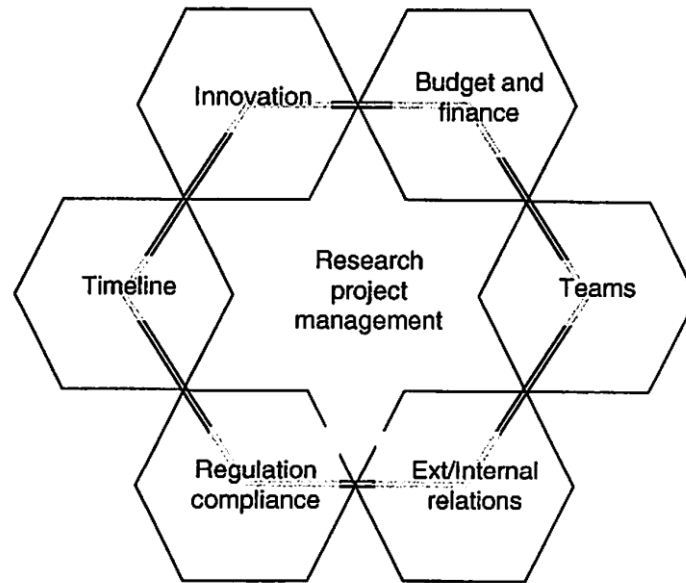
Most experienced researchers agree that well-communicated teamwork is the key for success. The PI must take care of their team members to ensure the effective teamwork to the research goals. A PI's responsibility includes the following:

- View and work on a big picture, have good understanding on progress and road-blocks.
- Prioritize the research tasks and resources to the objectives.
- Improve the communication among team members and stakeholders.

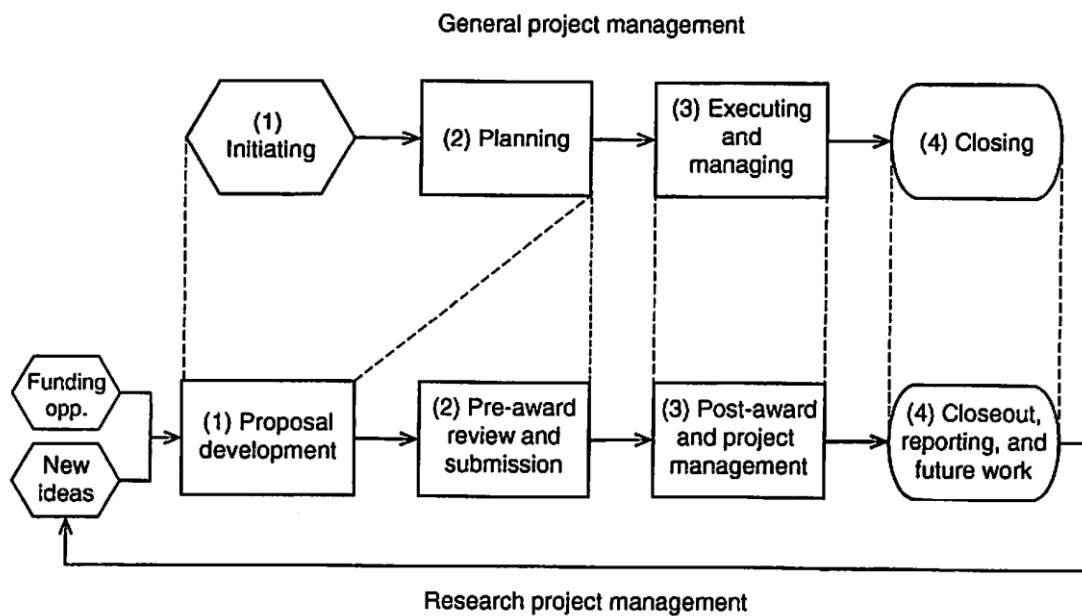
**Table 7.1** Tasks in four phases of research life cycle.

Phase	Tasks (ref. the book sections)	Contents
(1) Proposal development	Prepare, draft, review, revision (Sections 2.1–2.3) Literature Review (Chapter 3)	Problem statement (hypothesis) Literature review Funding sources Description of work Team build up Budget plan and justification Collaborator letter of intent (if applicable) Researchers' bio sketches Data management plan
(2) Pre-award review and submission	Review, compliance, routing approvals (Sections 2.4–2.5, and 7.3)	Administrative review and approvals Facilities and recourses review Finance review Internal coordination Collaborative planning Regulatory compliance review Submission
(3) Post-award and project management	Execution, monitoring, reporting, administrative process (Section 7.4.1)	Review, negotiation, and acceptance Project accounting set up Research tasks execution Resources and expenditures control Collaboration and sub-awards (if applicable) Cost sharing (if applicable) Award changes (if applicable) Regular reports
(4) Closeout, reporting, and future work	Reporting, administrative process (Sections 7.4.2 and 7.4.3)	Final project report Finance report Accounting closeout Equipment and facilities Records retention Dissemination Patent application and technology transfer

General project management consists of four process phases: initiating, planning, executing and managing, and closing. While as discussed above, a research process has four phases. Figure 7.3 shows a direct comparison between general project management and research project management for their phases.



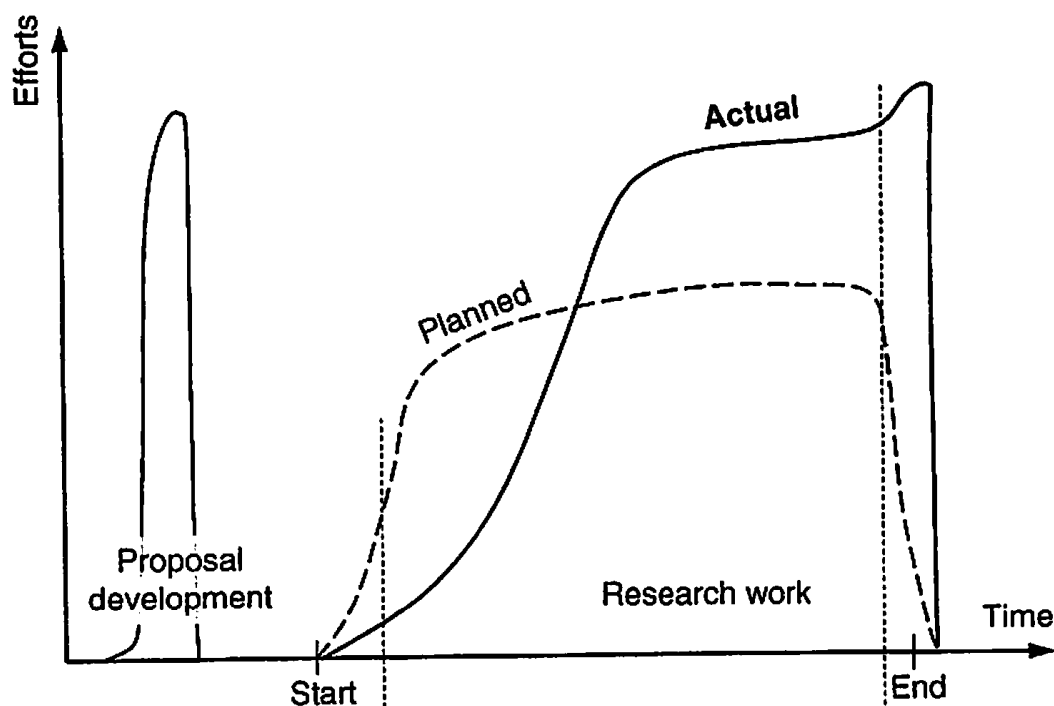
**Figure 7.2** Main aspects of research project management.



**Figure 7.3** General vs. research project management.

In a research proposal, we plan the research efforts to be as balanced as possible over the course of a project. However, the realistic efforts often deviate from the

planned, shown in Figure 7.4. For example, we may begin a project a little late and run slow at the beginning, which result in a more demanding workload later near the deadline. Please note that the total amount of the actual work can be more than that of the planned as well.



**Figure 7.4** Research efforts throughout project life span.

As emphasized, the essential requirement for research is innovation. After a research proposal is approved, we go to the post-award stage and focus on the research execution and achievements via project management. We should keep innovative thinking during the post-award stage as well. In fact, the successful closeout of a research project heavily depends on its innovative outcomes.

We must recognize that the research life cycle never ends, in terms of new directions, activities, and research opportunities. After a project is finished, we normally move research continuously forward for new projects. A research continuation on a specific topic may be carried out by ourselves, students, and/or colleagues. In this sense, research itself can “automatically” generate new ideas, new directions, and new methodology if we are open-minded and willing to continue.

### Performance of Research Project

For a research project, the three key indicators or elements of performance are outcome, cost, and timeline, as shown in Figure 7.5. We should clearly define and address all three elements in a research proposal. A viable work plan is the “blueprint” to accomplish the stated research tasks and meet the defined project objectives.

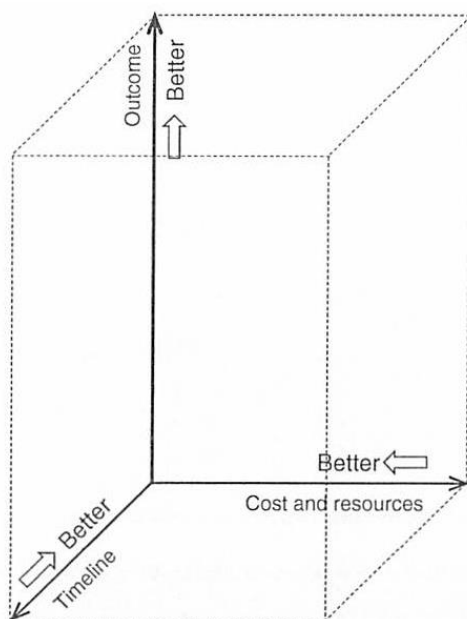


Figure 7.5 Three key elements of research proposal and execution.

Table 7.2 Evaluation considerations of research performance.

Outcome	Description	Form
Knowledge	Contribution to knowledge or establishing new understanding	Refereed publications, reports, policies, etc.
New artifacts	In forms of new products, process, software, standards, technologies, etc.	Effect data, savings, applications, etc.
Significant improvements	Impacts on environment, quality of life, safety, security, education, etc.	Changing rates, ratios, etc.

## Executing and Reporting

In the life cycle of a research project, project execution is the main effort. The detailed tasks of research execution can be project-dependent. In general, the main tasks of conducting a large research project, from a PI's standpoint, include:

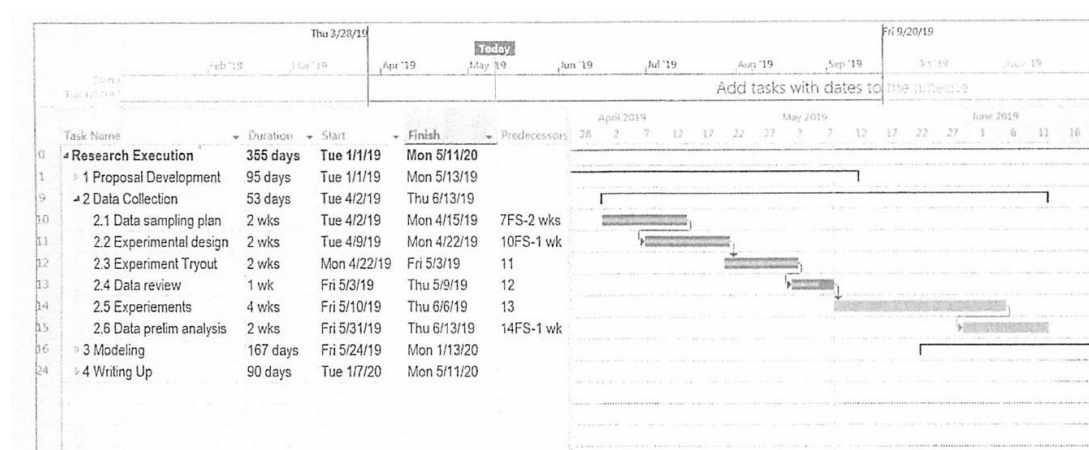
Tasks for a large research project (see next page)

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- Establish a project team
- Refine and update a research plan
- Guide a team for technical tasks, such as:
  - Retrieve information and collecting data
  - Analyze information
  - Obtain and reviewing results
  - Revisit and validate
  - Draw conclusions
- Manage resources and expenditure
- Coordinate with external partnership or suppliers, if applicable
- Work with institutional research administration (RA)
- Report to the funding sponsor

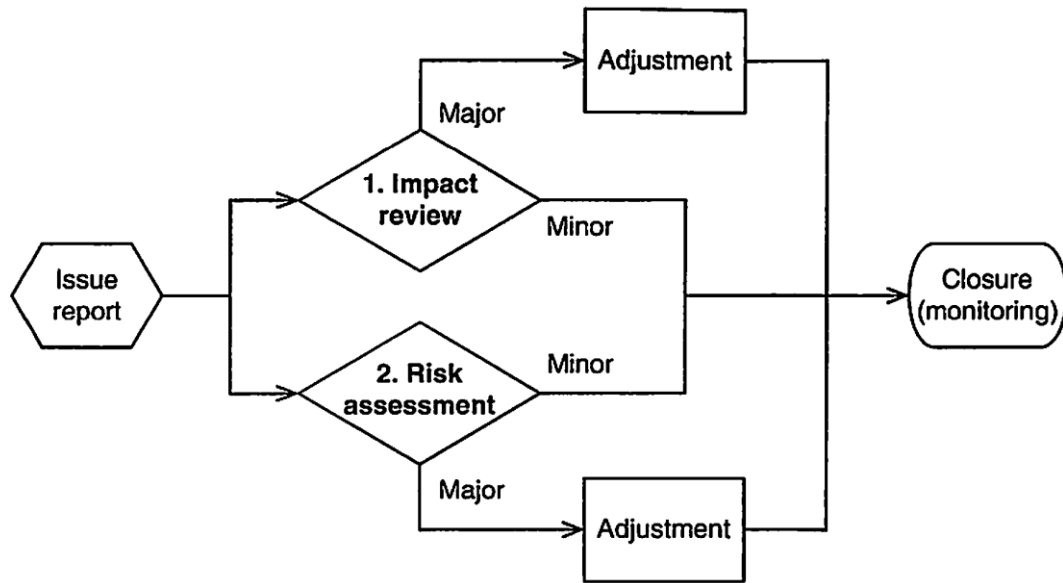
### Progress Monitoring

We often use a Gantt chart for a research plan during proposal development (Chapter 2). We use the same approach in the monitoring and management of research execution. Figure 7.6 shows an example of a research project Gantt chart (using Microsoft Project).

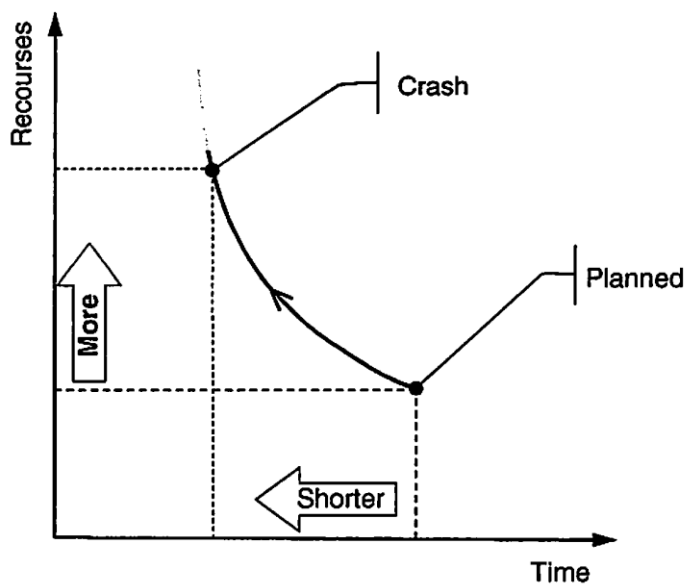


### Project Adjustments

It is difficult to predict precisely the timeline of research tasks in a proposal planning phase. However, during project execution, we can monitor and detect the progress of some individual tasks not following the schedule for various reasons. Thus, it is essential that we review and consider updating the plan based on the realistic achievements up to date. One important capability of a PI is sensitivity to the progress and willingness to adjust when needed. The required adjustments may involve the project schedule, budget, personnel, techniques, etc.



**Figure 7.7** A review process for reported issues in execution.



**Figure 7.8** A diagram of trade-off between time and resources of a task.

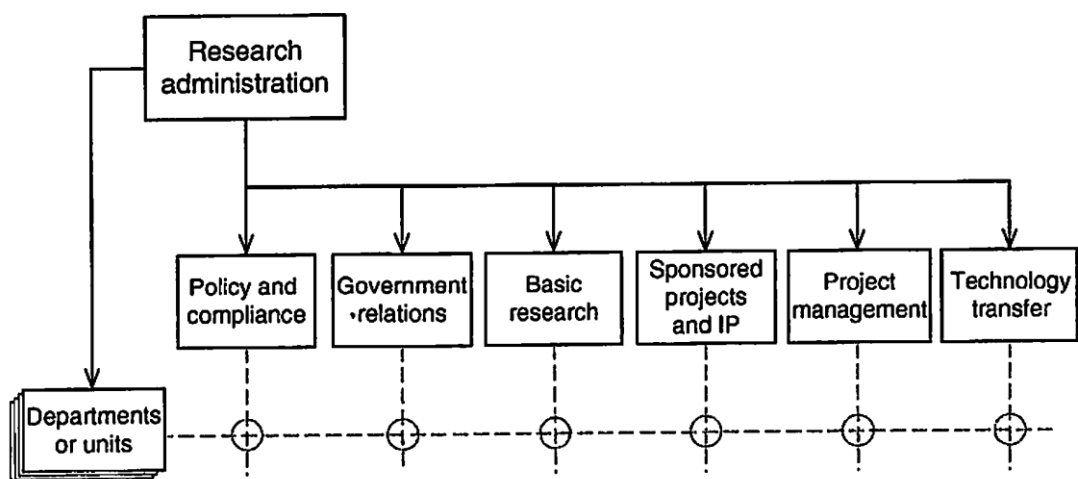
For a graduate student thesis or dissertation, the student is also the project leader under the supervision of a faculty advisor. As a part or a subset of faculty research, a graduate student normally does not control the project expenditures or recourses, and requires faculty advisor's approval. Thus, students need to work closely with their advisors to update and adjust their project as necessary.



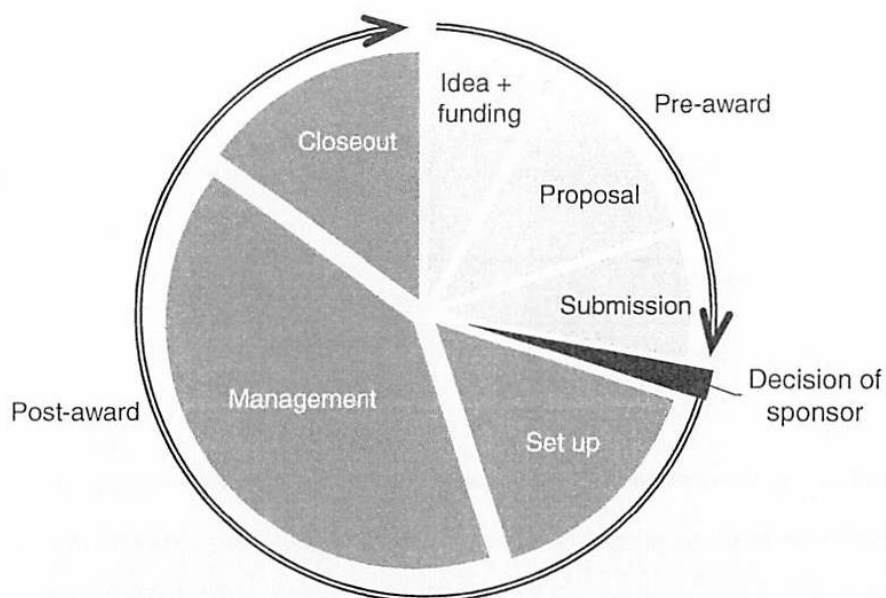
## 2. Research Administration

### Goals of Research Administration (RA)

There are many functions in an RA office (Figure 7.9). The functions include establishing policies, helping researchers find funding, processing grant applications,



**Figure 7.9** A diagram of functionality of research administration.



**Figure 7.10** Phases of research project management.

**Table 7.3** An example of work relationship between PI, RA, and Unit.

Phase	Task	PI	RA	Unit
Proposal	Provide grant information	C	R	I
	Identify funding opportunities	R	C	C
	Provide training and advice	I	R	I
	Prepare quality proposal	R	C	I
Pre-award	Review and revise proposal	R	C/A	C
	Do regulatory compliance and certification	S	R/A	I
	Prepare and route for approvals	C	R	S
	Submit proposal	I	R	I
Post-award	Accept (and negotiate) award	C	A	S
	Set up accounting	I	R	S
	Set up team	R/A	I	S
	Monitor and assure expenditures	R	C/A	I
	Manage research efforts	R	I	S
	Do regular reporting as required	R/A	S	I
Closeout	Prepare final (tech and fiscal) reports	R/A	C	C
	Review and submit final reports	S	R/A	I
	Maintain closeout doc and records	S	R	I

## Research Misconducts

***“(a) Fabrication is making up data or results and recording or reporting them.***

*(b) Falsification is manipulating research materials, equipment, or processes, or changing or omitting data or results such that the research is not accurately represented in the research record.*

*(c) Plagiarism is the appropriation of another person’s ideas, processes, results, or words without giving appropriate credit.”*

Plagiarism means using the material of others without acknowledging its sources or gaining authorization as required, which is a relatively common issue and may be serious as well. This may happen when copying information, including other’s opinion with a long phrase, a table, and a figure from literature, but without an appropriate citation. Plagiarism can be a copyright issue, which not only is a research ethics concern but also become a legal problem.

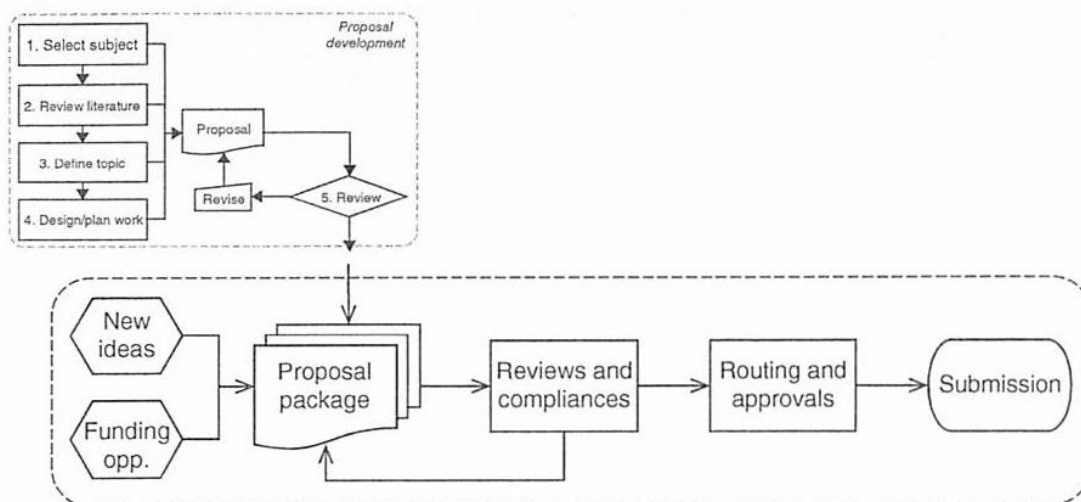
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Researchers can unintentionally use other's work without an appropriate acknowledgement and citation. In other words, they may plagiarize by accident. For example, a researcher fails to give a proper credit to someone else's ideas or statements probably due to not knowing how to do it appropriately. Training on the reference citation is important for student and novice researchers.

Interestingly, there is another concern called "paraphrasing", which means one takes another person's new and specific idea and putting it in his/her own words. In such a situation, we should have an indirect citation – even with no need for quotation marks. Note, using different words for general knowledge and common ideas is not "paraphrasing."

Another issue is called "self-plagiarism" or "text-recycling," meaning use of one's own previous work in another context without citing. This topic is controversial and in an ethical gray area, which is still being studied (Moskovitz 2019). It is true that we are the owner of the work and may reuse it, where the concern is on citation or referencing. It is appropriate that we let the readers know that this is not the first use of the material when reusing it. If there is a new development based on the original work, then the reused part should be a small portion in the new work or publication.

### **3. Pre-award Management**



**Figure 7.11** Pre-award tasks for external sponsors.

For reviews and approvals, the RA office routes a final proposal revision through an internal routing system of the organization. These reviews and approvals ensure the compliance with institutional and government regulations. After approvals at the department, unit, and institution levels, the RA staff will provide the authorized institutional signature and officially submit the research proposal.

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**Table 7.6** A proposal development checklist – overall readiness.

No.	Proposal submission readiness	Yes/No
1	Is the Project Summary completed?	
2	Is the project description completed?	
3	Are the budget section with details and justification completed?	
4	Are PI and key personal eligible and bio sketches provided?	
5	Is the facilities and resources section completed?	
6	Is research compliance (IRB, COI, etc.) completed?	
7	Are the recommendation/support letters received, if needed?	
8	Is the required assurance and certification completed?	

**Table 7.7** A proposal development checklist – key items.

No.	Key item satisfactory	Yes/No
1	Has needed emphases (on environmental, career, minority, etc.)?	
2	Meets the format requirements (pages, fonts, graphics, etc.)?	
3	Specifies the start and end dates?	
4	Meets sponsor's specific requirements?	
5	Meets the budget restrictions (max, items, salary, IDC, etc.)?	
6	Are internal reviews and approvals complete?	
7	Has the Unit commitment and cost sharing, as applicable?	

## **4. Post-award Management**

A proposal approval by a sponsor is a starting point for post-award management. A research proposal approved by the funding sponsor means the proposal is worthy of being supported with their money. With the approval, the PI and the research team should kick off the research work soon.

### *#1 Award Acceptance*

In principle, a research institute has the authority for the negotiation and acceptance of contractually binding obligations in a research grant or agreement. Accepting an award on behalf of an institute, its RA office needs to review the award. The acceptance of a research award is relatively simple if there are no changes from the original proposal and no additional restrictions from the sponsor.

## *#2 Project Setup*

Once a research proposal is approved, the research project is about ready to start. The accounts of the research project need to be set up in the RA and accounting offices. We may establish sub-projects if a project involves the collaboration between two or more investigators or units.

## *#3 Project Reports*

Project reports, for example a final project report for closeout, are the required documents of a research project. Depending on the requirements, size, and nature of a project, multiple reports may be required. For instance, if research is a multiyear project, an annual report is conditional to continued funding for the next year.

## *#4 Applying for Patents*

If the research outcomes of a research project not only contribute to knowledge but also have potential industrial applications and commercial values, it is a good idea to consider applying for patents before publishing the results. We may consider a patent protection as a way to recover research and development costs.

Applying for a patent means disclosure of research results for the patent right. Different from scholarly papers and presentations, an approved patent grants its owners the exclusive rights to make, use, sell, and import the research results for a limited period. The period is 20 years in the United States and European countries for the functional-feature patents in most cases.

## *#5 Final Report, Equipment Leftover, Time Extension*

The detailed requirements are specified in project agreements. A final technical report, in general, addresses the following items:

- Predefined objectives and deliverables
- Significant results and solutions
- Research impacts
- A few examples to support
- List of publications

After a research project completes, the equipment purchased and used may rest with the institute if no specific predefined arrangement in the research contract. As a property of the institute, the equipment that completes its duty in a specific project may be transferred between departments within the institute.

As the name suggests, additional time may be granted without additional fund from the agency/sponsor. The time extension may be approved either by the sponsor or within institute. With the time extension, researchers can have more time to finalize a project with the remaining fund.

## **5. Summary**

### **Basics of Project Management**

1. The life cycle of a research project has four phases: (i) Proposal Development, (ii) Pre-award Review and Submission, (iii) Post-award and Project Management, and (iv) Closeout, Reporting, and Future Work.
2. Research project management mainly addresses six aspects of a research project: (i) timeline, (ii) cost, (iii) team, (iv) external/international relations, (v) regulation compliance, and (vi) innovation.
3. It is common that realistic research efforts are more uneven and heavier than the planned.
4. The three performance indicators of a research project are its outcomes, timeline, and costs.
5. Research outcomes may be in format of knowledge, technology, artifacts, improvement, or their combinations.
6. For project issues, two key reviews address the impacts of the issues on project timing and potential risk in future.
7. Project task adjustments often involve additional cost and recourses.

### **Research Administration**

8. The functions of research administration include policy development and enhancement, help on funding information, processing grant applications, project coordination, regulation compliance, and technology transfer, and so on.
9. Close work relationship between research PI, RA, and unit is a foundation of a research project success.
10. Three types of research misconduct are fabrication, falsification, and plagiarism. They can be serious but avoidable.
11. Conflicts of interest are mainly on financial side but may include non-finance interests.
12. Export controls is a US law on imposing restrictions on commodity to foreign persons. Fundamental research may be excluded from the export control regulations.

### **Pre-Award Management**

13. The functions of research pre-award management include external funding search, proposal development support, review and compliance, routing and approvals.
14. Budget planning is an important part of a proposal and needs RA review and assistance.
15. Research with obtaining, using, analyzing, or generating identifiable private information is human subjects related.
16. Human subject related research should have an IRB's approval beforehand.

**Post-Award Management**

17. The functions of research post-award management include award acceptance, project set up, project reports, and change management.
18. There are two main types of invention patents: utility patent and design patent. The former is much more common for engineering and technical research.
19. Patent application process has six steps of preparation. International patent applications are different from domestic applications.
20. Project closeout is to manage the final reports and other required tasks by a funding agency.

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