



A Project Management Guide for Researchers

Prepared by:

Research Grant and Contract Services
MEMORIAL UNIVERSITY OF NEWFOUNDLAND

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Table of Contents

1.0	Introduction	4
2.0	What is a Project?	5
3.0	Triple Constraints of a Project	5
4.0	What is Project Management?	6
5.0	Project Management Process Groups	7
6.0	Initiating a Project	8
7.0	Project Planning	8
7.1	Plan Project Scope	9
7.1.1	<i>Define Project Scope</i>	9
7.1.2	<i>Identify Project Stakeholders</i>	10
7.1.3	<i>Identify Project Activities – Create a Work Breakdown Structure (WBS)</i>	10
7.2	Plan Project Schedule	11
7.2.1	<i>Sequence Identified Project Activities</i>	11
7.2.2	<i>Estimate Required Resources for Each Activity</i>	12
7.2.3	<i>Estimate Activity Durations</i>	12
7.2.4	<i>Document Project Milestones</i>	12
7.2.5	<i>Develop Project Schedule</i>	13
7.3	Plan Project Budget	13
7.3.1	<i>Estimate Activity Costs</i>	13
7.3.2	<i>Determine Project Budget</i>	14
8.0	Project Execution – Carrying out project Work	14
8.1	Resource and Manage Project Team	14
8.2	Project Plan Refinement	15
9.0	Monitoring and Controlling the Project Work	15
9.1	Monitoring & Controlling Project Scope	16
9.2	Monitoring and Controlling Project Schedule and Budget	16
10.0	Closing out the Project	17
10.1	Submission of Final Report and Administrative Requirements	17
10.2	Lessons Learned Documentation	17

11.0	Other Areas of Importance for Effective Research Project Management	18
11.1	Project Risk.....	18
11.2	Project Communication.....	19
11.3	Research Data Management.....	19

1.0 INTRODUCTION

The objective of this document is to provide an educational project management guide for Memorial University of Newfoundland (MUN) researchers to aid in their efforts in managing research projects.

The aim is to introduce the concept of project management and help communicate the potential value project management can add to research projects. This guide highlights and explains key project management processes that will help in the management of a research project. Researchers, regardless of the nature/size of their research projects, are encouraged to use this guide as an educational tool to apply project management best practices in their research efforts.

For more information on Research Project Management at MUN, and to access project management resources, such as tools/templates/guidance material, that will aid in the implementation of project management processes discussed in this guide, please visit Memorial's Research Project Management website at <https://research-tools.mun.ca/rpm/>.

Project management definitions and processes contained within this guide have been referenced and adapted from:

A Guide to the Project Management Body of Knowledge (PMBOK guide) (5th ed.). (2013). Project Management Institute.

2.0 WHAT IS A PROJECT?

Before we can discuss project management and its value to a research project, it is important to understand what a project actually is. A project is a temporary endeavor to create a unique product, service, or result.

The key characteristics of a project are:

- A project has a defined beginning and end. This is important to understand because if there was no end, the associated activities would be considered part of regular operations of an organization.
- The purpose of the project is to create a unique output.
- This output can be a product, service, or a result. Meaning that the unique output produced during the project can be tangible or intangible.

Examples of projects include: construction of a new building; implementing, improving, or enhancing existing business process within an organization; or conducting a research effort where the outcomes will be recorded.

When we look at the timeline of a project, a project starts with an overall purpose or objective that aims to work towards some novel outcome.

In a research project, the purpose of the research maybe to investigate a particular concept, however the desired outcomes of the research could include: publishing research results; to train highly qualified personnel (HQP) such as graduate students and post-doctoral fellows; or the development of a technology.

In order to realize a project outcome, resources have to be identified and planned for. Resources include, but not limited to, the people, equipment, facilities, and materials that are required to complete the project within the identified timeframe, or project schedule. Based on the resources required and the associated schedule, cost requirements can be identified to create the project budget.

In order to produce the desired outcome, or to maximize the outputs of a project, these resources and the associated project activities have to be **carefully managed within the confines of the project purpose, schedule, and budget.**

This is very important concept to be aware of when planning and carrying out a project, and lays at the foundation of project management. This concept is known as the triple constraints of a project.

3.0 TRIPLE CONSTRAINTS OF A PROJECT

In looking at a research project, depending on the nature of research, the project plan may differ significantly in regards to resources required. However, all projects will have:

- An overall purpose. This is called the **Scope** of a Project. This comprises the objectives, activities, and tasks that have to be carried out in order to produce the desired project outcome;

- Also, all projects, due of their temporary nature, will have a known timeframe in which project objectives are expected to be completed. This is called the project **Schedule**; and
- Finally, all projects will have an associated cost. How these cost are allocated over the life of the project determines the project **Budget**.

The scope, schedule, and budget are the foundation on any project and care must be given to ensure that they are planned for interdependently. The scope, schedule, and budget are referred to as the triple constraints of a project. As displayed in Fig. 1, the triple constraints can be visually depicted as a triangle to reflect the interdependency between each when carrying out any project. This means that you cannot change one variable without affecting the others.

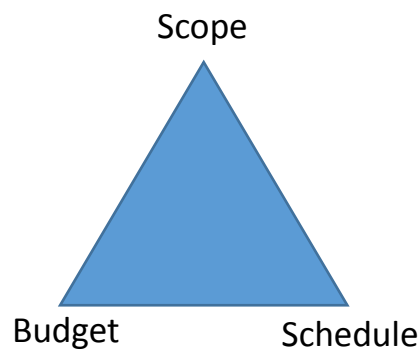


Figure 1: Triple Constraints of a Project

For example, purchasing research equipment that was not planned for will change the project budget. As a result funds may not be available to cover the cost of other project activities, and as a result the project scope and schedule can suffer.

This is why the triangle is referred to as the triple constraints of a project, as a project is constrained to its scope, schedule, and budget. Thus when preparing a project plan and carrying out project activities, the project scope, schedule, and budget have to all speak to one and other to ensure best results.

Project management processes can be applied to a project to aid in the planning and management of these project variables, in order to maximize the success of a project.

4.0 WHAT IS PROJECT MANAGEMENT?

Project management constitutes the application of knowledge, skills, and techniques to project activities to meet project objectives. Project management should not be viewed as a strict methodology that must be exactly adhered to in order to be effective. Rather, it is a collection of recommended processes which can be applied to meet the demands of a particular project.

More specifically project management is a collection of processes that can be used throughout the life of a project to aid in its management. Processes are a series of actions or steps taken to

achieve a particular end result. For application purposes these process are group into five (5) process groups. The project management process groups are:

- Initiating;
- Planning;
- Executing;
- Monitoring and Controlling; and
- Closing

5.0 PROJECT MANAGEMENT PROCESS GROUPS

When we look at a schematic view of these project management process groups (Fig. 2), we see that they flow together and are designed to work interdependently through the life of a project.

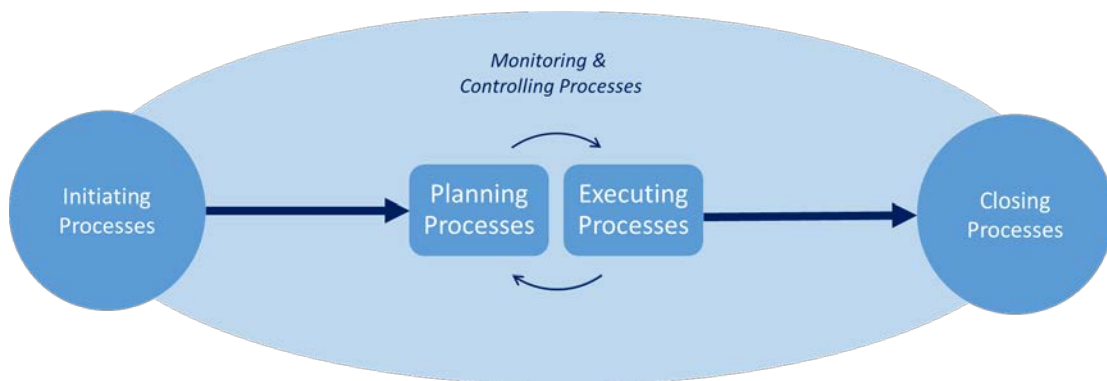


Figure 2: Project Management Process Groups

The **Initiating Process Group**: These are the processes performed to define a new project or a new phase of an existing project by obtaining authorization to start the project. For example receiving approval from a funding sponsor for a submitted proposal.

Planning Process Group: These are the processes related to the planning activities of the project. The key here is to plan scope, budget, and schedule interdependently. Depending on the nature of the research project other elements of the planning process may involve the development of the risk, quality, communication, change control, and human resources management plans. It is paramount that due diligence is performed during the planning stage to help deliver a successful project.

Executing Process Group: These are the process related to the completion of project work. It's where the execution of project takes place and project outputs are produced. In this process group communication and team management play a vital role. As you can see from Fig. 2, execution of project activities allows for further project planning to be carried out. This is an import

point to note especially in a research project. When planning a research project, the nature of your future activities may be vague at first, however as activities are completed more detailed planning can be completed on future activities.

Monitoring and controlling Process Group: Those processes required to review, and regulate the progress of the project; identify any areas in which changes to the plan are required; and initiate the corresponding changes. As displayed in Figure 2 you can see that this process group is an umbrella for all other process group, meaning that a project has to be regularly monitored and controlled to ensure the best results.

Closing Process Group: Those processes performed to finalize all activities and formally close the project. This usually consists of final reporting.

Overall these project management processes can be applied during the life of a project to aid in the planning and management of:

- The triple constraints of a project (scope, schedule, budget);
- The project resources (people, equipment, facilities, materials); and
- Other project factors that may have to be planned for and managed, such as project risks, communications, stakeholders, change, and quality.

The application of project management process within a project will aid in the successful completion of a project and maximizing its output.

The following sections outline these process groups in more detail and provides some context and recommendations in regards as to how project management processes can be of value to a research project.

6.0 INITIATING A PROJECT

Within this step a funding opportunity is identified for a research concept. Project sponsors may range from internal University grants, Provincial, Federal, or private industry. To maximize the potential success of a research proposal, it is crucial that the researcher fully understand the funding mandate of the targeted sponsor and the associated guidelines for proposal submission. All aspects of the proposal preparation should be geared towards emphasizing compatibility of the project with the mandate of the sponsor and any associated funding call. University researchers are encouraged to contact their respective Faculty Grant Facilitator to help with funding identification and research concept matching.

7.0 PROJECT PLANNING

Once a high level of certainty regarding a research project concept applicability with a sponsor is established, the project planning can begin. The proposal that is submitted to a funding sponsor represents your initial project plan or baseline. Depending on the nature of research concept,

and the targeted sponsor, the research proposal may differ significantly in regards to the information required. However, regardless of the application requirements, all research projects will have objectives (scope), a timeframe (schedule), and costs (budget) that have to be identified and justified. As outlined earlier, the scope, schedule, and budget are the triple constraints of a project, and foundation on any project plan. Care must be given to ensure that they are planned for interdependently when planning a project.

An important concept to understand when carrying out your research activities, is the concept of **progressive elaboration**. This refers to a project management technique in which the project plan is continuously detailed and improved as newer and improved information becomes available. When an initial project plan is established within the proposal stage, it may be of a high level depending on the nature of the research. However, when you move into carrying out research activities, your project plan will become clearer as you gain more information on the nature and direction of your activities. This additional information allows the researcher to take a preliminary plan and refine it into a more comprehensive plan. Thus, when carrying out research activities it is important to update your project plan as more information becomes available. However, the interdependency amongst the scope, schedule, and budget aspects has to remain intact.

The remainder of the planning section outlines a recommended sequential approach to planning project scope, schedule, and budget in order to ensure interdependency within the project plan. An overview of recommended project management processes are presented in Figure 3.

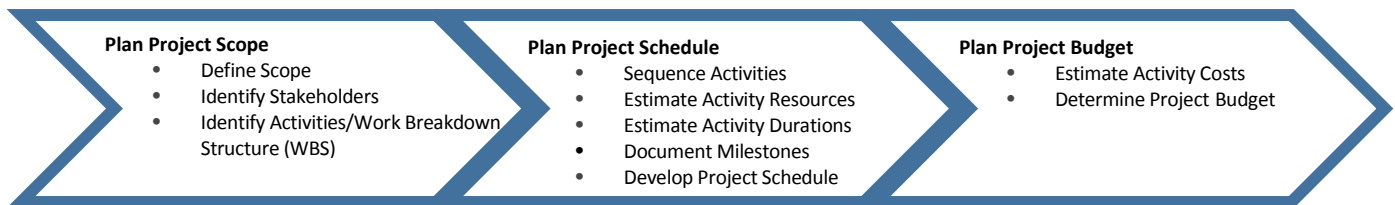


Figure 3: Project Planning Processes

7.1 Plan Project Scope

7.1.1 *DEFINE PROJECT SCOPE*

In preparing a research proposal, the first step of a researcher is to define the project scope. Most funding organizations require a project description, purpose, and objectives as mandatory proposal elements. Thus, by clearly identifying the research project purpose and objectives you have already formed a solid basis for the project scope. The project scope defines all of the work, and only the required work, to complete the project objectives. Also, it is essential to recognizing what the boundaries are within a research project in order to identify what is in, or out of scope. A good exercise for this is to take each objective and list what is, and what is not, within the scope of this particular objective. Furthermore, in defining a project scope you should identify upfront any project assumptions and constraints that may impact your ability to carry out the project scope. Assumptions refers to project related details that you believe to be true, while constraints are

limitations to project activities. These elements will help solidify the boundaries of the research project and will form the basis for you risk planning. Planning for risk is discussed in greater detail in section 11.1.

7.1.2 IDENTIFY PROJECT STAKEHOLDERS

In planning the project scope it is a good idea to recognize all stakeholders that maybe associated with your project. A project stakeholder is any person or organization that has a vested interest in a project's operation or its outcome. For example, MUN, collaborating universities, associated faculty, funding sponsors, community groups, regulatory bodies, and graduate students could all be project stakeholders. By identifying all relevant stakeholders in advance, the context to which a stakeholder is associated with the project is established and project expectations can be agreed upon with the stakeholder in advance. Based on the nature of the stakeholder and their interest, special requirements may have to be taken into consideration when preparing the research proposal and planning project activities. For example, the involvement of an external entity (academic or industry) in research activities will require special contracts/agreements to be put in place prior to the commencement of project activities in order to protect the intellectual property (IP) rights of both parties.

Key stakeholders in most university research projects are the associated graduate students. If your project plan includes the use of graduate students, special consideration has to be given to the research activities that they will be associated with. This is because depending on the nature of the research, or the stakeholders involved, there may be implications regarding a student's ability to publish or submit a thesis. Of particular importance is when there is an industry project stakeholder with some right to the project IP. It is vital that due diligence is carried out when incorporating graduate student into a research project plan in order to protect the best interest of the student and the project.

7.1.3 IDENTIFY PROJECT ACTIVITIES – CREATE A WORK BREAKDOWN STRUCTURE (WBS)

A WBS is a hierarchical decomposition of the total scope of the project required to complete the project deliverables or objectives. If the research project will be contractual in nature, project deliverables will have to be clearly identified within the research proposal. The purpose of a WBS in planning project scope, is that it allows you to breakdown each end deliverable into defined activities, or smaller work components, that are required to complete that deliverable. Figure 4 display a schematic view of a WBS. With the activity lists identified, the full scope of the project is more clearly illustrated and these activities can now be used for subsequent schedule and budget planning purposes.

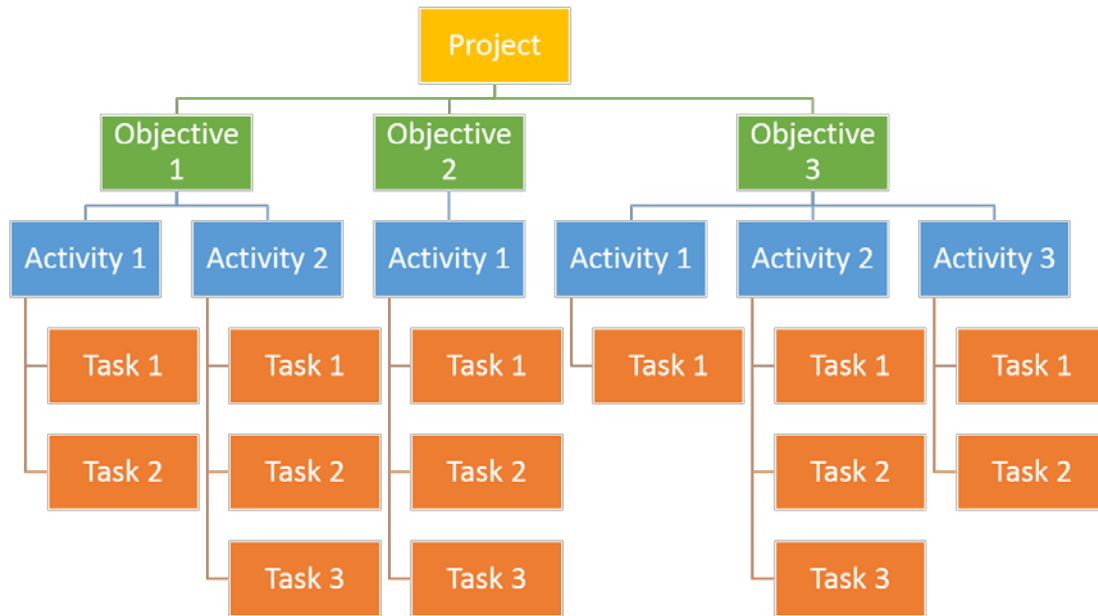


Figure 4: Schematic View of a WBS

Many university research projects are not contractual in nature, but are rather grant-based research. In the case of grant-based research, it may not be possible to clearly define project deliverables as the research may be discovery in nature. However, within this type of research, project objectives still have to be identified for the proposal. Thus, the project objectives can be treated as deliverables in the creation of a WBS. For this, the researcher would identify to the best of their ability all activities associated with carrying out each objective. These activities may be vague during the proposal preparation stage, however by identifying the high level activities required for carrying out the identified objectives, the researcher will be in a better position to plan the schedule and budget aspects of the project.

7.2 Plan Project Schedule

7.2.1 *SEQUENCE IDENTIFIED PROJECT ACTIVITIES*

In planning a project schedule, the recommended approach is to first take the activities identified through the WBS and sequence them in their natural order of occurrence. The key in sequencing work items is to identify all relationships and dependencies that will impact the flow of activities. Once relationships and dependencies are recognized the order of activities can be established.

The most common relationship between project activities that will impact your project schedule is the Finish-to-Start (FS) relationship. This basically means that one activity has to be completed

before another activity can begin. By identifying these activity relationships (or the mandatory dependencies) you have laid out the natural order of the project, and thus the flow of the project will become clearer. This is important because you will also know which activities may be carried out in parallel, or concurrently, as no mandatory dependency exists. Also important in sequencing your activities is to understand what external dependencies (factors out of your control) may affect the timing of project activities. Examples include the delivery of equipment from a vendor, the decision of an ethics committee, or activities that are time-of-year sensitive.

7.2.2 ESTIMATE REQUIRED RESOURCES FOR EACH ACTIVITY

With the WBS and associated activity lists identified, the researcher is in a position to accurately estimate all the resources required for the project. Each project activity should be carefully analyzed to determine what is required to carry out the activity. This means identifying the required resources and the amount required.

Human resources (the people required to carry out activities) include: principal investigator, collaborating researchers, lab technicians, research assistants, graduate students, post-doctoral employees, project manager, and undergraduate internship or co-op students. Identifying human resources in this manner will begin the process of documenting the **roles and responsibilities of project team members**.

Capital resources (infrastructure and equipment required to carry out activities) includes: access to special research labs (i.e the CREAT network), lab equipment purchases, computers and IT equipment, required renovations, and lab/office furniture. By identifying high level resources that are required for each activity, the researcher is in a better position to finalize the project schedule. This is because resource limitations or availability may impact the timing of your activities.

7.2.3 ESTIMATE ACTIVITY DURATIONS

Another important step in planning the project schedule is to accurately estimate activity durations. Activity durations are required in order to define a timeframe for the project. Within a research project a good way to estimate activity durations is to use historical information based on the amount of time that was spent on a similar activity in a past project. Also, expert judgement of the researcher can be used to define how much time should be devoted to an activity. A simple formula is recommended when employing expert judgement to estimating activity durations. This formula is based on a three point estimate from the researcher that consists of their optimistic, most likely, and pessimistic estimates. Based on these estimates an average can be obtained to predict how long an activity should take. The formula to use here is:

$$\text{Optimistic} + (4 \times \text{Most likely}) + \text{Pessimistic} / 6.$$

7.2.4 DOCUMENT PROJECT MILESTONES

Milestones are reference points in the project's progress that represent accomplishment. For example, approval from an ethics committee or regulatory body, accomplishment of a deliverable/objective, or indicator or a major reporting requirement. The milestones for a project

should reflect a clear list of events that incrementally build to the project completion. Having a well-documented milestone list will aid in the monitoring of project progress once started.

7.2.5 DEVELOP PROJECT SCHEDULE

Once project activities have been identified, sequenced, resourced, and estimated for duration, the project schedule can now be developed. It is recommended to use a Gantt chart format when scheduling project activities. This allows you to visualize your project schedule against a time frame and better allows you to monitor progress once the project starts. Figure 5 provides visual representation of a Gantt chart.

	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7
Activity 1	■	■					
Activity 2	■	■	■				
Activity 3			■	■			
Activity 4					■		
Activity 5				■	■		
Activity 6		■	■	■	■		
Activity 7						■	■

Figure 5: Gantt Chart Example

7.3 Plan Project Budget

7.3.1 ESTIMATE ACTIVITY COSTS

The first recommended step in planning a project budget is to estimate the costs for each activity within the WBS. Through an activity based costing method a cost estimate of the resources required for each activity can be obtained. Once resource cost totals are in place for each activity, the costs can be aggregated to produce the overall totals for each cost category of a project.

In identifying costs estimates for a project, it is important to remember that not all project costs may be directly attributable to project activities. This refers to the indirect costs that may have to be included in the project cost totals. Indirect costs can include building use, equipment depreciation, building/equipment maintenance, insurance, research administration, financial administration, and human resources. Please see Memorial University's 'Indirect Costs Policy for Externally Funded Research' for more information regarding its applicability to your research proposal. It is also important to understand the eligible costs of the funding sponsor(s). Please follow-up with the funding sponsor and your Faculty Grant Facilitator to determine if project costs are eligible.

7.3.2 DETERMINE PROJECT BUDGET

Once activity costs have been estimated the budget can be determined. The difference between the cost estimate of the project and its budget, is that the cost estimate shows cost by category, while a budget shows costs across time. Based on the project schedule, the aggregate costs of project activities over time can be established. In this way project cost can be broken down over specific timeframes, i.e. by quarter or year. This allows the researcher to better understand the flow of funds across time. Thus, in order to fully understand the funding required for a project, and to better communicate/justify the requirement, it is recommend that researchers prepare both a categorical breakdown of costs, and a time based project cost budget

8.0 PROJECT EXECUTION – CARRYING OUT PROJECT WORK

This is the phase of a research project in which the rubber hits the road, you can now finally begin your research activities.

8.1 Resource and Manage Project Team

One of the earliest actions when executing a project is the establishment of the project team. Requirements for the team have already been identified when the human resource requirements were estimated for the project activities (see 7.2.2).

Once a project team is established, the roles and responsibilities regarding project work has to be clearly communicated. Regardless of the size of a project team, i.e. single graduate student vs. a multi-disciplinary research team, roles and responsibilities have to be clearly communicated, and understood, by each member of the team. The responsibilities of each team member should flow from the project activities that they are associated with. A good way to document and communicate these roles and responsibilities is through the creation of a Responsibility Assignment Matrix (RAM). Within this matrix tasks can be identified under each activity, and the relationship of a project team member to the task can be identified. The most common form of a RAM is the Responsible, Accountable, Consult, and Inform (RACI) matrix. Using this matrix, project responsibilities can be clearly outlined and communicated in terms of who is accountable (A) for the activity, who are responsible (R) for completing activity related tasks, who should be consulted (C) when carrying out an activity, and finally who should be informed (I) on project related

activities or results. This RACI matrix can also be used as a starting point for the project communication plan discussed in section 9.2. A sample RACI matrix is displayed in Figure 6.

	Principal Investigator	Research Assistant	Graduate Student	Industry Sponsor
Activity 1	A,C	R	I	I
Activity 2	A,C	R	I	I
Activity 3	A,C	R,C	R	I
Activity 4	A,R	C	I	C

Figure 6: Sample RACI Matrix

8.2 Project Plan Refinement

As mentioned earlier, an important concept to understand when carrying out your research activities, is the concept of progressive elaboration. This refers to a project management technique in which the project plan is continuously detailed and improved as newer and improved information becomes available. When a project plan (scope, schedule, and budget) is established within the proposal stage, it may be of a high level depending on the nature of the research. However, as you start executing project activities, your project plan will become clearer as you gain more information on the nature and direction of your activities. This additional information allows the researcher to take a preliminary plan and refine it into a more comprehensive plan. Thus, when executing project activities it is important to update your project plan as more information becomes available. However, the interdependency amongst the scope, schedule, and budget aspects has to remain intact. It is recommended to use a change control system when updated a project plan. Change control systems are discussed within section 9.1.

9.0 MONITORING AND CONTROLLING THE PROJECT WORK

Monitoring and controlling a project confirms if the project is following its plan, and if deviations are found, a response can be implemented. This monitoring and controlling should not be seen as a onetime event within the life of a project, rather it is important that the project is continuously monitored and not just assumed that all is well because research activities are being completed. As displayed in Figure 2, Monitoring and controlling process encompass the life of a project.

Furthermore, this monitoring activity can then be used as the basis for the progress reporting with the funding sponsor(s). The extent of the monitoring activities will depend on the nature and scale of your research project, however the current state of the project scope, schedule, and budget should be monitored as least on a quarterly basis to ensure corrective actions can be taken in timely manner. The remainder of this section outlines some key monitoring and controlling activities

that researchers are recommended to implement within their research projects to help maximize project potential.

9.1 Monitoring & Controlling Project Scope

Scope monitoring and control is about protecting the project scope from change, and when change does happen, managing those changes. ‘**Scope creep**’ is a common project management term that refers to activities that are undertaken within a project that were never part of the original plan. Scope creep is dangerous to a project because the extra activities take up the use of valuable resources, and as a result the project schedule and budget will be impacted. Thus, the original scope of the project may not be completed. Project activities should be reviewed regularly to ensure alignment with the original project plan/objectives.

Keeping the previous point in mind, it is also recognized that within a research project many uncertainties can exist in regards to project direction. For example, the original plan of a research project may involve the investigation of a certain set of objectives, however once initial research has been carried out it may become evident that additional objectives/activities are required. The takeaway message here is that given the inherent uncertainties that can exist in carrying out the scope of a research project, quick identification of relevant activities that are outside the original project scope is required. Then, just as was done during your project planning, these activities will have to be estimated for resources, scheduled, and budgeted. Based on scope, schedule, and budget implications of incorporating the additional activities, a decision has to be made regarding its inclusion. Often times the addition of extra activities means that another portion on the scope cannot be done. Based on the nature of the funding, you may also need to receive the sponsor and/or institutional approval in advance of implementing such changes. If approved, the project plan must be updated to reflect the changes. It is also important to note that a change in the project scope may require approval from an ethics board.

Having a basic **change control system** in place will make responding to project change more efficient. At a minimum a project change control system should ask the following questions:

- How does the change affect project scope?
- What is the cost of change?
- What is the impact on project schedule?
- Who can approve this change?
- Does this change require ethics approval?

Overall, controlling scope is not intended to restrict a researcher’s ability to redirect project activities towards research of greater scientific or commercial impact. Monitoring and controlling project scope is about fostering positive scope change, while preventing negative scope creep, through sound change management practices.

9.2 Monitoring and Controlling Project Schedule and Budget

As with the project scope, it is important to monitor the project budget and schedule on a regular basis. It is important to note that just because you may stay within the scope of a project in terms of activities, does not mean that you are effectively managing your project schedule or budget. It may be very well that you are spending more, or taking longer to complete activities than

originally planned. By regularly monitoring the schedule and budget of a project will enable you to react more effectively to deviations when they occur. This will allow you to get an activity under control before it affects the rest of the project. Furthermore, this monitoring will allow you to better forecast schedule and budgetary implications of project activities. A worst case scenario is that a project will have to remove or limit project activities because of schedule and budget overruns. This reduced scope may impact the quality of the overall project. If any schedule or budget deviations are identified through the monitoring of a project, they should be captured within the change control system (identified in 9.1.1) for possible action if warranted and approved. It is important to note that a change in scope, schedule, or budget may require an amendment to an existing funding agreement or contract, and thus must be identified in a timely manner.

10.0 CLOSING OUT THE PROJECT

10.1 Submission of Final Report and Administrative Requirements

This is the stage of the project when activities are completed and a final report is prepared for the relevant project funding sponsor(s). If the research project was contractual in nature, the project deliverable(s) would be provided to the project sponsor(s) at this stage for review and acceptance. Furthermore, depending on the nature of the research project, a number of administrative procedures may have to be carried out to ensure proper close-out of a research project.

10.2 Lessons Learned Documentation

Lessons learned is the learning gained by carrying out project activities. Often times during a project, valuable learning/experience is gained in the management of an activity, or in your approach to a particular project issue. These experiences may have led to a positive or negative outcome, however regardless of the outcome, the lessons you have learned may be valuable to subsequent research projects that contain similar situations. The purpose of documenting lessons learned is to share and use knowledge derived from experience to:

- Promote the recurrence of desirable outcomes; and
- Preclude the recurrence of undesirable outcomes

It is recommended that these learning experiences be documented and communicated to the relevant project stakeholders at the end of a project. Lessons learned documentation should include the issue, your approach, the outcome, and recommendations for similar situations in the future. It is also recommended that this documentation be carried out during the course of the project to ensure accurate reflection of the project incidents.

11.0 OTHER AREAS OF IMPORTANCE FOR EFFECTIVE RESEARCH PROJECT MANAGEMENT

11.1 Project Risk

A project risk is an uncertain event or condition that may affect a project outcome. Given the inherent uncertainties that can exist when carrying out a research project, it is important that the project plan is carefully reviewed to identify known areas of uncertainties. During the planning of a project, the project scope, schedule, and budget should be analyzed for risk. For example, during the planning of a project, it may be identified that particular skill sets are required to carry out certain aspects of the project scope. This skill set may have to be added to the project through the hiring of a project employee or the onboarding of a graduate student or post-doctoral fellow. Regardless, there is a risk the project scope will not be completed until this position is secured. Furthermore, the project schedule may be impacted if there are delays in acquiring this skill set.

Once project risks are identified, they next need to be investigated to determine their likelihood (probability of occurring) and impact (effect on project if the risk occurred). Based on the probability and impact of the identified project risk, a risk rating can be determined. Figure 6 provides an example of a 'Risk Probability and Impact Matrix'. This matrix structure combines the probability and impact of a project to qualify the over risk exposure and thus identifies priorities for attention. In this manner risks can be rated as low, medium, or high in terms of priority. As shown in Fig. 6, as the impact and probability of a risk increases, so does its priority for attention. Mitigating measures should be identified in a priority manner to identify measures that can help avoid the risk or lessen its impact on the project. As part of the mitigation strategy, a contingency plan may need to be identified to outline the actions required if the project risk is realized. The identified risk and the associated mitigation strategy should be identified and recorded within a project risk register. This risk register should be created in the planning stages of the research project, however it is recommended that the register be updated regularly throughout the life of the project as risks are identified.

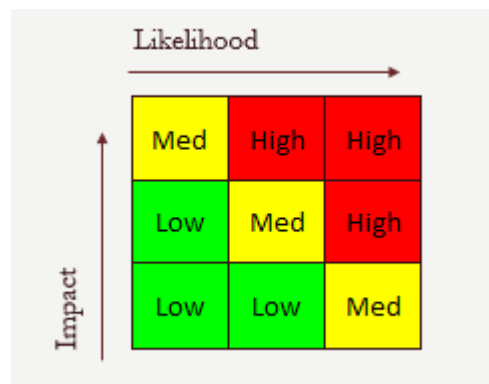


Figure 6: Risk Probability and Impact Matrix

11.2 Project Communication

Maintaining effective communication within the project team, and with project stakeholders, is of critical importance in successfully carrying out a research project. Poor communication within a research project can lead to the misalignment of project objectives amongst the research team, and unintended stakeholder expectations. These possible ramifications from poor project communication will inevitably result in reduced project potential. It is recommended that a research project have a communication plan established to maintain effective communication throughout the life of a project.

The first aspect of the communication plan is to ensure that project expectations are established with project stakeholders and that these expectations are managed throughout the life of the project. During the initial planning of a project, a stakeholder register can be created that identifies all relevant project stakeholders and their relationship to the project. To help set and manage the stakeholders' expectations, the research team must take time to get stakeholders involved in the project, answer questions, and at a minimum, communicate the project status. Ineffective stakeholder management can lead to the addition of scope creep to project activities, or unwarranted criticism of project results.

Another aspect of the project communication plan is to ensure effective communication within the project team. A good place to start here is with the Responsibility Assignment Matrix (RAM) that was established to assign roles and responsibilities to research team members. This matrix will ensure that each team member is clear on their expectations and who to communicate with.

It is also important to have regular team meetings with the research team. Not only will this allow the research progress to be monitored, but it will also enable team members to gain a holistic view of the project and help in the flow of information to relevant project team members.

11.3 Research Data Management

It is recommended that researchers put in place a research data management plan that outlines how the data will be handled during the research, and after the project has been completed. Data management plans can incorporate:

- Data storage and backup
- Data documentation and file structure/organization
- Data sharing and access

Information Technology Services (ITS) provides related services for MUN researchers. For more information on these services please visit: <http://www.mun.ca/cc/services/servicedesk.php>

Furthermore, the MUN libraries offer a service that can help you in preparing a data management plan. Namely:

- Providing assistance with writing Data Management Plans
- Advising on Best Practices
- Advising and assisting with data documentation and metadata

- Assisting with choosing a data repository
- Finding existing data sets
- Providing assistance with creating data citations
- Providing avenues to share your data

For help with any of the above research data management services, please visit the Research Data Management Services page hosted through the MUN Library website at:
<http://guides.library.mun.ca/datamanagement>