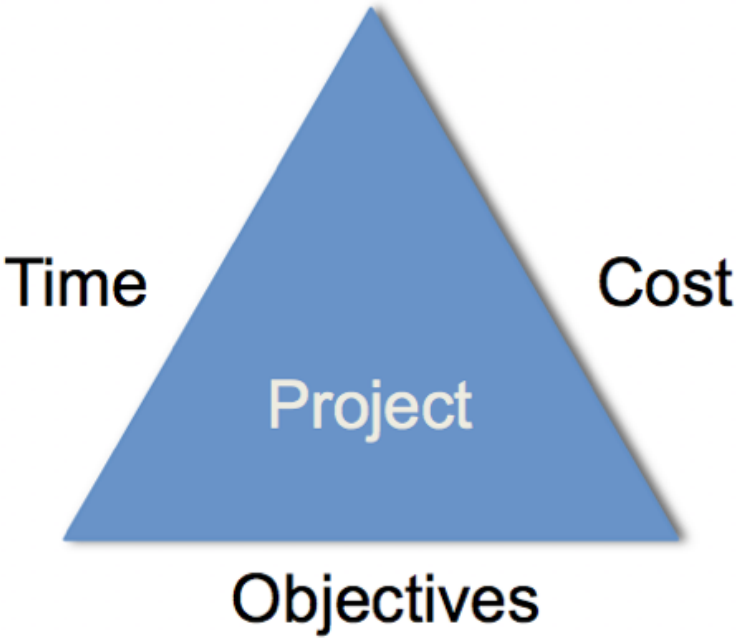
Module 5: Strategic Project Management for Scientists



Strategic Project Management for Scientists

Introduction

Scientists practice project management almost every day of their careers, yet few scientists actually realize that Project Management is a discipline in its own right and that following even basic project management practices can produce substantial benefits. A thorough presentation of Project Management is beyond the scope of this course, but we will introduce you to many of the most important concepts and ideas that will help you better understand how projects work, and how projects fail. Some of the knowledge in this chapter may well also positively impact your own research activities right now! In many ways, project management takes advantage of, and depends on the applications of many, if not most of the skills you have learned in this certificate program. In that sense, this project management module can also be viewed as a review and summary of the SciPhD Certificate Program.

Immediate Benefits

- Better control of your research project
- More accurate assessment of how long your project will take
- Ability to negotiate with your PI to have clear common set of objectives
- Better ability to anticipate what could go wrong and how to best prepare for that

Longer Term Benefits

- The ability to demonstrate your knowledge of project management using your own research as examples with accomplishments
- Demonstration that you recognize the important of meeting deadlines and working within budgets (which is very important to professional organizations)
- The ability to distinguish yourself from your competition for good jobs

Definitions:

Project: A *temporary* organized set of activities to achieve a specific set of objectives that has a defined endpoint.

Project Management: An organized accountable approach to starting, planning, executing, monitoring and closing a project and meeting the objectives. The Project Manager controls all aspects including personnel, materials and supplies, sub-contractors and costs management.
PMI: The Project Management Institute. This is the group that issues and governs various project management certifications like the Project Management Professional (PMP).

The Iron Triangle of Project Management

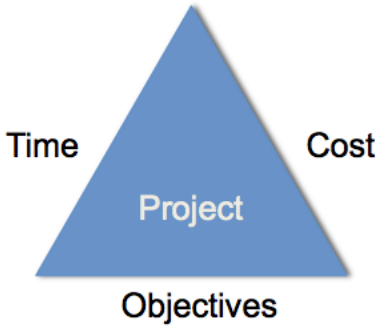
Professional project managers will spend a great deal of time planning for the *objectives* (*scope)*, *cost* and *time* allowances of a project. The reason for this is that these three items are inextricably linked together. If one of these conditions changes, the others must also be re-evaluated and changed as needed. Changes in one of these three parameters almost always impacts one or both of the others. Project managers refer to these interdependencies as **constraints**.

Time: Considers the *duration* necessary to complete all the project objectives.

Cost: Considers fully burdened expenses in order to complete the project and meet objectives. These include personnel, materials & supplies, sub-contractors and all other direct and indirect costs.

Objectives (scope): All the major accomplishments that must be achieved in order to successfully meet the goals of the project. The combined objectives for the project are often referred to as the project *scope*.

In order to successfully manage a project, the project manager MUST control at least one of the three cornerstones. If there are proposed changes to any one of the three cornerstones, those changes will likely impact at least one of the other cornerstones. If the project manager does not have control (authority and accountability) of at least one of those constraints, and allows the customer to dictate all three, the project is likely to fail.



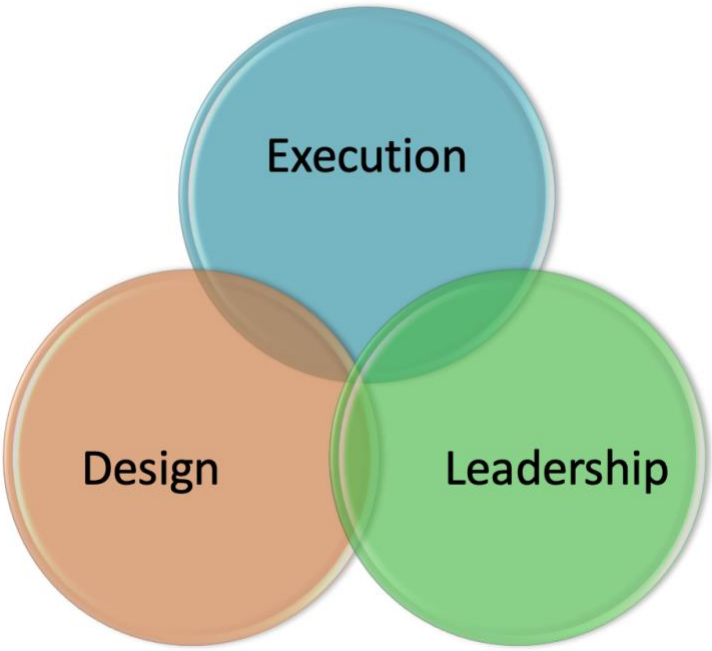
For example, let's say you are the project manager for a project that is planned to complete three main scientific objectives in 12 months that are going to be used as preliminary data in a grant proposal, with a budget of $25,000. You have agreed to time (12 months) cost ($25,000) and objectives. If your advisor comes to you and says that her budget has been slashed by 30% so you now only have about $16,500, the only way you can accommodate that change is to either also modify the objectives to something that can be completed with the reduced budget, or possibly get more time to complete the project with less available resources. You must have control of at least one of those three constraints.

Risk Management

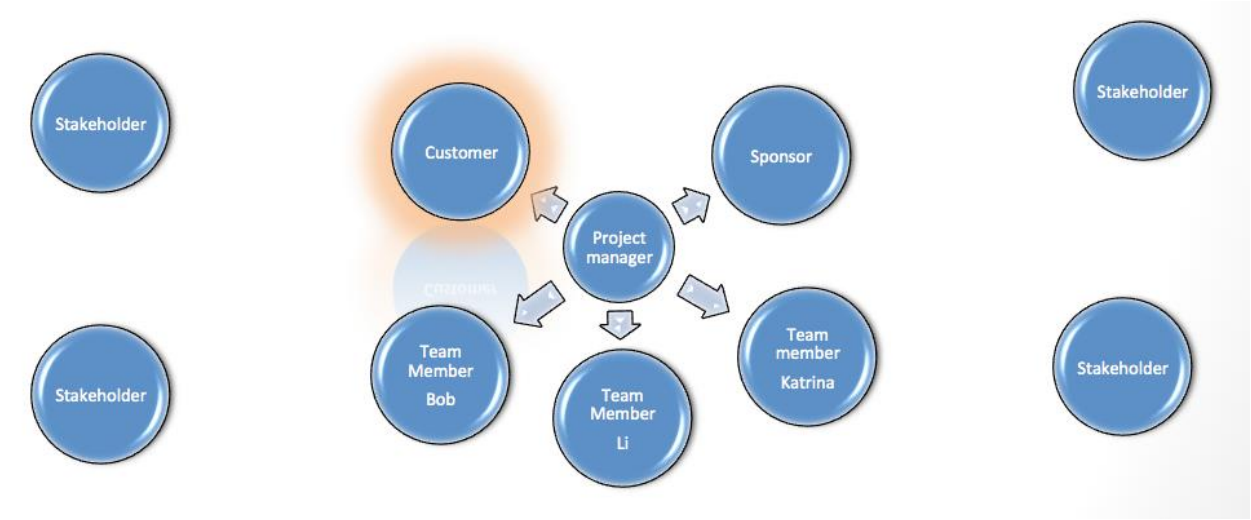
One of the most critical skills in successfully managing a project is accurately assessing potential risks and having an appropriate strategy to address those risks if they come to bear. In fact, often times the "go, no-go" decision as to whether a proposed project is approved is strongly influenced by the risk assessment during the planning stage. We will deal with risk management more later in this chapter.

Macro View of Project Management

Project Management involves managing the project design, execution, and leadership of the team members who perform that work. As such there are both tactical as well as leadership skills that make an effective project manager.



Typical Project Team



The Project Customer

The project customer is the INDIVIDUAL with whom you (re)negotiate Time, Cost and Objectives. You can only have ONE project customer. Identifying that individual is critical, as all negotiations ultimately are between the project manager and the project customer. Any other sponsors, supervisors, or other players who desire to have influence over the project must ultimately have their requests agreed to by the project customer. This is one of the most important jobs of the project manager. Ignoring this is one of the most common causes for scope creep, cost and time overruns, and failure of projects.

It is critical that the project manager identify a single person as their customer. The customer is the person who will make the decision about whether or not the project has met the goals and accept the deliverables. In addition, the customer must have the authority to make decisions and negotiate the time, scope and costs of the project.

The ability of the customer to determine the success or failure of a project is what separates them from the stakeholders. Care must be taken not to "promote" stakeholders to the role of customer. It is easy to get the two confused. Similarly, if a customer represents a group of people, it is essential that all their requests and interactions be routed through the customer. It is their job to keep their side of the project in order, not the project manager's.

Project Stakeholders

Stakeholders are defined as anyone who has an interest in the outcome of the project. This can easily get to be a very large group and it is easy to confuse stakeholders and customers. In general, while stakeholders have an interest in the project, they don't have the authority to make changes in the project or to decide if the project has succeeded or failed. However, they may have the authority to either enable or derail a project in its entirety, which is why they are important.

One of the tasks that project managers tackle early in a project, and maintain throughout the life of the project, is identifying stakeholders and making sure that they know what, and how, to communicate to the stakeholders.

For example, you could be involved in a multi-laboratory collaboration with your PI as the lead. In this case, your PI is likely the customer since he or she can negotiate time, scope and cost. However, other PIs may have critical equipment you need or have special analytical abilities. They could easily derail the project if they decided they didn't like how things were going!

Project managers generally rank stakeholders according to their level of *interest* in a project and their level of *power* over a project. Stakeholders who are both highly interested and highly powerful definitely need regular attention, while someone with low interest or low power may need only occasional attention. But regardless of the level of engagement, be sure that you know how to communicate with each stakeholder. It does no good to send email to someone who doesn't use email. Similarly, trying to have face-to-face meetings with someone who is only rarely in the office won't work either. Here is a rough guide to classifying and handling stakeholders.

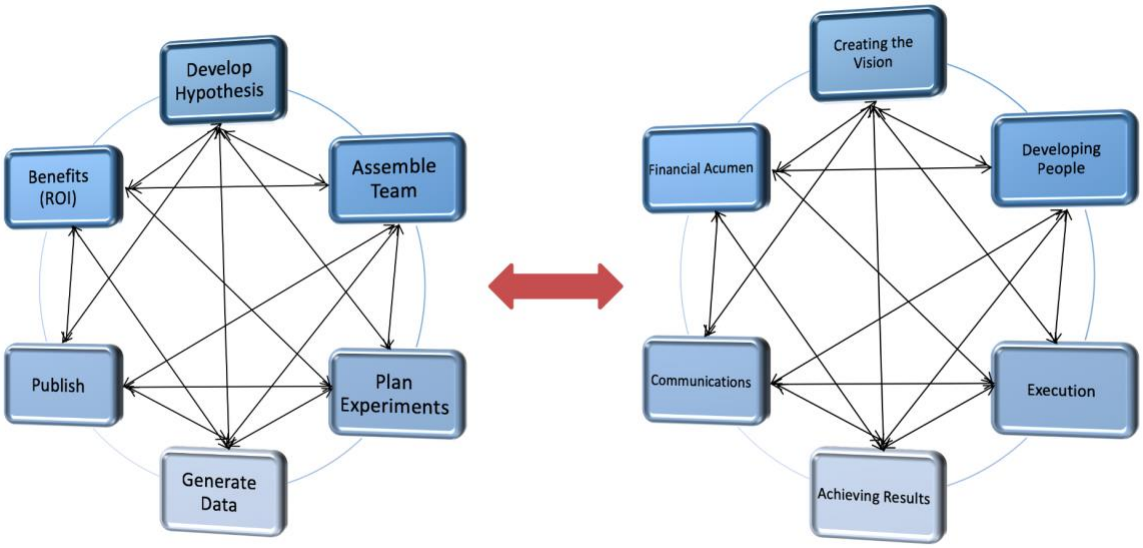
Stakeholder power level	Stakeholder interest Level	Project Manager action
Low	Low	**Monitor** these individuals and engage them only if needed
Low	High	Keep these individuals **informed** about progress
High	Low	Keep these individuals **satisfied** with the progress
High	High	**Closely monitor** these individuals. These are the most important stakeholders

Your Current Science Team

Role (Your Research Project)	Name
Project Customer	
Project Sponsor(s)	
Project Team members	
Project Stakeholders	

Project Management and the Scientific Method

As scientists, you should easily understand the concepts and implementations of project management, as there are very close parallels between the scientific method and project management. This underscores a fundamental point of SciPhD philosophy, which is that throughout your scientific training and professional career, you have learned and experienced thought and implementation processes that parallel the business life-cycle.



Let's take a look at the five phases of a project as defined by the Project Management Institute (PMI) and their counterparts in the scientific method.

Project Phase	Scientific Method
Initiating	Hypothesis
Planning	Design and planning experiments
Execution	Performing experiments and analyzing the data
Managing and Controlling	Validating/Controlling the experiments
Closing	Publishing the results, lessons learned

Initiating

In project management, the Initiating phase is all about understanding the feasibility of the project, doing a preliminary check for resources and making sure that there is a sponsor, with authority, who will back the project. Like forming a hypothesis, Initiating is all about understanding why the project should, or should not, be done.

Planning

This is the stage in the project lifecycle where the over-arching goals and success criteria for the project are defined, followed by the objectives necessary to meet the goals, and finally the specific tasks (work) necessary to meet each of the objectives. It is during this process that the potential risks to the success of the project are assessed and, based on those risks, required resources and time required to complete the work are estimated. All the above information is necessary in order to make an informed decision as to whether the proposed project is worth pursuing (i.e. that it will be profitable to the company). With respect to the scientific method, this parallels the process of developing a hypothesis and determining whether it is feasible and worth the risks to pursue testing that hypothesis, considering the value of the anticipated results, the costs, time to complete, and risks to success due to factors outside of your control.

Executing

This is the part that scientists generally love. Rolling up their sleeves and actually doing the experiments! If your planning has been thorough, this part should go smoothly and give you lots of data to work with and accomplish the project goals.

Managing and Controlling

Managing and Controlling is something that scientists generally lump together with Execution, but project management considers a separate process all its own. The goal of Managing and Controlling is to make sure that work done in Executing is actually what it is supposed to be and making corrections if it isn't acceptable. In other words, if you're running an experiment, how do you know that the results you get are valid? Project Managers will build a Quality Plan as part of their planning process, and the entire goal of this is to make sure that all work done in Execution is known to be good, or bad.

Closing

Of the five project phases, Closing is the one that is probably the most different from the scientific method. In project management, closing is all about making sure that there are no loose ends left over from completing the project and delivering the product. Another important aspect of closing a project is *lessons learned*, which unfortunately is often overlooked. This valuable step takes the time to review the project, identify the aspects that went well and those that did not, and based on that, offers recommendations on process improvements that can improve efficiencies in the future. Scientists may consider publishing to be the equivalent of closing, but there is an argument that a paper is actually the deliverable for an experiment. In that case, closing could be putting any materials in long-term storage or depositing algorithms where they can be accessed in the future, reflecting on the original hypothesis and whether or not the project supported that. This would be essentially *lessons learned.* But the result is the same: The goals have been reached and the project is now done.

A final word on the phases: Iteration

Project management is clearly all about planning in advance, but it does recognize that not *everything* can be known at the start of a project. In fact, it recognizes that significant amounts of information may be discovered only after the project has started and the initial plans around those unknowns may be very vague at the start. So one of the hallmarks of a good project manager is the ability to iterate on plans over the entire life of the project. As new information comes to light, plans may have to change in order to handle that new information.

Organizing a Project

In order to determine whether a project is worth performing, there is some up-front planning that must be done in order to get a reasonable idea of how much time and resources must be allocated to meet the objectives of the project. Once these parameters are known, there can be a "Go, No-Go" decision. The steps necessary to get to this decision include:

- Clearly defining the project goal
- Defining objectives necessary to achieve the goal
- Outline expected outcomes
- Identify dependencies and assumptions

Once the above information is available, decision-makers can give the go-ahead and authorize the project.

Four Critical Questions

In defining a project, there are four critical questions that must be addressed, and *in the following order*:

1. What are we trying to accomplish and why?
2. How do we know if and when we're successful?
3. What other conditions must exist (that are outside our control)?
4. How do we do it?

The discipline to address the first three questions *all in order* before planning the actual work (question 4) is a critical aspect of strategic project management. Oftentimes scientists jump right from answering question 1, to answering question 4 which can result in projects with no defined end-point, performing work (experiments) that are not aligned with the stated goal and objectives, and virtually assuring that the project will not be completed on time, or on budget. These four critical questions also align very closely with the scientific method.

Success Criteria- How do we know when we're done?

A project is defined as a **temporary** set of activities with a **defined end-point**. As such, one of the essential aspects of defining a project is clearly defining those end-points, or *success criteria.* These are the expected accomplishments from executing the project which, if achieved will result in the project customer agreeing that the project has been successfully completed. Success criteria should map to objectives and goals. Note that the customer is really the final arbiter in determining whether or not a project is successfully completed. Because of this it is critical that success criteria be defined to *everyone's* satisfaction before any work is done.

Scientific and Business Language

Each of the Four Critical Questions maps back directly to basic scientific activities that you perform regularly. As with so many other aspects of The Business of Science, learning how to express those scientific project management behaviors using business language is an effective way to convey to prospective hiring managers that you do in fact have project management experience.

Questions	Scientist Language	Project Management Language
What are we trying to accomplish and why?	Hypothesis	Goals, Objectives (Initiation phase)
How do we know if and when we're successful?	Anticipated results	Success Criteria (Planning phase)
What other conditions must exist?	Availability of equipment, reagents, funding etc	Assumptions, Risks (Planning phase)
How do we do it?	Experiments Protocols Previous Studies	Work Breakdown Structure, Resource Allocation, Critical Path (Planning phase)

Goals and Objectives: Strategic Top-Down Project Planning

Project managers use a process called **decomposition** to break down large goals and tasks into smaller, more easily addressed work packages. In general, the goal of decomposition is to define the overall goal in terms of a series of understandable tasks. When doing this sort of breakdown, be aware of a couple of items:

- Over-decomposition is a risk. You don't want to micromanage through planning, the idea is to have easily understood, achievable goals, not the actual experimental details.

- You may not know everything during the planning phase. Information needed to break down some tasks may not be known until in the future. This is OK and just needs to be noted so that decomposition can happen when all the information is available.

In developing a project plan, use causative if-then statements to work from the Project Goal to define all the objectives and then for each objective, define the required outcomes and the tasks needed to reach those outcomes.

Causative "if-then" statements

"If I do A, that will cause B" is an example of a causative "if-then statement". These are distinct from "sequential" or "temporal" if-then statements that simply state "If I do A, then I can do B". The difference is that the former is causative, the latter is only enabling. For the purposes of strategic project planning, focusing on causative relationships ensures that all activities related to designing and executing a project lead towards fulfilling the project goal.

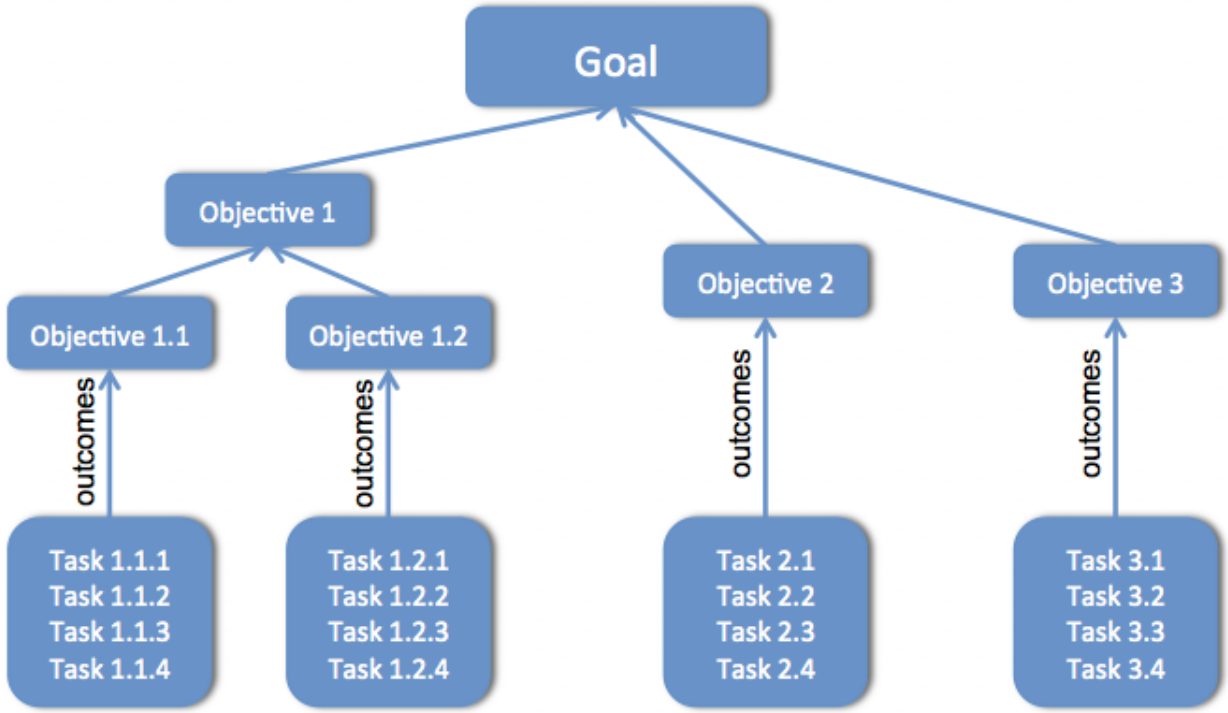
Components of a Strategic Project Plan

Goal: What are we trying to accomplish and why?

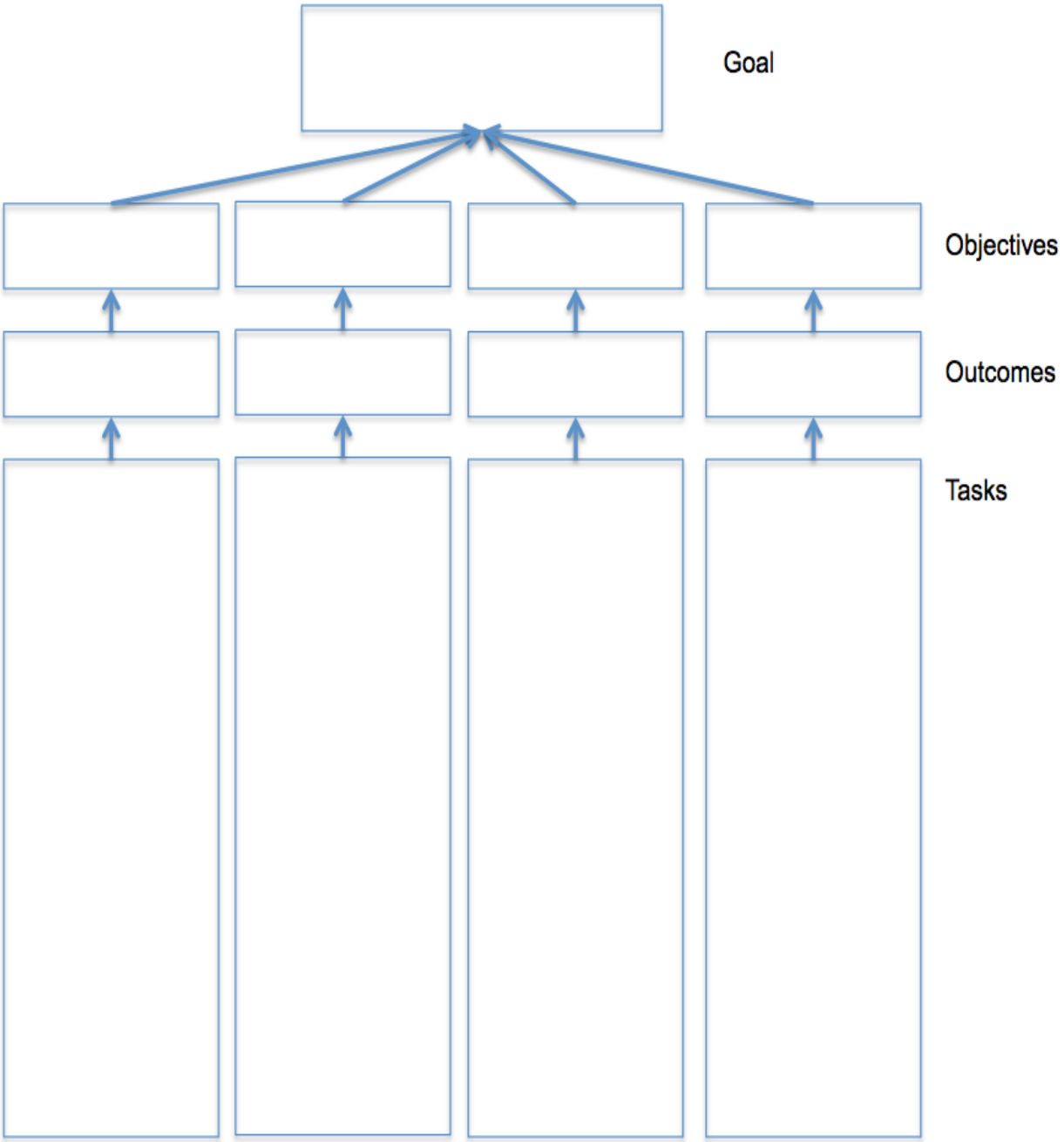
Objectives: What must be done to achieve the goal?

Outcomes: What are the results of actual tasks necessary and expected to achieve the objectives?

Tasks: What are the activities ("action items") necessary to gain the outcomes that meet each objective?



Mapping of your Project:



Why all this structure?

- Ensures that all work is relevant and necessary
- Specific objectives provide logical structure to work
- Required outcomes provide mechanism to determine if project should continue
- Provides mechanism for defining assumptions
- Defining tasks provides most accurate estimation of time and cost required to meet objectives

Assumptions and Risk Assessment:

These are external factors that can influence the progress of a project and are essentially outside the direct control of the project manager. As a result, assumptions should be documented and monitored throughout the duration of the project. Although they are typically outside the control of the project manager, in some cases they can be influenced, or at least managed through backup plans or risk mitigation strategies.

Documenting assumptions prior to initiating a project also ensures that the project customer is aware of inherent risks, and either explicitly or implicitly accepts those risks by approving implementation of the project despite the assumptions being part of the project plan.

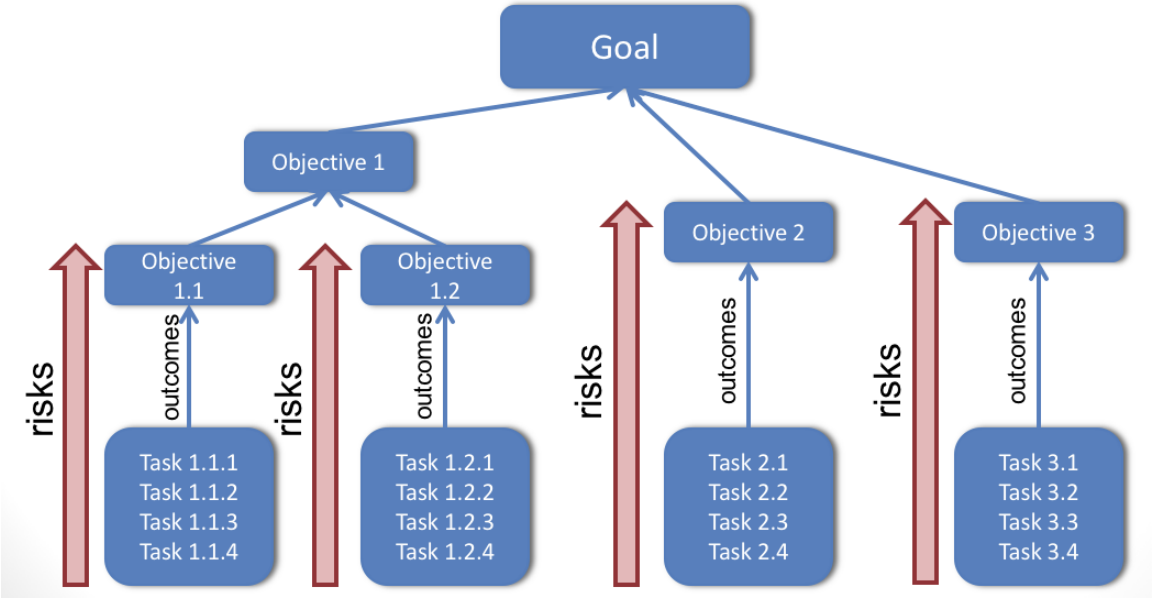
Risks are defined as events that can influence the success of a project but haven't materialized. Unlike common usage, in project management "risk" is a neutral term, risks can be either positive or negative. For example, a positive risk could be that the experiments generate enough interesting data that they can be used to win additional funding for the project. However, because of the common usage of the word "risk", project managers often refer to positive risks as *opportunities*.

Regardless of the nature of the risk, project managers define risks with two parameters:
Probability - This is an estimate of how likely it is that a risk will occur
Impact - This is a determination of what kind of effect a risk would have on a project should the risk actually occur.

Risk Response Strategies

Risk	Opportunity	Description
Avoid	**Exploit**	Change the project as necessary to ensure that the risk cannot occur (or absolutely will occur if the risk is positive).
Transfer	**Share**	This involves having a 3rd party responsible for the risk. Insurance is one example transferring risk or partnering to help share a risk.
Mitigate	**Enhance**	In this case, the team takes steps to change the probability and/or impact of a risk. The risk still remains, but at a different probability/impact.
Accept	**Accept**	This means recognizing that a risk exists but not taking any steps to change the probability or impact.

Generally, a good approach to risk management is to first develop a list of the possible risks. This list shouldn't be exhaustive (that is just too exhausting) nor should it include fanciful risks. Yes, it is possible the sun won't rise tomorrow, but from a project perspective, that isn't worth the worry. You can always add or remove risks later. One way to develop this list of potential risks is to look at your project map and read each individual path from tasks to objective and think about where the risks are in each path.



Once you have a list, then assign a probability and an impact to each risk. There are dozens of models on how to do this, but most of them are just a text or numerical ranking representing low, medium or high. From this ranking, you can order the risks from high probability, high impact to low probability, low impact. Now comes the hard part: planning how you are going to handle each risk in the event it actually happens. Project managers have four different categories of risk response:

ID Risk in Your Project- Near-Term Risk

The process described above is an effective method to identify, anticipate and plan for near-term risks in your project, and can help you make decisions on whether those risks are worth taking relative to the value of the project.

Breakout Room Exercise- Defining Strengths, Weaknesses, Opportunities and Threats

All of you share a common workflow in pursuing your PhD or your postdoctoral fellowship:

- Meet with PI to discuss project
- Develop strategy
- Plan out actual experiments (breakdown the work structure)
- Execute work
- Review results with PI
- Make adjustments as needed
- Complete all agreed-to work
    - Publish
    - Get PhD

In the breakout room, use the approach above to identify the potential risks to your project, and share and discuss with others in your breakout group. Help each other to identify risks and think about the best strategies to manage that risk.

Risk Management

List major objectives from project diagram, assign risk, and select a strategy to manage the risk (avoid, share, mitigate, or accept)

Objective	Risk	Strategy

Risk Over Time

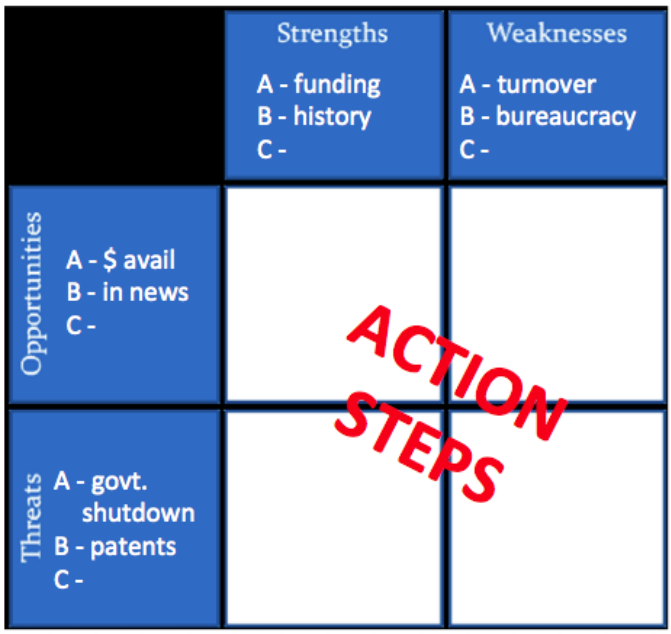
The approach used above can provide tactical decisions on how to manage specific situations if they come up during the course of a project. In addition to these important considerations, there are longer-term risks (and opportunities) that can be anticipated, and even leveraged to the benefit of your project. SWOT analysis is a systematic approach to risk management that considers your internal strengths and weaknesses as well as any external opportunities and threats that may exist. The analysis results in specific action items you can take in order to leverage your strengths to take advantage of external opportunities, and mitigate external threats, and how to use external opportunities to mitigate your weaknesses.

SWOT Analysis

Reference: http://en.wikipedia.org/wiki/SWOT_analysis

SWOT analysis (alternatively **SWOT Matrix**) is a structured planning method used to evaluate the **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats involved in a project or in a business venture.

SWOT Matrix Configuration:



Strengths: characteristics of the business or team that give it an advantage over others in the industry.
Weaknesses (or Limitations): are characteristics that place the firm at a disadvantage relative to others.
Opportunities: *external* chances to make greater sales or profits in the environment.
Threats: *external* elements in the environment that could cause trouble for the business.
SWOT analysis may be used in any decision-making situation when a desired end-state (objective) has been defined.

Key Questions to answer:

- How can we use and capitalize on each Strength?
- How can we improve each Weakness?
- How can we exploit and benefit from each Opportunity?
- How can we mitigate each Threat?

Set Up Considerations:

- Ideally a *cross-functional team or a task force* that represents a broad range of perspectives should carry out the SWOT analysis.
- For example, a SWOT team may include an accountant, a salesperson, an executive manager, a scientist …
- Be realistic about the strengths and weaknesses of your organization
- Distinguish between where your company is today and where it could be in the future
- Be specific – no gray areas
- Apply SWOT in relation to your competition (eg. Better than or worse than competition)
- Keep it short and simple

Scope Creep

One of the biggest risks to projects being completed on time, on budget and meeting the agreed-upon objectives is a phenomenon called "scope creep". When projects are poorly planned (i.e. don't follow the strategic planning process), what often happens is, not long after the various tasks begin, unanticipated problems crop up requiring additional unplanned work, which impacts time to complete the tasks as well as cost. This is why thorough strategic planning is so important during the concept and feasibility phase. Accurate estimates of time and cost to meet the objectives can only be achieved if careful consideration of all the steps has been considered. With all projects, because there are time and cost constraints, goals inevitably have to be prioritized, and concessions made in order to achieve what is necessary, not necessarily everything that is possible.

One of the most insidious, and difficult to manage, forms of scope creep is called **gold plating**. Quite simply, gold plating is when a team member gives the customer more than what they asked for. What makes gold plating difficult is that frequently the team member doing the gold plating thinks they are doing a better job by going beyond the original scope. People frequently believe that "going the extra mile" and "giving 110%" are traits that will get them noticed and advance their careers. However in a project, this behavior can have profoundly negative impacts. First, there is no such thing as free scope. Time and resources spent on gold plating could (and should) have been spent on the agreed-upon objectives. Second, it is possible that the original customer thought of, and rejected, the extra features. That sets up a very unpleasant surprise for both the project manager and the customer.
Can you think of episodes of gold plating in your research projects?

The Tools of Project Management

Requirements Gathering- The User Story

A project always has a customer who negotiates time, cost and objectives with the project manager. In determining the scope of a project, once the four critical questions are addressed and we have a clear goal, supporting objectives, anticipated outcomes and tasks, those should then be translated into a unified user story which outlines the proposed solution and how a user of that product would implement the product to achieve the desired goal. The process of developing the unifying user story that is written from the perspective of the end user's *human workflow* is what ensures that all the individual tasks that fulfill individual objectives will actually integrate appropriately to provide a usable solution. It is not enough to define all the components necessary to build a car- wheels, brakes, steering, seats, doors etc. The way those parts have to interact with each other and the end user dictate how they have to be assembled so that the *human workflow* is fulfilled and the car is drivable. The steering wheel must control the wheels and be accessible to the driver while the brake, accelerator, and other controls are also within reach.

This process of defining goals, objectives, tasks, expressing those in the context of user stories is referred to as *requirements gathering*. Just as defining a project "top down" starting with the goal and using causative if-then statements to define the supporting objectives and tasks, requirements gathering follows the same "top-down" approach.

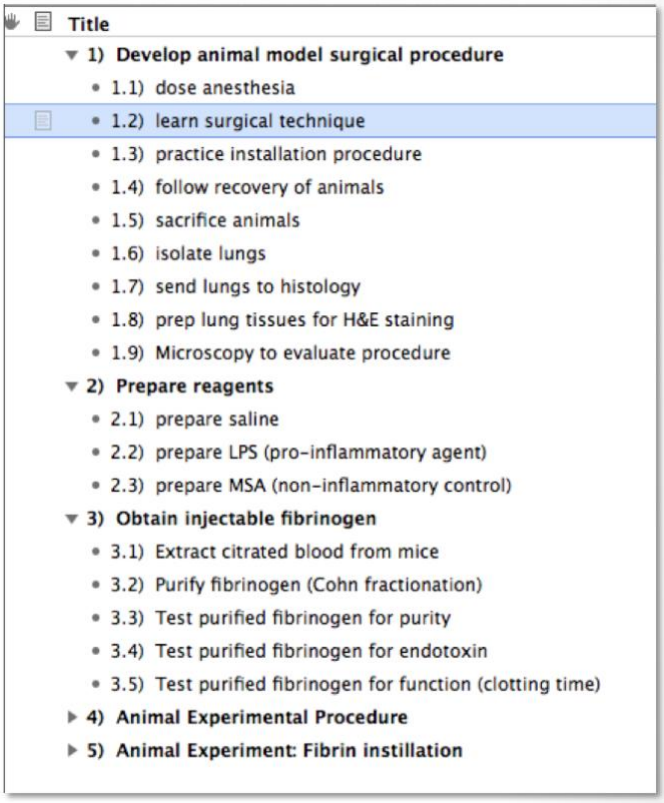
Steps in Requirements Gathering

1. User story: Describes at the user experience level how users will interact with the finished product to achieve their goals (the *human workflow)*.
2. User requirements: Based on the user story, individual user requirements are extracted, typically in the form: "user be able to X", "user be able to Y", "user be able to Z" (often abbreviated as "UBAT"). And should match the objectives and respective tasks identified during the Concept anda Feasibility phase.
3. Technical requirements: Based on the individual user requirements, technical or implementation requirements are derived that describe the actual tasks the system/product must perform to satisfy the user requirements.

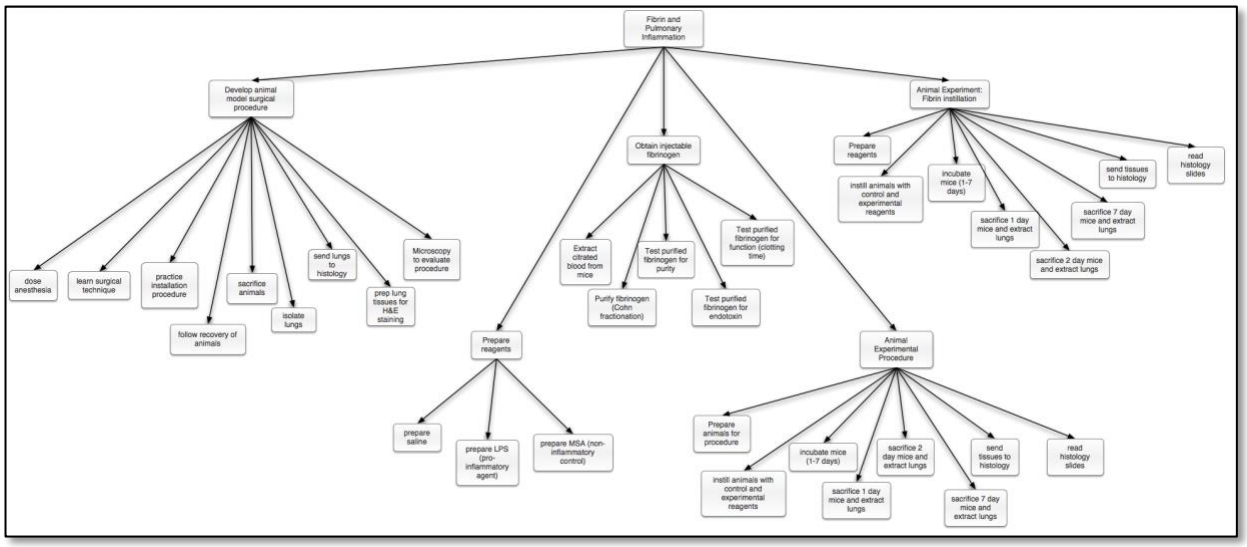
The technical requirements are the guidelines for the product development team to actually implement a solution. Because the technical requirements were derived from user requirements, which in turn were derived from a user story, the process ensures that all activities are supporting achieving the product goal.

Planning and Organizing the Project- The Work Breakdown Structure (WBS)

The Work Breakdown Structure (WBS) is a graphical or list representation of all of the tasks necessary to execute the project. Two common ways of depicting a WBS are in hierarchical lists organized by objectives, and network diagrams.



Heirarchical WBS



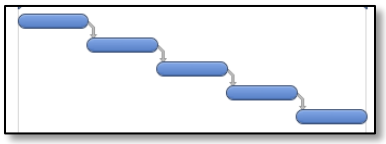
Network Diagram WBS

Dependencies

When organizing tasks associated with a project, the project manager must consider the personnel resources available, equipment, space, and other supporting resources, as well as the dependencies between the tasks to be performed. Some tasks cannot be started until other tasks are completed, while some tasks can be started independently. Defining the relationship between tasks is important in determining the most efficient way to execute the project, both with respect to time and cost. There are four types of dependencies between tasks that have specific impacts on scheduling. These include:

- Finish to Start
- Start to Start
- Start to Finish
- Finish to Finish

Finish to Start



One task cannot start until its predecessor finishes.
Examples:

1. Isolate and purify fibrinogen
2. Instill fibrinogen in mouse lungs
3. Sacrifice mice
4. Remove lungs
5. Prepare for histology

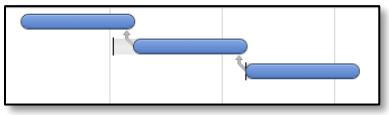
Start to Start

One task can't start until its predecessor starts
Example:

- Synchronized Experiments:

Treating control and various experimental conditions in an experiment requires all processes starting simultaneously.

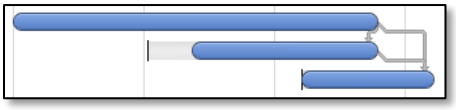
Start to Finish



One task cannot finish until its successor starts
Example:

- Setting up a long-term incubation project that has regular timepoints (every 2 hours). The work is split between project team members so that no-one has to stay up for a week! But the person "on duty" cannot "finish" (leave the lab) until the next person "starts" (arrives).

Finish to Finish



One task can start, but can't complete until its predecessor task(s) complete.
Example:

- When performing a time course experiment that includes tissue histology and whose endpoint is not known initially (e.g. end point is paralysis or death
    - Although you can start reading histology while harvesting tissue, you can't complete the histology task until animals have died or exhibit paralysis.

Level of Effort, Duration and Resources

Level of Effort: How much actual hands-on work-time the specific task will take (sometime referred to as "people-hours". Level of effort is important in assigning human resources to a project.

Duration: Total length of calendar time necessary to complete the activity (impacted by LOE and resource availability).
Level of effort and duration are not necessarily the same. For example: If an experiment is designed to run 5 days, but only requires 2 hours of actual manipulation per day, the LOE is 10 "people hours" and the duration is 5 days. Thus, individuals can be assigned to multiple tasks that have overlapping duration on a scheduling chart as long as their total LOE doesn't exceed that allowable for the work period. Gantt charts (below) are very helpful for assigning resources to tasks and maximizing those resources.

Resources: The people, equipment and supplies required to perform the task.

Project Execution

Monitoring Your Project

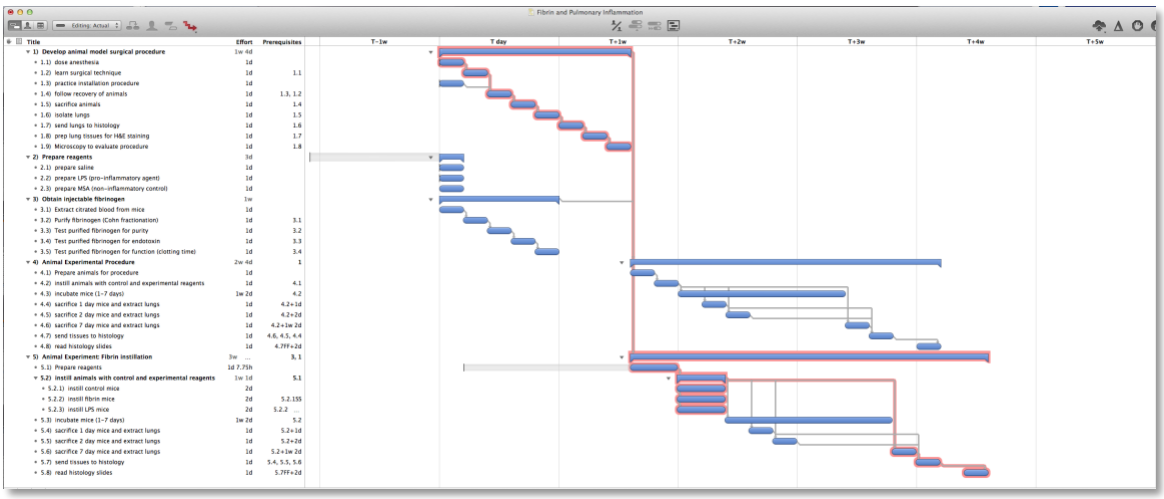
Professional project managers develop and use a **Quality Plan** that documents the processes that will be used to determine if a project is doing the right things. A quality plan is simply a description of what the result of any particular process should be and how the project will know that the result can be trusted. A quality plan also addresses how to tell if a project is on time and on budget.
For a bench scientist, developing a full-blown quality plan is overkill, but there are a few concepts you can use that will help you know if your project is on track or is getting into trouble.

Gantt Charts

Gantt Charts are an intuitive way to view projects organized by objectives and tasks that show a timeline, dependencies, milestones and assigned resources. Popular project management software, such as Microsoft Project (Windows), OmniPlan (Mac OS X) and others (see below) will generate various views of projects including Gantt Charts, network maps for WBS, and will also calculate Critical Paths and display those visually.

Critical Path

Based on the relationships (dependencies) between tasks in a project, when they are scheduled to begin, and which resources are assigned to them, certain tasks become time-critical, meaning that any delay in their completion date will necessarily delay the completion date of the whole project. Other tasks have more flexibility, in that if they are delayed, they will not necessarily hold up the project. For example, if there are two tasks which both can't start until a previous task is complete, one task takes 4 days and the other takes 7 days, and the next task depends on both of them being complete, then the task that only takes 4 days has as much as three days of "flexibility" in which it would not impact the rest of the project. The critical path is the sequence of tasks, which, if delayed will absolutely delay the completion of the project. *Critical path* can be calculated manually, but most modern project management software packages will determine the critical path automagically once the dependencies, duration and resources are assigned.



Performance metrics

The question performance metrics are trying to answer is a simple one: How do you know your experiment worked the way it was supposed to? All experiments have some sort of controls that can help with this, so for this purpose, knowing what the controls are and checking if the controls behaved the way they should will give you the information to tell if the results are valid.

It is important to know the current status of your project with respect to meeting your project objectives on time and on budget. There are two parameters that can help monitor the progress of the project to make sure it is on schedule.

Milestones

Similar to deliverables, milestones typically map to completed outcomes and are defined to be relatively evenly spaced temporally across the duration of the project. Their purpose is to provide a continuous gauge on whether the project is on schedule. Milestones do not have to have complete functional value, but typically represent completion of a significant step in the project. In the example above, a milestone could be the final design of the backend database, even though there is not yet a user interface completed in order to begin registrations.

Milestones for your Project	Date or Timeframe

Deliverables

Deliverables are completed *components* of a project that have some inherent value and function. This typically is the result of completing one or more related tasks that provide an outcome that is functional. In designing a software registration system, it could be the user interface for registering as a customer, along with the backend database that stores the information. Even though the rest of the project may not be completed, that registration software has inherent functional value.

Deliverables for your Project	Date or Timeframe

Execution

Once the Initiation and Planning phase of the project is complete (sometimes referred to as "Concept and Feasibility), the decision-makers review the objectives, success criteria and assumptions and based on that determine whether the risks justify advancing the project forward. If they do, then the project enters the Execution phase. The execution phase typically starts with the Kickoff Meeting during which the following topics are covered:

Kickoff meeting

- Assignment of roles
- Presentation of Schedule
- Review of Deliverables and Milestones
- Review of assumptions
- Schedule Periodic status meetings ("Standup Meetings")
- Update Project Management Plan (versioning)

Managing Your Team

- Clearly define time, cost and objectives
- Define milestones
- Define deliverables
- Negotiate
- Communicate regularly
- Develop relationships!!!
- Keep your team motivated (promote mastery, autonomy and shared purpose)

Change Control

- Planning
- Structure
- Work Breakdown Structure
- Gantt Chart
- Resourcing
- Communications plan

Change Management

- Managing your team members
- (re)setting expectations
- Involving them in the process and the solution
- Everyone's input is important:
    - Customer
    - Sponsor
    - Stakeholders
    - Project team members

Total Control

- Time
- Cost

- Objectives
- Social Context (culture)
- Acceptance Criteria
- Quality

Review and Audit

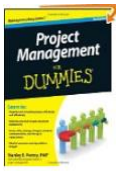
- Milestones
- Deliverables
- Schedule
- Budget
- Lessons Learned
- Update Project Management Plan

Top 10 Project Management Challenges

- Poorly defined goals
- Scope changes
- Inadequate skills for the project
- Lack of accountability
- Improper risk management
- Ambiguous contingency plans
- Poor communications
- Impossible deadlines
- Resource deprivation
- Lack of stakeholder engagement

References

Strategic Project Management Made Simple: Practical Tools for Leaders and Teams by Terry Schmidt (Feb 9, 2009)



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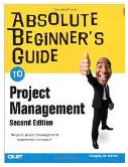

Absolute Beginner's Guide to Project Management by Gregory M. Horine (2009)

Project Management Software

Windows
Microsoft Project (Microsoft Corporation)

Mac OS X
Omniplan & Omnigraffle (The Omni Group)

Opensource replacement of Microsoft Project.
http://www.projectlibre.org/

GanttProject: Open Source project management software (Windows, OSX, Linux)

Mindview: Matchware

Web-based
LiquidPLanner www.liquidplanner.com

asana.com

monday.com

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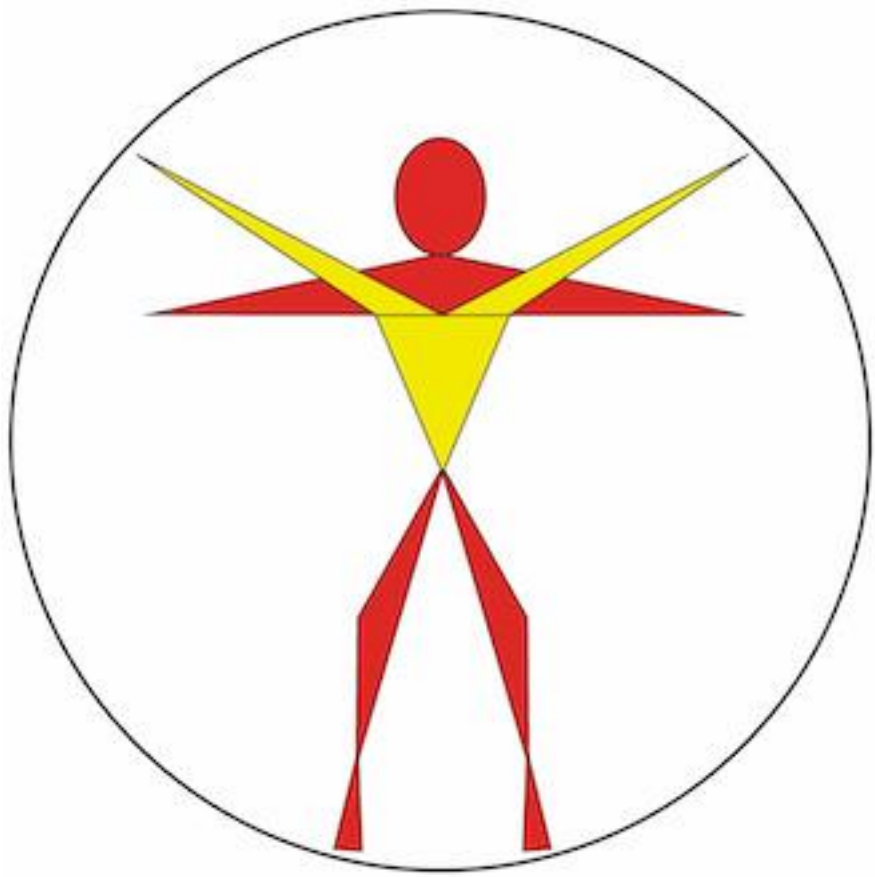

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