

UMD Project Management Symposium
Capturing Costs and Value of Research Products¹

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ABSTRACT

The nature of research projects does not lend itself to project management. Requirements are rarely concrete, scope is evolving, and each project is an entirely new problem to find solutions for. With so much unpredictability, how can we possibly estimate research costs accurately? Is there a way to determine the value of research products?

This paper will discuss the project management methods and processes developed to help estimate costs, manage budgets, and better determine the value of products for research initiatives. I will also discuss useful tips on how to effectively manage costs and budget from the planning phase through project closeout.

INTRODUCTION

Research is an approach to solving problems, developing new methods, and improving existing processes. Research involves creativity, trial and error, and exploration, exposing it to variability, unknowns, and risk. How can we possibly assign a level of effort to a research initiative when all these factors are at play?

From my experience managing externally sponsored, reimbursable research projects at the U.S. Census Bureau, the budgets for these initiatives are never large, scope is complex and ever-evolving, and the process for initiating and tracking these projects was often informal and inconsistent. Due to the nature of research projects, it was challenging to avoid issues, such as poorly estimated costs, budget overruns, and scope creep. It was also difficult to determine the value of the final ‘product’.

In this paper, I will discuss methods to improve cost estimation, budget management, and how to better determine the value of research.

¹ This paper is released to inform interested parties of ongoing operations and to encourage discussion of work in progress. Any views expressed on operational issues are those of the authors and not necessarily those of the U.S. Census Bureau.

COST ESTIMATION

The goal of cost estimation is to produce an estimate that is accurate, all-encompassing, reasonable, and defensible. Achieving all of these factors is not easy, especially when estimating costs for research initiatives. Here is an eight step cost estimation process that can help accomplish this goal.

Cost Estimation Process:

1. Determine Scope
2. Provide Historical Data
3. Estimate Effort
4. Estimate Costs
5. Review & Update Cost Estimate
6. Develop Cost Estimate Memo
7. Send & Negotiate Cost Estimate
8. Follow Up & Finalize

Below I will go into each step in more detail, adding in some best practices and lessons learned.

Step 1: Determine Scope

Work with the project sponsor to determine the scope.

- Start with the overall goals of the project then break that down further into requirements
- Ensure that the final deliverable is defined (i.e. a final report on project findings)
- Discuss constraints, initial risks, and any information that could be useful to the project
- Determine if the project is feasible given staff skillsets, availability, and timeframe
- Make sure key project stakeholders are in agreement and fully understand the scope
- Set realistic expectations

Lesson Learned: This step is crucial! It sounds simple, but too often projects have ill-defined scope and the final product is unclear. You are almost guaranteed to experience scope creep and/or budget issues down the line if you do not thoroughly discuss and agree to expected outcomes of the project.

Step 2: Provide Historical Data

Provide historical project data to the subject matter experts (SMEs) to assist with their effort estimates.

- Schedule actuals from similar past projects
- Lessons Learned from similar past projects
- Average effort of standard products (Table 1)

Table 1. Standard Products - Average Effort by Project Type and Resource Grade.

Standard Product	Qualitative Project (hrs)			Quantitative Project (hrs)		
	GS-12	GS-13	GS-14	GS-12	GS-13	GS-14
Operations Plan	11	6	7	91	67	28
Analysis Plan	59	22	7	67	17	15
Expert Review	72	43	33			
Analysis	139	106	26	312	132	29
Recommendations	48	30	28	0	0	0
Report	67	21	7	116	65	18

This example shows the average hours, based on past schedules, required to produce a standard research product.

Lesson Learned: Put good in, get good out. Put in the effort to develop and maintain up-to-date, comprehensive schedules and encourage your project teams to report accurately. As a result, you will get good output in the form of usable schedule data to reference for future project costs. The more data we collect, the better our estimates get. This means no longer needing to rely solely on the “best guess” of SMEs.

Step 3: Estimate Effort

Provide a user-friendly effort estimation template with instructions for SMEs. Using historical data from step 2, SME provides information needed for cost estimate.

- Research project proposal- revised to capture updated scope based on initial meetings with the sponsor
- Timeline of work/milestone schedule (planned fiscal year by task)
- Three-point effort estimate (optimistic, most likely, and pessimistic) for each project task
- Level of confidence in each estimate (high, medium, low, guesstimate)

Table 2. Effort Estimate Example.

Deliverable	Fiscal Year	Resource A Effort (hrs)			Resource B Effort (hrs)			Confidence
		Optimistic	Most Likely	Pessimistic	Optimistic	Most Likely	Pessimistic	
Deliverable 1	19	5	8	12	5	8	12	high
Deliverable 2	19	24	48	64	16	24	32	medium
Deliverable 3	20	48	72	96	32	48	64	medium

Lesson Learned: Using a mix between bottom-up and parametric estimating creates more reliable, defensible cost estimates than expert judgement alone. Leveraging historical data to make informed deliverable-level effort estimates leads to more accurate costs.

Ensure the SMEs are accounting for the following effort.

- ✓ If the project requires assistance from other areas- work with those areas to account for their effort, availability, and costs
- ✓ Project management - consider team meetings and meetings with the sponsor
- ✓ Project-specific background research or staff development and onboarding

- ✓ Project planning and preparation
- ✓ Stakeholder management
- ✓ Addressing comments and feedback on deliverables
- ✓ Travel expenses, if applicable
- ✓ Project Closeout- lessons learned, finalizing and archiving documents, and planning for related future projects

Step 4: Estimate Costs

Build in risk and uncertainty.

Using the data gathering from the previous step (example in Table 2), calculate a final estimate that accounts for risk and uncertainty. There are many methods of doing this, I use SPERT®.

“Statistical PERT® (SPERT®) is a freely licensed, probabilistic, estimation technique. Use Statistical PERT to estimate uncertainties that have bell-shaped risk properties, like: task duration, work effort, revenue, expenses, agile story points, project portfolios, event attendance, and more.” (Davis, 2019)

I learned about SPERT® at the 2017 University of Maryland Project Management symposium and have been using it to build uncertainty into all research project cost estimates ever since. All you need to do is plug in the three-point estimate and the SMEs feeling of confidence then SPERT® uses Microsoft Excel statistical functions to calculate a reasonable set of final estimates that incorporate uncertainty. You then choose the probabilistic estimate that works for you, for example, since research is more variable than regular projects, we use the 90% confidence level estimate. As a result, we feel more comfortable with our estimates being able to say we are 90% likely to complete the project within the estimated cost.

Build in training, leave, and overheads.

Run the final effort estimates through the most up-to-date cost estimate worksheets to get the final cost including any overheads, training costs, leave.

Lesson Learned: For various reasons, we experience pressure to keep our research projects low cost. For example, federal budgets are especially tight in recent years, research is usually lower priority than production work, and often research is initiated as a result of small surpluses that need to be spent before funding expires. Because of this, in the past we were providing bottom-up, optimistic cost estimates that didn't account for any risk, uncertainty, or other non-project related time, such as, training, onboarding, and leave. We found ourselves frequently going over budget. The research staff are obviously entitled to take leave and trainings so this is something we have to build in to each and every project no matter how tight the budget.

Step 5: Review & Update Cost Estimate

Review of cost estimate.

- Compare to past similar projects to ensure the estimate is realistic
- Are we able to predict how the sponsor would react to the cost estimate? If they already have a budget in mind or are limited by how much they can spend, we should keep this in mind
- Receive management and SME approval

Lessons Learned: If we know the project budget is small, suggest cost saving alternatives for the sponsor to consider.

Step 6: Develop Cost Estimate Memo

Develop cost estimate memo.

- Addressed to the project sponsor
- Summary table of cost estimates by fiscal year
- Project proposal/scope
- Cost saving options (if offering them)
- Proposed milestone schedule (if available)
- Routing List- all necessary approvals needed
- CC list- ensure the appropriate stakeholders are all included
- Cost estimate breakdown/worksheets to account for bureau and division overheads
- Document all known assumptions, constraints, and risks

Management review and updates incorporated.

Step 7: Send & Negotiate Cost Estimate

Send draft cost estimate memo to the project sponsor.

- Provide a deadline for feedback
- Highlight any important information that the sponsor needs to be aware of

Sponsor reviews and provides feedback.

- Schedule a meeting to discuss or negotiate (if needed)
- If the sponsor is trying to cut costs, determine ways to cut back on scope without compromising the integrity of the project.

Lesson Learned: Since it is challenging to get an accurate estimate (hence the word “estimate”), we experimented with providing a cost estimate range. This backfired on us. Our project sponsors almost always gave us the lower end of our range. Completing our project within our “best case scenario” cost estimate is obviously more challenging than if we were to provide a reasonable single estimate.

Step 8: Follow-Up & Finalize

Follow up with project sponsor.

- Incorporate agreed upon changes from step 7
- Send cost estimate memo back to sponsor
- Receive sponsor approval

Finalize costs.

- Route the cost estimate memo for finalization, receiving all necessary approvals
- Distribute cost estimate memo to stakeholders on the CC list
- Update project status on appropriate project directories and maintain notes associated with the decision
- Store finalized costs estimates in the appropriate document repository for easy reference

Finally, execute project and manage your budget!

BUDGET MANAGEMENT

Proper budget management begins from the kickoff meeting for any project, but is especially important on research initiatives. Below are budget related topics that should be discussed before the project starts.

- Confirm the funding you are receiving is in line with the agreed upon budget
- Determine the sponsor’s tolerance for budget variance

On research projects you may find yourself going down a certain path, hitting a dead end, then starting back from the beginning. Some trial and error should be expected, but how much exploration can we afford?

- Decide on frequency and format of budget updates
- Establish a list of initial risks

Budget Monitoring

- Change Management- Because research scope is often evolving, change control procedures are extremely important. Make sure you have an understanding for the sponsor’s tolerance for change with respect to budget and schedule. It’s amazing how much small requests and changes here and there can really add up, especially when you

are working with a small budget. Formally document every change no matter how small and ensure that you are getting sponsor approval for any change that could have even a slight impact on any of the triple constraints (scope, schedule, budget).

- **Risk management**- After the kickoff meeting, estimate the potential impact of the risks on the project budget and communicate this to the sponsor. Continue to manage risk throughout the project. Frequently communicate risks and issues to the sponsor so that if issues do arise they are more prepared and willing to provide additional funds if needed.
- **Schedule management**- When developing the schedule, align schedule effort with the cost estimate so that the status of the budget is directly linked to schedule health. This allows you to use the schedule as a budget tracking tool. For example, you can easily pinpoint budget concerns if a task is taking longer than the baseline plan.
- **Reporting**- Provide regular budget reports and updates to management and the sponsor. Create and analyze monthly reports to ensure projects are staying on track. Use earned value management to assess project health and use time reported and work remaining on schedules to forecast the potential project surplus or deficit. Good budget reporting enables informed decision making throughout the project.

Project Closeout

- Ensure the sponsor is in acceptance of the final deliverable and acknowledges project completion
- Develop a final budget report, share with necessary stakeholders, and store for future reference
- Perform a lessons learned session

Lessons learned sessions have had a huge positive influence on planning for future projects. We have been able to acknowledge and break bad habits, pinpoint weaknesses in our processes, and make the necessary improvements.

- Release remaining funding back to sponsor if necessary

DETERMINING VALUE

There are two aspects of value to consider in relation to research products. The first is the usefulness of the product to the customer and the second is the monetary worth or cost. Usefulness is fairly simple. Did the customer use the final product? Did the project results influence decisions or create cost saving efficiencies? If the answer is yes to these questions than the research is considered valuable. The monetary worth takes some effort to fully understand.

In order to assign a monetary value to a research product, you must track the costs. This is possible using a deliverable/product-based schedule that the project resources report their time to. Use the time reported on a deliverable to calculate the associated costs. Tracking the costs that are needed to develop these products allows us to provide the sponsor with options on future

projects. The more data you gather on projects, the more informed your decisions become. For example, if we know how much on average two rounds of cognitive testing costs on a project, we can convey that to our project sponsors when they are deciding what their needs are. We can more easily show them where their money will be best spent, where the value added is highest.

An example of a situation when the value of the product was not necessary worth the cost is developing a final report when the customer gets what they need from the preliminary results. On some research initiatives, after the preliminary results are delivered to the sponsor, developing the final report falls in priority to other projects that are more time sensitive and competing for resources. This happens when the preliminary results provide all the research outcomes and answers that the sponsor expected from the project and therefore, they are not as concerned with receiving a final report. The valuable product here is the preliminary results and, although a useful summary of the project, the final report is not valuable enough to be worth the cost and effort. The resources can be better utilized elsewhere. This is just an example. Often the final reports are extremely valued depending on the project or sponsor.

CONCLUSION

Since establishing formalized procedures for cost estimation and budget management of our research initiatives, we have a better understanding of the actual costs and value of the research products and are able to more successfully manage our budgets. As you can see from Table 3 below, our likelihood of going over budget has greatly decreased in recent years.

Table 3. Research Project Budget Improvements.

Year of Project Initiation	Percent of Over-Budget Projects
2015 - 2017	53%
2018 - 2019	17%

Note: The project budgets include any approved changes from the original plan.

Achieving greater value from research initiatives begins with thorough planning. The more time spent planning, the more likely projects will have well-defined scope, realistic budgets, desired outcomes, and less room for misinterpretation and issues. Because research lends itself to uncertainty, focusing effort on schedule and budget monitoring, change control, and risk management during the execution phase of a project will decrease the likelihood of surprises and issues. Lastly, don't forget to apply your lessons learned to future projects.

REFERENCES

Davis, William W. (2019). *Statistical PERT® Normal Edition, Version 3.0.*, Statistical PERT®

<https://www.statisticalpert.com/download-free-templates/#duration>