Project Group 5: Cross Agency Effectiveness

Project Proposal

SYST/OR 699 Master's Project

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Project Sponsor:

The MITRE Corporation

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Section 1. Introduction

The purpose of this proposal is to present the background, problem to be solved, approach and plan to execute for the Spring 2014 SYST/OR 699 Project Group 5: Cross Agency Effectiveness.

1.1 Cross-Agency Goals

Federal Government uses goals to improve performance and accountability to the American people. The Government Performance and Results Act (GPRA), implemented in 1993 was designed to make improvements in the way that Federal Government conducts its business. The GPRA Modernization Act of 2010 requires Federal agencies to identify priority goals, assign officials responsibility for accomplishing them, and report the progress for these goals on regular basis using performance measures. These performance measures help the agencies to evaluate the efficiency and effectiveness of their programs by calculating the Return On Investment (ROI).

To improve and promote cross agency harmonization and best practice sharing, Federal Government has adopted a limited number of Cross Agency Priority (CAP) goals. The Office of Management and Budget (OMB) with the help of CAP goal leaders identify the agencies that can contribute to these selective goals. The participating agencies develop strategic plans every four years and set priority goals every two years. All Cross-Agency Priority Goals are published on Performance.gov.

1.2 Science, Technology, Engineering and Mathematics (STEM)

If the United States is to maintain its competitiveness in the fields of science, technology, engineering, and mathematics (STEM) then the country must produce about 1 million more STEM professionals than currently projected by 2020. The United States institutions of higher education will need to increase the number of students who receive undergraduate STEM degrees by about 34 percent over current rates by 2020 (Performance.Gov, 2013).

In support of this goal that the U.S. Federal Government has established a CAP with education partners to improve the quality of STEM education at all levels. Specifically, the Government has set a performance goal to increase the number of STEM graduates by one-third by 2020, which results in an additional 1 million graduates with degrees in STEM subjects (Performance.Gov, 2013).

In Fiscal Year (FY) 2014 Fourteen Federal Agencies will administer 110 investments with approximately $3.1 Billion in STEM program funding as shown in Figure 1.

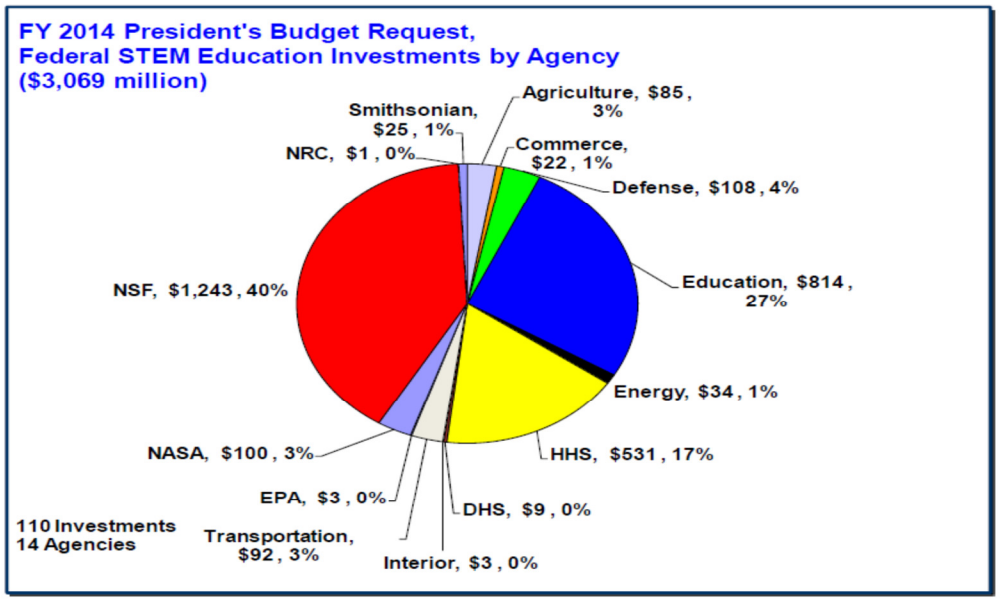

Figure 1 - STEM FY14 Funding Summary

An overarching area of opportunity in reaching this performance goal is increasing retention of STEM students. A report by the President's Council of Advisors on Science and Technology (PCAST) concluded that a strategy which focuses on retention of STEM students would by the lowest-cost and most efficient policy. This conclusion is based on the fact that only 40 percent of students who enter college to study a STEM field complete a STEM degree (U.S. Department of Education, 2004).

The PCAST study found the following reasons that affect STEM retention:

- Uninteresting introductory courses and lack of effective teaching practices;
- Lack of access to research;
- Difficulty with required mathematics; and
- Insufficient focus on women and minorities (President's Council of Advisors on Science and Technology, 2012).

To address these challenges to retention the President has established the STEM CAP to:

- Reorganize federal STEM-education programs for greater impact, coherence, ease of evaluation, and focus on specific priorities (e.g. undergraduate education).
- Use best practices to improve STEM teaching and attract students to STEM fields and courses.
- Provide more hands-on opportunities for students early in their undergraduate education
- Focus on women and underrepresented minorities.
- Address the gap in mathematics preparation prior to an undergraduate education (Performance.Gov, 2013).

The majority of these objectives focus on enhancing or preparing for an undergraduate education. Many STEM programs are focused on improving quality of the education students receive and preparation before students reach college to ensure retention.

Another challenge focuses on making STEM more inclusive to all people. As Hazari et al note, "Science will only suffer if there are factors that impede the participation of any particular group … Every member of society should have the capability to economically, socially, and politically empower themselves regardless of gender, race, or class. (Hazari, Tai, & Sadler, 2007)" These programs focus on making STEM programs and subjects more appealing to these underrepresented groups, eliminating barriers to entry and ensuring better retention.

Section 2. Problem Statement

The Federal Government lacks ways to evaluate effectiveness in achieving CAP goals. CAP goals generally involve many programs that interact towards a common goal. These programs have interactions and synergies that are difficult to characterize and trace. This project plans to develop a prototype, rigorous data driven approach to evaluate CAP performance and provide insight to support program and funding decisions related to the STEM CAP.

The table below shows the high-level stakeholders (actors) for the cross agency initiatives and the factors that contribute to the success of these initiatives. This project will implement this model to Measure Success and ultimately draw Conclusions relating to STEM.

Table 1: High-Level Stakeholders, Processes and Success Factors

Actors	Processes	Measuring Success	Conclusions
President	Cross-Agency Goals	Data-Driven Model	Is a program effective?
Agencies	Supporting Programs	Return on Investment	Is the goal being achieved?
		Key Measures of Effectiveness	Characterization of Data

Section 3. Scope

The scope of this project is to model the impact of Federal agency funding policies on the STEM workforce pipeline. In support of model development, the project group must gather data and information regarding various aspects of the problem and the contributing agencies' programs, functions, investments, performance and program evaluations. Simulations of the model will be performed to measure the effects different funding policies. Based on the results of this analysis, recommendations will be made for performance measures, data and research to improve the effectiveness and efficiency for STEM and CAPs in general. Due to large number of STEM programs in fourteen Federal Agencies; we will limit our scope of study and research to three (National Science Foundation, Dept. of Education, and Health and Human Services).

Section 4. Preliminary Requirements

These high-level preliminary requirements describe the items the project must satisfy:

- Develop a prototype model to evaluate the effectiveness of programs and agencies to achieve the STEM a cross agency goal.
    - Develop a preliminary framework to evaluate cross agency goals including data requirements.
- Identify the challenges in developing an effective methodology, data inadequacies and critical needs, and recommended methodology improvements.
- Make recommendations for changes to agency programs/activities/investments / policies to improve performance against the goal.
- Make recommendations for performance measures, data, research and the model to increase strategic management capability.

Section 5. Technical Approach

The technical approach summarizes how we will solve the problem as presented in Section 2. The effort in this project will be centered on building a model to assess the effectiveness of STEM Programs. The first step in technical process is gathering data and classifying STEM Programs. STEM Programs will be classified as targeting one of the following goals or target audiences:

1. Preparing students for a undergraduate STEM education
2. Marketing STEM to youth and the public
3. Making STEM more inclusive to minorities and women
4. Improving the experience of STEM undergraduates
5. Matching graduate STEM education to work force demands

The categorization of STEM programs will help facilitate comparison of program goals and provide an easier basis of comparison and eventual inclusion in model structure.

5.1 Model Inputs

The following data obtained through literature review will be included into the STEM model:

5.1.1 Funding amount for each program supporting STEM goals

This will determine the hierarchy of program importance. Once the model is functional, sensitivity tests will be performed to reveal how programs' performance changes based on funding and which programs have the most potential for furthering the goals at the minimum cost.

5.1.2 Current or proposed performance metrics for each program

Current program effectiveness metrics will be used to drive decision making about future program funding or actions. If performance metrics cannot be found or do not exist for a program then project team will estimate effectiveness using available data. Relevant performance metrics will be suggested on a case-by-case basis to draw comparisons to similar programs.

5.1.3 Proportion of population affected by each program

Based on Census data, and program target demographics, a proportion of the U.S. population will be assumed to be affected by each program over the period of time under consideration. The performance metrics will measure the amount of people directly or indirectly supported by the activities of the respective program(s)

5.2 Determine Model Structure

The modeling process will begin by creating two primary network maps (influence diagrams). The first is the hierarchy of funding for each program. In this step, programs within an agency will be classified according to their purpose. Programs will also be ranked according to their funding level. Next, programs with similar objectives and methods across agencies will be classified together. Programs within these classifications will act on similar populations. The goal of the modeling procedure will be to show the interactions between programs within different agencies and highlight how they augment or negate each other. This will be accomplished by adding the performance metrics. The next iteration of the influence diagram will be to link programs to performance metrics that would measure some piece of that program's output (whether or not the performance metric was originally intended to measure that particular program).

Due to the high level of dynamic complexity of the system and the need for a model to easily output various sensitivity tests on parts of the system, a System Dynamics model seems most appropriate. The System Dynamics model inherently considers the structure of efforts between and within agencies. The flows to be included in the model would be people (as calculated/estimated from Census data), and program funding. Another benefit of a System Dynamics model is the inclusion of circular causality to model policy decisions and their, sometimes far off, consequences.

5.3 Model Analysis

The modeling program to be used is Vensim VLE, due to the abundance of free instructional material as well as the availability of free academic licenses. The modelling program will

also us to perform simulations to assess the effectiveness of various STEM programs to the overall cross agency goal. The project will perform sensitivity analysis on various Government funding scenarios to:

- Find levers towards STEM program performance
- Calculate Return On Investment
- Provide funding advice with regard to STEM programs

Section 6. Expected Results

The main deliverable of this project to the Sponsor will be a dependency model showing how STEM programs interact within and across agencies and which performance metrics are most important to funding decisions. The secondary deliverable will be documentation of the process of building the model and a generalization of the procedure to be applied to the performance evaluation of other cross agency goals.

In order to provide these deliverables, the following data analyses will be performed:

- Return on Investment - For example, how many additional STEM students are produced per dollar spent on STEM programs?
- Best Value Initiatives – Recommendations regarding which programs are most effective at STEM cross agency goals.
- Effective Investment Strategies – Recommendations regarding program funding with the variation of inputs
- The number of students, teachers, institutions directly served by each program per dollar

Section 7. Project Plan

The execution of this project includes the development and delivery of several major items, which includes the STEM model, project report, final presentation brief and project website. The schedule for the development of these items is shown in Figure 2.

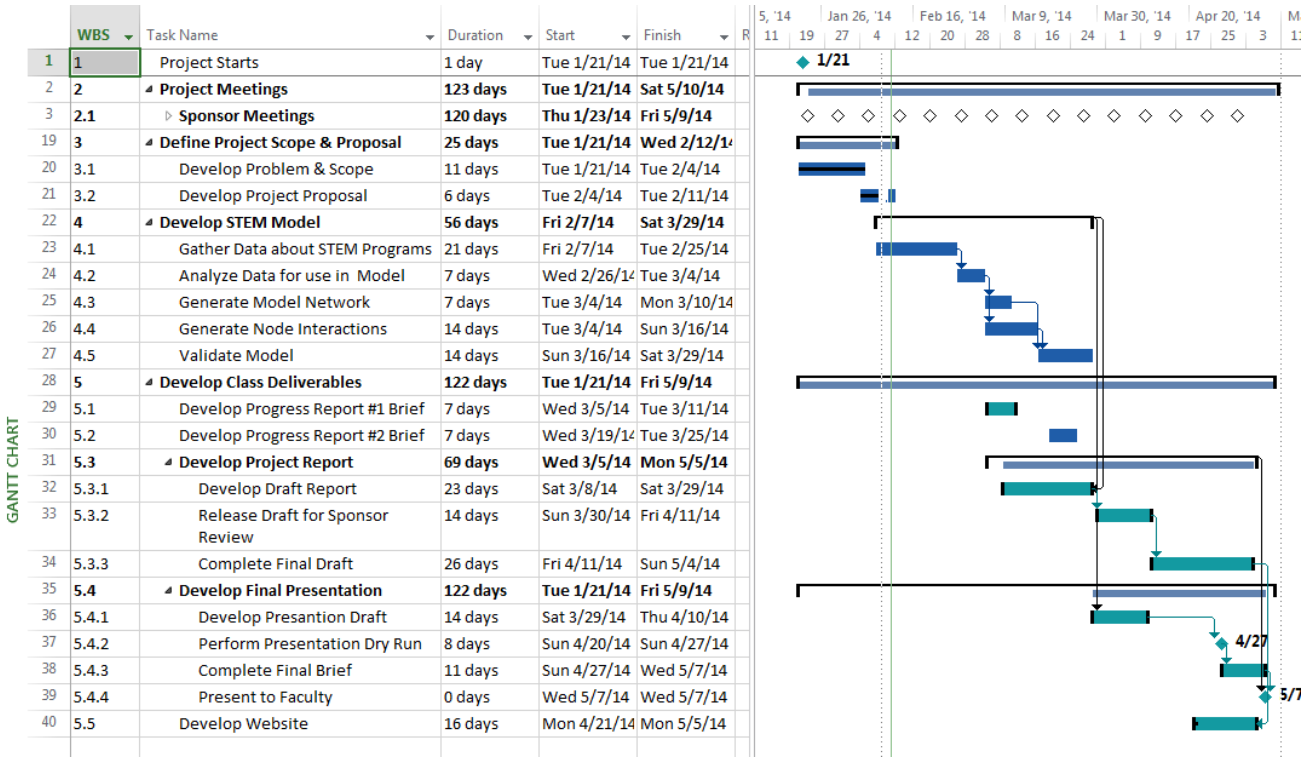

Figure 2 - Project Schedule

Each of the major items will have an associated task lead to ensure that they are completed per the project schedule. The task leads will identify sub-tasks needed complete a deliverable. The task lead will work with the group to assign each task. Table 2 below shows the assignment of each task lead.

Table 2 - Task Lead Summary

Deliverable	Task Lead
Progress Report	Syed Jaffrey
STEM Model	Paul Dolan
Final Report	Jeffrey Chitim
Final Presentation	Syed Jaffrey
Website	Jeffrey Chitim

Section 8. References

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