

SwiftGrant: Design of a Streamlined, Collaborative University Grant System

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Abstract - Grants constitute a considerable portion of a tier one university's budget, and thus, participating in manifold research endeavors is essential for the economy of the university and obviously improve the quality of life. Any research effort begins with the proposal development process. This is where proposals are written by proposal writers in response to a solicitation from an agency in the hope of receiving funding for a specific area of research. George Mason University (GMU) sends approximately 1000 proposals to different government agencies each year. From these proposals, approximately 50% of proposals are rejected and 14% are still pending, of which, more than half, if not all, will be rejected. The average proposal writer at GMU spend approximately 21 days developing a proposal, which based on average salary [15], is a \$3,864 investment, and would be a loss if the proposal does not win. With an approximate 30% win rate, over a year that leads to about \$2.7 million in losses for the university. A lot of proposal losses are related to the non-technical aspects of the proposal process, such as document gathering, and proposal formatting. Consequently, expedition of these non-technical aspects of a proposal development process leads to an increase the time available to prepare the technical material, which means higher quality. By using SwiftGrant, which incorporates a combination of the proposed design alternatives, the system can save approximately 1.3 days from the non-technical aspects

which can be used for technical aspects or review time.

Index Terms - cloud, grants, proposals, universities

INTRODUCTION

The grant research enterprise is a very important part of a universities ability to function as a whole. Universities not only encourage their professors to write proposals most of them require them to, as a part of the tenure track, professors are required to write and submit a certain number of proposals every year. Professors also have the added motivation of getting recognition and performing research to push them to submit the proposals. But, with an extremely low acceptance rate a vast majority of their efforts are wasted. After a thorough analysis of the current proposal process at George Mason University (GMU), the process has been laid out. Figure 1 represents the current proposal development process at George Mason University. The process begins when the sponsoring agency sends out a solicitation document, or a BAA and ends with the completion and submission of a final proposal. Within the proposal process, there are different manual or labor intensive tasks that are tedious and repetitive. Communication between the parties involved is also crucial because they rely on each other when it comes to changes in the proposal. These tasks create inefficiencies in the use of time when creating the proposal [3].

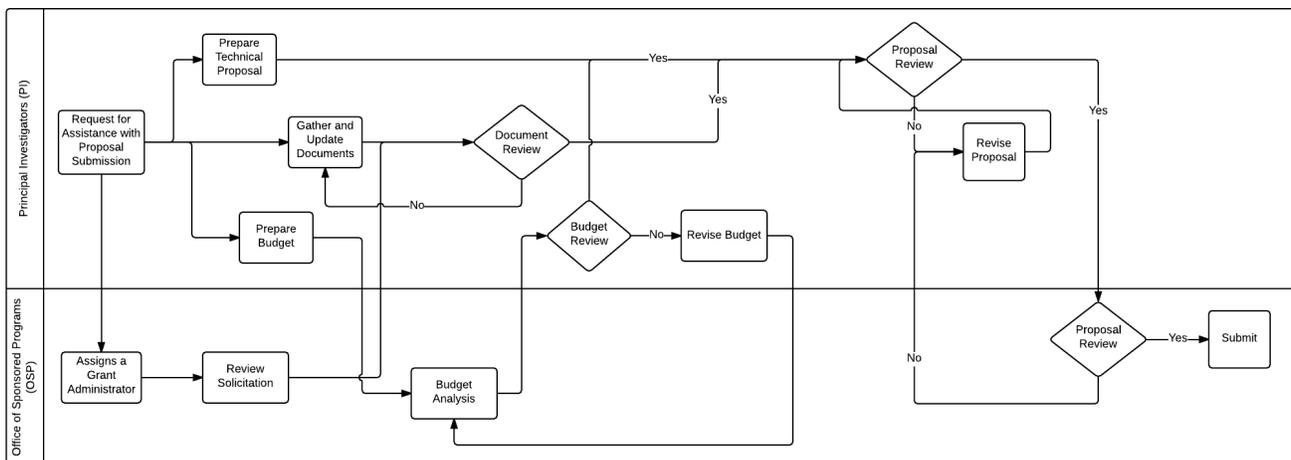


FIGURE I
 FORMAL PREPARATION PROCESS

SYSTEM STAKEHOLDERS

There are two major stakeholders of the system, the Proposal Writers or Primary Investigators (PI) and the Office of Sponsored Programs.

I. Proposal Writers

PIs are the ones who spend time doing research and complete the technical parts of the proposals. The proposal writers have relatively the most invested into the process and have the most responsibilities in making sure that the proposal, which is being worked on, meets the requirements set out by the sponsoring agencies. Proposal writers also have the most to gain.

At GMU, proposal writers are professors and fall into one of three categories; tenure, tenure-track, and term professors.

Tenured professors are the most senior and have no set requirements by the university as to how much work they are required to do for proposals and are usually driven by their own personal goals as to much work they wish to for a proposal.

Tenure-track proposals are hired for a fixed term and have requirements set forth by the university as to how much work they must do for a proposal in order to become a tenured professor. Therefore, a winning proposal not only helps to advance their research, but it helps to advance their careers at the university for tenure-track professors.

Lastly are term professors who are hired on contracts and also have requirements as to how much work they must put into proposals. They are also required to pay for their own research giving them more incentive to write winning proposals.

II. Office of Sponsored Programs

At GMU the Office of Sponsored Programs (OSP) is the entity that assists the PIs in the process. They assist the principle investigators by gathering documents required for the proposal, editing the proposals to ensure that it meets the formatting requirements set by the funding agency. They also assist in preparing the budget for the proposal, considering travel costs, equipment, paid assistants and any other costs that may be associated with the proposal. Their primary function is to make sure that all proposals meet compliance and regulatory guidelines.

III. Stakeholder Tensions

The four stakeholders for the proposal system at George Mason University are the professor's, or principle investigators (PI), the Office of Sponsored Programs (OSP), the funding agencies, companies that provide training services for proposal writers and professional associations for proposal writers. The biggest tension during the process is about time allocation during the process.

The PI's want as much time as possible for technical proposal writing to make their proposal the best that it can be. At the same time the OSP wants their four-day period to

review the proposals, more than 60% of the time the PI's take too long writing and the OSP does not get their four-day period. An overall tension of the entire process is the fact that there is no governing body for the overall process. Since no one is accountable for the entire process there are deficiencies throughout that lead to conflicts. The OSP for example has no stake in if a proposal is accepted or rejected therefore they have less incentive to make sure the proposal is correct.

PROBLEM STATEMENT

Proposal writers invest time, which translate to monetary value, in order to write and develop high quality proposals in order to obtain funding. During the proposal process, the time they invest are underutilized because of the inefficiencies and labor intensive tasks that needed to be performed.

On average, proposals writers invest 21 days, which translates to about \$6,440, on every proposal. Only approximately 30% of proposals submitted at George Mason University receive funding. With around 1000 proposals submitted each year, this translates to \$4.5 million of invested money lost each year on rejected proposals. The low acceptance rate of 30% leads to this high amount of lost investments.

CONCEPT OF OPERATIONS

The proposed solution is a system that will reduce the time inefficiencies of the system by better distribution time among important tasks as well as a better distribution of responsibilities among proposal writes and grants administrators. It will also provide an avenue for proper communication between the PI's and the GA's along with solicitation matching for the PI's.

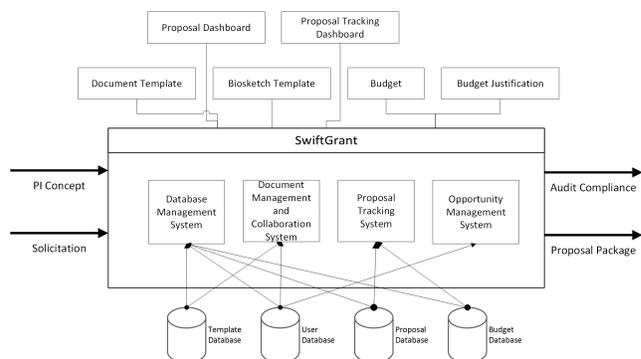


FIGURE II
SYSTEM FUNCTIONAL DIAGRAM

DESIGN ALTERNATIVES

The proposed design alternatives address two types of tasks associated with the process: labor-intensive tasks and quality related.

I. Alternative A: Addition OSP GA's

Hiring more OSP members, enough to have a member for each department on campus, would increase efficiency by having the same GA working with the same PI's on each proposal therefore creating a working relationship.

II. Alternative B: New Support Group

A separate department that is responsible for the whole proposal process, assisting both the OSP and the PI's. This department would assist with the review process by utilizing professors who are familiar with the technical field as well as English professors familiar with proper paper writing.

III. Alternative C: Database Management System

A system that would store proposal requirements and document templates specific to each funding agency with the formatting and general requirements embedded in it.

IV. Alternative D: Document Management and Collaboration System

A cloud based system that will allow proposal writers and OSP members to work collaboratively on the parts of the proposal simultaneously in order to reduce time inefficiencies. The system is tied to the database management system and will use the templates from the database management system on the funding agency.

V. Proposal Tracking System

This system can be integrated into a web-based tool along with the Database Management System and the Document Management and Collaboration System. Its function is to provide a constant status report to both the PI's and GA's working on a proposal. These updates will let them know which documents have been completed, which still need to be done. It will show all users when updates have been made to any documents, such as the budget, so everyone involved will be aware when one person makes changes.

VI. Opportunity Management System

This system would be used to match proposal writers with solicitations that match their area of expertise. This would eliminate the tedious and time-consuming process of sifting through emails and grant websites searching for appropriate solicitations. The user would create a profile consisting of their education and working experience; based on this profile the system will match them with solicitations.

Table I below shows the relationship between the proposed design alternatives, the solutions, and the tasks that they are connected with.

TABLE I
PROPOSAL PROCESS TASKS

| | Solution | Design Alternative |
|------------------------------|--|--|
| Labor Intensive Tasks | Reuse of previous materials | Database Management System |
| | Collaboration | Document Management and Collaboration System |
| | Eliminate downtime | Proposal Tracking System Document Management and Collaboration System |
| | Supplementary Documents | Database Management System |
| Intellectual Labor | Matching PI's skills and experiences with Solicitation | Opportunity Management System |

DESIGN OF EXPERIMENT

In order to determine the bottlenecks of the system, as it currently exists the process will be simulated as the baseline. The simulation will then be modified to test each design alternative. There will be a total of 18 different combinations of alternatives. The results from these simulation runs will be used as an input to a mathematical equation used to determine how the proposal win rate is affected.

METHOD OF ANALYSIS

The design alternatives will be evaluated using a Colored Petri Nets (CPN) simulation that was created based on the process flow diagram of the system, as it currently exists. A baseline simulation model was created and run to verify its accuracy to the system as it is currently. The simulation determines how much time is required for a proposal to go through the proposal process. For each of the 18 treatments the original distributions were modified based on the design alternatives being simulate (Table II).

TABLE II
DESIGN OF EXPERIMENT SIMULATION TREATMENTS

| Treatment | Configuration | Alternatives | | | | | |
|-----------|---------------|--------------|---|---|---|---|---|
| | | A | B | C | D | E | F |
| 1 | Baseline | | | | | | |
| 2 | A | x | | | | | |
| 3 | A, C | x | | x | | | |
| 4 | A, C, D | x | | x | x | | |
| 5 | A, C, D, E | x | | x | x | x | |
| 6 | A, C, D, E, F | x | | x | x | x | x |
| 7 | A, F | x | | | | | x |
| 8 | C, D | | | x | x | | |
| 9 | C, D, E | | | x | x | x | |
| 10 | C, D, E, F | | | x | x | x | x |
| 11 | C, E | | | | x | x | |
| 12 | F | | | | | | x |
| 13 | B | | x | | | | |
| 14 | B, C | | x | x | | | |
| 15 | B, C, D | | x | x | x | | |
| 16 | B, C, D, E | | x | x | x | x | |
| 17 | B, C, D, E, F | | x | x | x | x | x |
| 18 | B, F | | x | | | | x |

Treatment results were evaluated by performing utility analysis and cost analysis. The value hierarchy used in evaluating the results is shown in Figure III.

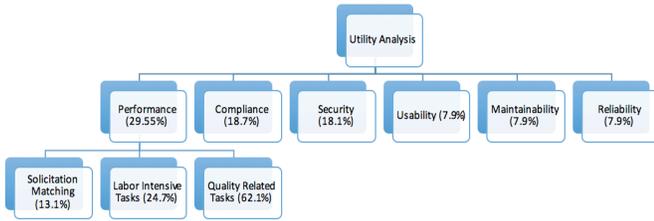


FIGURE III
VALUE HIERARCHY

SYSTEM SIMULATION

With the simulation, only the sub processes that involve the OSP were manipulated in the simulation runs. This is because the behavior of PIs as individuals cannot be controlled since each one of them has a different method of preparing their proposals due to their other responsibilities in their day-to-day work. However, OSP interactions and OSP actions can be streamlined since their day-to-day actions in the system are their only roles in the University.

Those processes that are effected were provided a certain distribution, based on interviews or engineering estimates, and will be left unchanged between simulation runs. Some of the sub processes that will be manipulated include but are not limited to, budget preparation, document gathering and review time. These are the sub processes that our proposed system will be able to change by making them more efficient and ultimately reducing the time required to complete them.

The process starts with the arrival of a solicitation or a blank proposal. The arrival rate was calculated using the data received from the Office of Sponsored Programs (OSP). From there, it is first checked to see if the incoming solicitation is a Limited Submission or not. To process this, every incoming solicitation is assigned a 1% of being a limited submission since it is a rare occurrence. If it is processed as a limited submission it then goes through a separate process where it gets an added delay time, if not then it moves to the next sub process where it is assigned to a grant administrator. After this the proposal is split into two different sections, one side is the OSP and the other side is the Principle investigator or the PI.

The PI begins to work on the proposal and this process was given a separate distribution that was also calculated from the data received from the OSP, after the prep time the PI does the formatting and document gathering, both of

which also have separate distributions. The OSP during this time works on compliance checks and their own document gathering. After these steps the OSP and the PI collaborate to work on the budget. Through the research performed, it was discovered that the budget is a repetitive process so to address that, a loop was incorporated that first generates a random number between 1 and 10 and goes through the budget loop that number of times.

After the budget the OSP gets the final copy of the proposal and gets to review it. According to the OSP, there is an unwritten rule stating that the PI's must submit the proposal four days before the deadline, giving the OSP enough time to review for compliance.

In order to validate the model, it was run for a 1000 time units in CPN tools, this led to a total of 113 solicitations being created (distribution created by data received from the OSP) and 109 of them actually submitted. Some preliminary results were obtained which corroborated the initial predictions based on the OSP data [17]. The initial run resulted in a Total Preparation Time of 20.745 ± 14.35 days with a p-value of 0.783. This shows that there is no statistical difference between the simulation results and the raw data from the OSP. Another key statistic obtained was that only 31% of the total proposals met OSP's 4-day internal deadline, which validated the data obtained from the OSP. Table III shows the breakdown of the Total Preparation Time.

TABLE III
BASELINE SIMULATION RESULTS

| Sub-Processes | Duration (μ) (days) | Stdev (σ) |
|-------------------------------|---------------------------|--------------------|
| Total Preparation Time | 20.715 | 14.35 |
| Writing Time | 14.557 | 13.306 |
| Formatting/General Req. Time | 1.033 | 0.990 |
| Budget Preparation Time | 3.091 | 2.982 |
| Document Gathering Time | 2.076 | 1.976 |
| OSP Review Time | 3.445 | 4.29 |
| Internal OSP Deadline Reached | 31% | |

RESULTS

I. Simulation Results

Figure IV shows the results of the simulation with the treatments applied. Positive numbers represent time saved, while negative numbers represent time added. Comparing all the treatments to the baseline, Treatment 9 and 10 saved the most time at approximately 1.333, followed by Treatments 16 and 17 at 1.323. Treatments 16 and 17 are the same as Treatments 9 and 10 respectively but with the addition of Alternative B. This shows that adding more people to the system will not necessarily improve the distribution of time and inefficiencies in the current system.

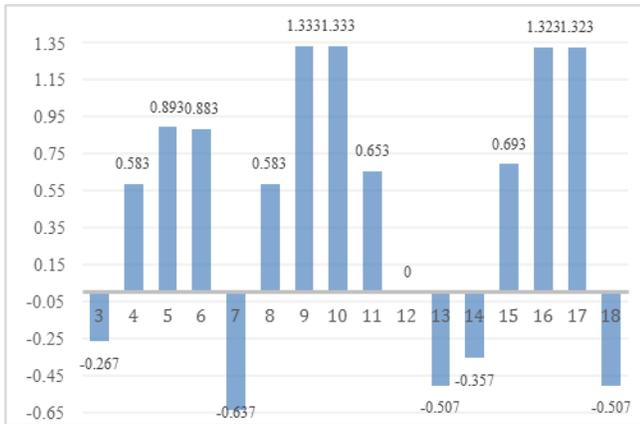


FIGURE IV
TIME SAVED ON LABOR INTENSIVE TASKS (IN DAYS)

II. Utility Analysis

Results of the simulation were further analyzed using a utility analysis using the value from the value hierarchy in Figure III.

Figure V shows the results of the analysis on the performance effects of the alternatives and different treatments. It shows that Treatment 10, with all the tech alternatives C, D E and F, has the highest performance score of 0.666. Figure VII shows only the technological alternative based results.

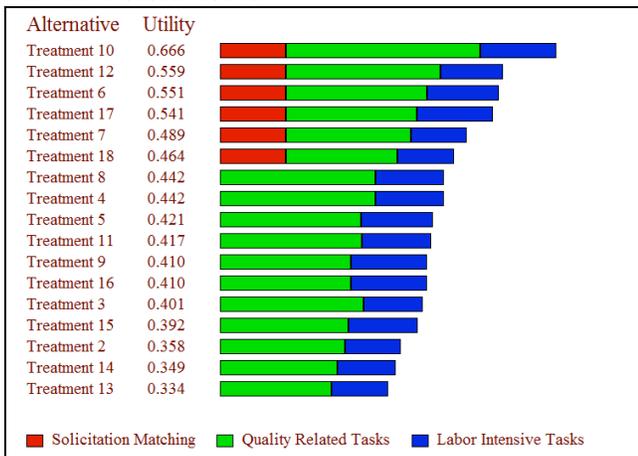


FIGURE V
PERFORMANCE MEASURE UTILITY RESULTS

These scores were applied to the overall utility analysis, with results showing in Figure VI. Similar to the performance measure, Treatment 10 still has the highest utility at 0.727. The next to it is Treatment 17 which is similar to Treatment 10 but includes Alternative B. This verifies the previous claim that adding people to the system will not necessarily be the best or improve performance, since Treatment 10 has the highest utility. Figure VIII shows only the technological alternative based results.

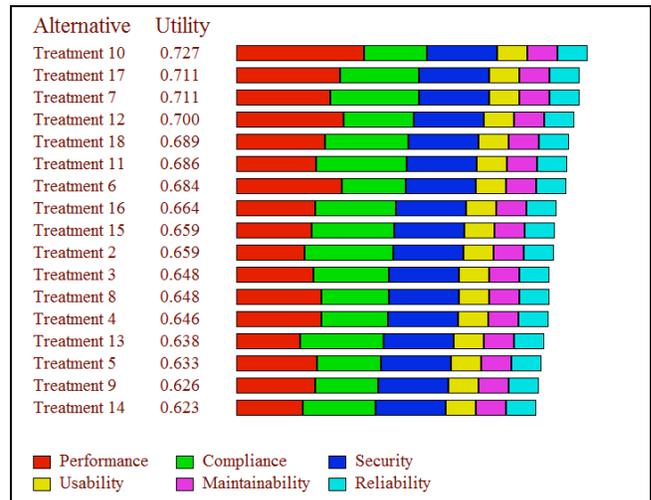


FIGURE VI
OVERALL UTILITY RESULTS

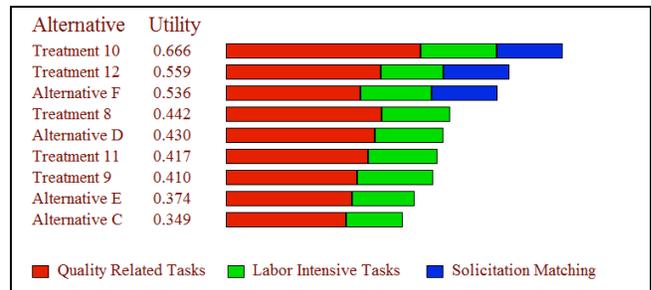


FIGURE VII
PERFORMANCE MEASURE UTILITY RESULTS

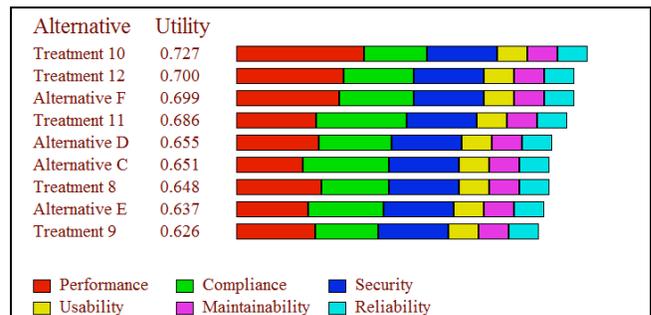


FIGURE VIII
OVERALL UTILITY RESULTS

III. Cost Analysis

There are three alternative deployment methods being considered for the automated system: two of them are commercial off the shelf products (OTS 1 and OTS 2), and a new system that is being proposed which is SwiftGrant. OTS 1 is represented by Treatment 11 which has the Database Management System and the Proposal Tracking system (utility 0.686), OTS 2 is represented by Treatment 8 which has the Document Management and Collaboration System and Proposal Tracking System (utility 0.648)

whereas SwiftGrant is represented by Treatment 10 (utility 0.727).

TABLE IV
COST OF DEPLOYMENT METHODS

| Vendor | Annual Cost | Alt C | Alt D | Alt E | Alt F | Trt |
|------------|--------------|-------|-------|-------|-------|-----|
| OTS 1 | \$118,800.00 | x | | x | | 11 |
| OTS 2 | \$70,800.00 | x | x | | | 8 |
| SwiftGrant | \$192,000.00 | x | x | x | x | 10 |

IV. Cost vs. Utility Analysis

The annual user cost for each alternative is plotted against the corresponding utility in Figure IX. It shows that although SwiftGrant has the highest cost, it has the highest utility providing the users the best opportunity to improve the process.

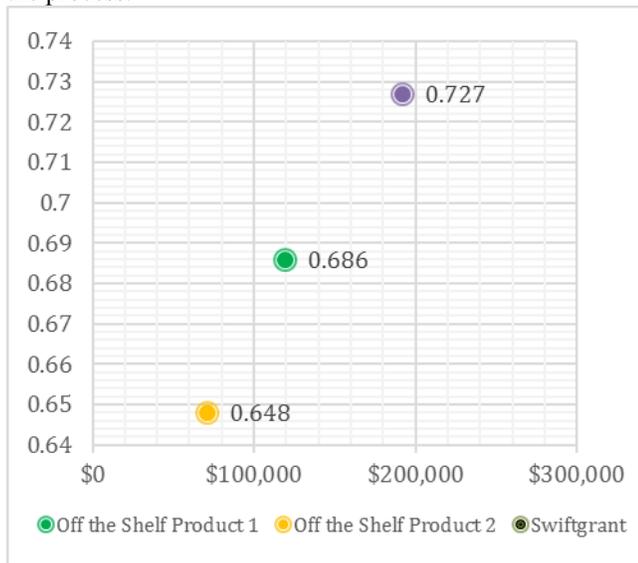


FIGURE IX
COST VS UTILITY

RECOMMENDATIONS

Based on the results of the study, it is recommended that a cloud-based system through SwiftGrant be implemented and incorporated to the current proposal process at George Mason University. This cloud-based system is to implement Treatment 10, which is a combination of a database management system, document management and collaboration system, proposal tracking system and an opportunity management system with SwiftGrant. This cloud-based system will allow the PIs to focus on the technical aspects of the proposal and at the same time allow the GAs to track the compliance simultaneously. It also eliminates the idle time and allows the users to track the progress of the proposal. Alternatively, it can be deployed as an Add-on to already commercially available tools (e.g. Innoslate).

The entire grant proposal process at GMU is incredibly complex and involves a large number of areas and sub-processes that are not within the scope of this study. Because this study is focused on the formal proposal

development process further analysis on the front end of the grant proposal process is necessary. This includes a process for matching solicitations to specific principal investigators to increase the chances of a winning proposal. It is also recommended that other non-technical aspects of the proposal process, such as, the political aspects of the process, since the proposal process is a social process.

BUSINESS CASE

SwiftGrant will be provided on a monthly subscription basis. There will be three subscription types, Basic, Premium and Premium Plus costing \$120, \$140, and \$160, respectively. There are approximately 200 tier 1 universities and with an average of 100 users per university that equates to an annual market value of \$38.4 million, this is assuming all subscriptions are premium plus. With a startup cost of approximately \$272 thousand and yearly recurring costs of about \$600 thousand the break-even point will be during year five with a 357% return on investment with 1% market penetration.

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