

Cornell University

M. Eng. Project

Cornell University Sustainable Design

Final Project Report:

A Systems Engineering approach to assess projects

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Introduction

Cornell University Sustainable Design is a project team that is focused on creating dynamic and innovative solutions for economic, social, and ecological difficulties faced in global communities. Only through the different projects CUSD takes on each semester is it capable of fulfilling its mission of spreading sustainable solutions to impact communities. These projects are the core of CUSD, they define the organization and all work is based on them. Finding the right project is, therefore, crucial for the success of CUSD. PIE, project investigation and expansion works every semester to find new projects that CUSD can take on. Performing this task well, being able to choose the correct project, is a work of art. There are a lot of aspects that play an important role in choosing the right project, and being able to spot those projects that are not of positive outcome, before it is too late, is essential for the success of CUSD.

As a division of the PIE team, we used a Systems Engineering approach to devise a tool that will do the job of finding right projects for CUSD. At the least, it will provide CUSD with a systematic approach to finding projects, ranking those on the table, from better to worse. Of course, this methodology uses a holistic approach that removes as much bias as possible. The goal of this tool is to help CUSD choose its next projects, through a prior comprehensive evaluation, certifying the success of any project embarked.

We will be walking through the tool, explaining how it works and the motive behind the different approaches and decisions made. This will allow for the users to understand how to use it better and to make it a more effective tool for future CUSD members in charge of evaluating potential projects.

1. Analytical Hierarchy Process (AHP)

We lead extensive discussions with CUSD EBoard members, current members and the faculty advisor of CUSD to understand what makes a good CUSD project from every perspective. Throughout these discussions as well as our interactions with stakeholders within the PIE team, we were able to construct a holistic view of the priorities and objectives of a CUSD project.

The Analytical Hierarchy Process is used to encompass all the fundamental goals for a given project. Moreover, it helps weigh each goal with respect to each other and as a whole.

1.1. Fundamental Goals

As one can visualize in the AHP we begin with the three most fundamental goals that each CUSD project needs to have in mind:

It needs to have a mission towards sustainability. That is, CUSD must work on a project that achieves a sustainable impact.

It needs to have a mission towards students. That is, CUSD must work on a project where students learn and improve their skills.

And finally, it needs to follow certain project logistics. That is, CUSD must work on a project that has all the elements to be successfully completed by CUSD. If these three major goals are followed, any project will or at least should be one that CUSD defines to be a success.

1.2. Mission towards sustainability subgoals

Delving further into each goal, we begin with the first, having a mission towards sustainability. In other words the project at hand has to be aligned with the great mission of CUSD. The project has to be in a field that looks to provide a design-build sustainable solution to a community in need of social, economical, and/or environmental change.

1.3. Mission towards students subgoals

The second goal, following a mission towards students, was elaborated behind the idea of the nature of the CUSD team. Being a student organization, students come first and their constant development is a priority above all. We have identified three crucial aspects that stimulate the learning curve of students and are important elements to CUSD.

First, is that of multidisciplinary, which involves working on a project that involves people from different majors and colleges. It is essential for students to interact with colleagues from different fields in order to be exposed to new ways of thinking and different approaches. The more diversity in a group, the more a student can broaden his or her horizons.

Secondly, CUSD revolves around designing and building a solution. Thus, any project must have a design focus, which involves working on a project that requires the creation of a physical or virtual object. Being an engineering based organization, focusing on a tangible product allows students to better experience engineering, in contrast to offering consulting work or a service.

Finally, our last subgoal, within a mission towards students, is that of academic value, which involves working on a project that has been certified by a professor as a project having a good learning experience for students. We find that this factor, along with the previous one of design focus, is one of the most important thresholds to defining a successful project in terms of enhancing students learning. Being in a university setting, nothing is more valuable than the input of an experienced professor, who at the end of the day is our greatest resource, as students, for learning.

1.4. Project logistics subgoals

The third goal in finding a successful project for CUSD is that of project logistics, which involves working on a project that has all the elements to be successfully completed by CUSD. In other words, CUSD should be working on a project that is attainable and realizable, otherwise, they should not spend time on such projects. By project logistics or the different elements, we define two subsets, those logistics with respect to the stakeholder and simply the elements regarding the project scope.

1.4.1. Stakeholder

For CUSD, the stakeholder refers to the partner/sponsor of the project. It is generally the community (i.e. non-profit organization) where the project will take place. We have found that

for a project to be successful the support of the stakeholder is essential. Any stakeholder plays a key role in any of CUSD's projects.

In order to alleviate any issues and to facilitate the project development a stakeholder has to be fully committed to have the project succeed and for this, he needs to be accessible, meaning CUSD should not be constrained to move forward on a project by the lack of interaction with stakeholders. We have found it to be the case, that many stakeholders are not engaged in projects and this is very deteriorating for a project.

As an example, it has been the case that a project stakeholder does not get in contact with CUSD for weeks or months, and this is counterproductive for the team who is trying to lift a project from the ground. Especially for those projects that rely heavily on stakeholders. With this being said, it is not generally the case that CUSD finds itself in such situations.

1.4.2. Project scope

The other portion of a project with regards to its logistics is the project scope. This encompasses many facets. These facets are as follows: Human skill, Human resources, Financing resources, Time scope, and Professional Advisory.

In regards to the first two human facets, CUSD needs the capacity to gather and manage the number of people needed for the project. The project needs to require an amount of manpower that is within CUSD's reach. We find that a typical successful project for CUSD ranges between 20 and 40 students. Beyond the number of students needed, for human skill, as long as CUSD is able to find the students with the necessary skill set that the project requires, the project will not be limited to succeed.

Financially, it is pretty straightforward, the funds needed to accomplish the project have to be provided either by the stakeholder or CUSD has to be able to raise them. Without the necessary funds, any project is not viable.

With regards to the time scope, it is important to be sensible to the rotation of students. Students only attend college for four years and generally are part of CUSD for two or three of those years. Therefore, any project will have a completely new set of students after the third year. This is why limiting the project to three years allows for a project to be completed without a full rotation of students, which allows for stronger familiarity with the project and ease for any stakeholder.

Finally, it is important to have a professional advisory board. That is, each project should have the right set of academic/industry advisors from the areas needed for the project. Being students, it is sometimes hard for CUSD members to see beyond what they are working on and having this board is important to direct students and projects in the right directions. This aspect is essential to the success of a project, especially since projects are implemented outside the university doors.

With this, we conclude the analytical hierarchy process by providing an exhaustive list of the final goals with their associated weights (see Table 1). The successive weights have been assigned according to the relative importance of goals. These have been discussed and iterated with the different intervenants in to make sure to capture the right representation of a good CUSD project.

	Goal	Weight
1	Mission towards sustainability: Work on a project that achieves a sustainable impact	0.3
2	Multidisciplinarity: Work on a project that involves people from different majors	0.06
3	Design focus: Work on a project that requires the creation of a physical or virtual object	0.12
4	Academic Value:	0.12

	Work on a project that has been certified by a professor as a project having a good learning experience for students	
5	Stakeholder Commitment: The stakeholder is committed to have the project succeed	0.08
6	Stakeholder Accessibility: CUSD should not be constrained to move forward on the project by the lack of interaction	0.08
7	Human Skills: CUSD is able to find the students with the necessary skill set that the project requires	0.048
8	Human Ressources: CUSD has the capacity to gather and manage the number of people needed for the project	0.048
9	Financing Ressources: The funds needed to accomplish the project are either provided by the stakeholder or CUSD is able to raise them	0.048
10	Time Scope: Work on a project that is intended to be done attainable within a student rotation within CUSD	0.048
11	Professional Advisory: Have the right set of academic/industry advisors from the areas needed for the project	0.048

Table 1: Final Goals and weights

2. Originating Requirements

The concept of what we call our requirements is as follows. There are certain things that any project need in order for it to be a viable one. That is, more than meeting the goals mentioned above and evaluating them, as better or worse, there are some requirements that are absolutely necessary in order to go ahead with a project. The idea is that in order to begin evaluating a project all these requirements must be met. If one is not met, CUSD must find a way to meet this requirement before going ahead and evaluating the potential success it can have. Later on, we will be scoring the goals mentioned above and giving overall scores to projects, but these requirements will not be part of that evaluation. That is, not only will the goals be evaluated, but

some of them are so important that without them the project cannot endure. In a separate and binary way, these requirements must be met in order to then go ahead and evaluate the projects. This comes with one caveat. It can be the case where a requirement is not met and the project can be evaluated. This is done in the following scenario. If a project requirement is missing, but the team believes it can be met, they can go ahead and evaluate the project as if this requirement was met, in order to see if it is worth enabling this requirement based on the score of evaluation. That is, if they evaluate a project and it brings a really high score, the team may want to commit a strong effort to fulfilling that unmet requirement.

Table 2 presents the complete list of these originated requirements. Following we explain each one of the requirements.

Project_Advisor- All projects shall have at least one assigned academic advisor that agrees to oversee students. This requirement is per the rules of the university and moreover, an expert in the field has to oversee student work, as was mentioned above for the professional advisor goal in the AHP.

Skill_Set- All projects shall have an identified list of skills. This requirement allows for CUSD to understand the skills needed for each project, which will let them better gauge if they have the necessary skills to complete the project. This will also allow the team to understand the different fields and majors that will play a role in the project, giving them an idea of the number of majors and colleges that will form each team, a variable needed when evaluating one of the goals in the AHP mentioned above, multidisciplinary. The skill set has to be listed under 3 priorities levels: A must to have skill set, a should have skill set and a could have skillset.

All projects shall have the must have skills identified in the above list of skills. This is simply to reinforce the list of skills, which will be needed at a minimum.

Project_Legality- All projects shall stay within the legal bounds of the university and students. As simple as it sounds, this requirement ensures all projects must follow the Codes of the university. This can range from ownership bylaws to academic integrity codes.

Stakeholder_List- All projects shall have a list of things needed from a stakeholder. This requirement ensures and allows both the CUSD team and stakeholder to be on the same page, with regards to the needed commitment and accessibility required from the stakeholder. This once again allows for the evaluation of the stakeholder logistics goal mentioned above in the AHP. This list of things needed from a stakeholder has to come under 3 priorities levels: A must to have, a should have and a could have.

All projects shall have the stakeholder commit to fulfill the must haves from the list of things needed from the stakeholder. This requirement basically ensures that the stakeholder is committed to what is essential from him. It formalizes what will be needed from him. In a way, this requirement formalizes the agreement made with the stakeholder.

Expert_List- The project shall have a completed list of experts. This requirement lists the experts both academic and professional that will advise the project teams. Once again, having external non-student feedback is essential to better direct projects. The success of any project depends not only on the work of the students but also on the guidance of experts in the particular fields.

Index	Requirements	Abstract Function Name
OR.1	The project shall have at least one assigned academic advisor that agreed to oversee students project_advisor	advisor
OR.2	The project shall have an identified list of skill_set	skills
OR.3	The project shall have the must have skills identified in skill_set	minimum skills

OR.4	The project shall stay within the legal bounds of the university and students project_legality	legal
OR.5	The project shall have a list of things needed from a Stakeholder stakeholder_list	stakeholder
OR.6	The stakeholder shall commit to fulfill the must have from stakeholder_list	minimum stakeholder
OR.7	The project shall have a completed expert_list	expert

Table 2: Originated Requirements List

3. Goal, Question, Metric (GQM)

Now that we have identified the requirements without which a project is not qualifiable, we tackle the task of finding ways to measure the different objectives that we outlined in the AHP. For this, we rely on other Systems Engineering tool, the Goal Question Metric.

The Goal, Question, and Metric tool works as follows. For every goal that CUSD wants to attain with a project, that is the goals mentioned in the AHP, we devise a set of questions that, when answered, will confirm the extent to which this goal has been met. Furthermore, we assign both an ideal and an approximate metric that will allow us to quantify the responses to the questions. Finally, we also state a method of data collection for these metrics. The overall objective of this tool is to help define goals and how they will be measured. Following we will expand on each of the 11 goals which we are now very familiar with.

Our mission towards sustainability goal, where we work on a project that achieves a sustainable impact, we want to know how important is the impact of the project to the people it affects. That is, we can have a project that has a great impact in a certain aspect, but this aspect may not be a priority to the community of people at hand. We need to ensure that our projects resolve relevant issues. In order to measure this, we will simply let our CUSD team score what they think appropriate. For this particular goal, where we cannot see the effects of our project until it is implemented, we need to allow CUSD project members to use their own judgment. However, we constrain their judgment by defining what does achieving a sustainable impact means for CUSD.

Then, we ask them to give ratings to specific attributes. We discuss this in further details in the coming section.

For our multidisciplinary goal, where we want a project that involves people from different majors, we simply ask ourselves how many majors/subjects do the project need. We proceed to estimate both the number of colleges and majors involved in the projects. We consider and distinguish different majors within the same college and majors separated by college. Having five engineering majors versus having a major in each college is accounted for.

With regards to design focus, where we want the project that requires the development of a creation of a physical or virtual object, our question intrigues if the project is designing a not yet defined engineering solution. We want to embark on projects where CUSD implements creativity and not in projects where the stakeholder has already identified a solution to a problem. In order to measure this variable, the mean grade of project evaluations by academic advisors (from expert_list, OR.7) is taken. As mentioned previously professors are the best way of measuring applicability to student learning. Here again, we ask specific questions to the academic advisors to guide their answers into specific attributes.

For the academic value goal, where a project has to be certified by the professor as a project having a good learning experience, it is important to know if the project problem is well defined and if CUSD has a clearly specified deliverable. This will be measured by the same evaluation made from the advisors above (from expert_list, OR.7). They will fill out an evaluation that encompasses both the design focus and the academic value.

Switching gears to our project logistic goals we first ensure our stakeholder commitment goal is well assessed. In order to ensure the stakeholder is committed to having a project succeed, we ask if they are a good fit for CUSD in general. This will be evaluated through the stakeholder's past experiences. We will gather three different recommendation letters from organizations that

the stakeholder has previously worked with. This will validate the stakeholder's commitments through third party sources.

Stakeholder accessibility reflects the readiness of the stakeholder and ensures his lack of interaction is not hindering CUSD. We, therefore, want to know if the stakeholder is going to be available whenever he is needed by CUSD. The way we will be measuring this variable is by the mean response time of the stakeholder in interactions up to date.

For the next goal, human skills were CUSD must find students with the necessary skill set that the project requires, we need to know if the skills needed for the project are available to CUSD. That is, are the skills required elementary enough that students can take them on, or does the project require a set of professional skills that are not available in CUSD's student body. In order to measure the readiness of the students for the technical skills needed, measuring the list of skills in the skill set list (OR.2) versus the skills available to CUSD will give an estimate of the match between student skills and skills needed.

Human resources, or CUSD's capacity to gather and manage the number of people needed for a project, are completely dependent on how many students will be working on the project at a given time. In order to measure if the project falls in the within CUSD human resources, we will need to find the size of the team during the project. This will be done by summing the required students on each of the requirements mentioned in the requirements list (OR2).

Financially, when considering if the funds needed to accomplish the project are either provided by the stakeholder or CUSD is able to raise them, we just need to know who will be providing the funds and how much will they be providing if they do. We will approximate this measure by the cashed pledged in the verbal agreements generated during fundraising. In the case that a project is accepted, when moving forward with the project, any verbal agreement would be formalized.

With regards to time scope, it is imperial to have a clear understanding of the time needed to the completion of the project. This is estimated with a detailed timeline.

Finally, to set the professional advisory board, where professional advice is provided by specialty or field, it is important for CUSD to understand how many and which specialties will be involved with the project, and that will be assigned by the academic advisor in charge of the project.

With this, we finalize a very important step towards our overall tool. We now know for each goal what is the data that we need to collect and how we will be collecting it, in order to evaluate if the projects evaluated fit these goals.

4. Decision Matrix (DM)

The decision matrix is the final step of the puzzle. In this step, the scores will be imputed for each goal, and the weighted average total score for projects will be delivered. With this being said, we have tackled this decision matrix in a, somewhat, unconventional form, which better fits the nature of its use. We will not be assigned a predetermined set of scores, such as from 1 to 5, with respective definitions for each score, as is common. Indeed, we have created a scoring table where variables need to be assigned. For example, a variable could be the number of colleges involved in the project or the size of the team. From these variables, we automatically compute scores in a scale of 1-5. Mathematical formulas will be applied for each goal, following the metrics described in the GQM.’’ We discuss the score used for each goal below.

4.1. Mission towards sustainability

Every team member evaluates the mission toward sustainability of the project by evaluating 4 aspects (Representing the 3 pillars of CUSD):

- What is the environmental impact of the project (Score from 1 to 5)
- What is the social impact of the project (Score from 1 to 5)
- What is the economical impact of the project (Score from 1 to 5)

- What is the overall impact of the project (Score from 1 to 5)

A team member scores the project on every aspect. The grading scale is as follows: (1) poor, (2) fair, (3) good, (4) very good and (5) excellent). Then a team member computes the average score on these 4 aspects. This constitutes the grade of the team member on the mission towards sustainability. The mean grade of all the team members constitutes the final grade attributed to this project on the mission towards sustainability aspect.

4.2. Multidisciplinarity

The multidisciplinarity score takes into account the colleges multidisciplinarity and the degrees multidisciplinarity. The college multidisciplinarity is computed as follows $multidisciplinarity_{college} = \frac{\min(n_{colleges}, 3)}{3}$ where $n_{colleges}$ represents the number of different colleges that might involve students for the particular project. This score will be 1 if there are 3 or more colleges involved, and 0 if there are 0 colleges involved. 3 is the number of colleges threshold, meaning the number of colleges starting from which the multidisciplinarity college score is 1. This is to represent the idea that it starting from a certain number of colleges, the diversity targeted was achieved and adding more colleges does not add to the diversity. We represent this number as a constant $NB - COLLEGES - THRESHOLD = 3$. This constant can be changed according to the needs of the team. In the following, we refer to constants by capital letters variables names. Constants can all be changed according to the team's considerations.

Similarly, the degree multidisciplinarity is computed as follows:

$$multidisciplinarity_{degrees} = \frac{\min(n_{degrees}, 6)}{6}$$

With $n_{degrees}$ representing the number of different degrees required for the project and $NB - DEGREES - THRESHOLD = 6$.

Finally, the multidisciplinarity score is an average of the latter two scores and rescaled from 1 to 5.

$$multidisciplinarity = (0.5 \times multidisciplinarity_{colleges} + 0.5 \times multidisciplinarity_{degrees}) \times 5$$

Using this formula a project that involves 4 degrees from the same college will get a lower multidisciplinary score than a project that involves 4 degrees from 4 different colleges.

4.3 Design focus and academic value

These two scores rely on the expert's evaluation.

Every academic or industrial advisor of the project has to assign the following two scores.

The score of the project on its design focus component (Score from 1 to 5). In this part the expert needs to consider the following questions:

- How much would this project require the design of a solution?
- How much is the solution required to be close to professional quality?

The final design score of the project is the mean between the grades of all the experts.

Second, the score of the project on its academical value (Score from 1 to 5). In this part the expert needs to consider the following questions:

- What would be the main learning outcomes for this project for students?
- How would the learning outcomes of this project compare to a curriculum of a class?

Similarly, the final score of the project on the academical value is the mean score of the grades given by the experts.

4.4. Stakeholder Commitment

To measure the stakeholder seriousness and implication, we choose to rely on recommendations and referrals given on his behalf. This allows to base the judgment on the evidence of the past, allowing the evaluation to be objective and unbiased. The commitment score of a stakeholder is computed as follows:

$$commitment_{stakeholder} = \frac{\min(n_{recommendations}, 3)}{3} \times 5$$

Where $n_{recommendations}$ represents the number of recommendations received on the stakeholder, $NB - RECOMMENDATIONS - THRESHOLD = 3$. This represents the rate of recommendations by the rate of recommendations expected. This score is rescaled from 1 to 5.

4.5. Stakeholder Accessibility

The stakeholder accessibility score is based on an estimate on the mean time to answer of the stakeholder. The estimate is based on the previous interactions of CUSD with the Stakeholder. The score is computed as follows:

$$accessibility = \frac{1}{t_{answer}} \times 5$$

Where t_{answer} represents the mean time (in days) needed from the stakeholder to answer to a CUSD request. This is an estimate from the previous interactions. $BEST - RESPONSE - TIME = 1$ represents the number below which the accessibility score will be 1. Similarly, accessibility is rescaled from 1 to 5.

4.6. Human Skills

The skill set list (OR2) used to determine the skills needed for each project consists of both the skills that the project should have and the skills that, even though not necessary, the project could still benefit from. In order to normalize the absolute values collected for this goal we need to compare the skills we need to those that CUSD can offer, as well as taking into account that those necessary skills are of more importance to the project than the other extra skills that would not be bad to have. The following formula accounts for these differences and also rescales the score for our typical 1 to 5 scores.

$$Human\ Skill = \left[\frac{\# of\ skills\ available\ to\ CUSD}{\# of\ skills\ the\ project\ should\ have} \times .8 + \frac{\# of\ skills\ available\ to\ CUSD}{\# of\ skills\ the\ project\ could\ have} \times .2 \right] \times 5$$

From the formula, one can observe the multiplication by 5 accounts for the normalization of the score from 1 to 5. As it can be seen from the formula, more weight is allocated to those skills that the project should have (.8) versus those skills that a project could have (.2). This weight allocation is consistent with the relevance that each type of skill has for a given project.

4.7. Human Resources

The human resources score evaluates how much the team size corresponds to CUSD's expectations. In CUSD, teams need to be big enough to exhibit diversity and offer a workforce

that is able to tackle big projects. However, they need to be small enough to be able to be managed by E-board members. E-Board members estimate that a good size range is anywhere between 15 and 35 people, with 25 being a perfect size. Thus, the human resources score is modeled as the gaussian function shown below. The gaussian is centered around 15 and with a standard deviation of $35-25=25-15=10$. As shown Figure 1, this function gives the desired effect. First, the highest score is achieved at 25. Second, the further points move away from 25 the lower is their score. Finally, the high scores are concentrated between 15 and 35. Let's note that the curve is reshaped from a scale of 1 to 5.

$BEST - TEAM - SIZE - LBOUND = 15$ and $BEST - TEAM - SIZE - UBOUND = 35$ are constants that can be modified according to the team consideration

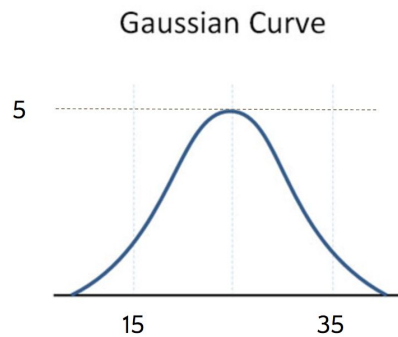


Figure 1: Human Ressources score function.

4.8. Financing Resources

A similar approach is used to find a score of financing resources. The Eboard team estimates that a good financing for a project is between 50k\$ and 150k\$. Below 50k, the project might not impactful enough. Above 150\$, it might appear to be too big for what CUSD is able to handle. A financing of 100\$ is a perfect amount for a CUSD project. Thus, a gaussian function is used with a mean 100\$ and a standard deviation of $100\$-50\$=150\$-100\$=50\$$ (see Figure 2) .

$BEST - FINANCING - LBOUND = 50k$ and $BEST - FINANCING - UBOUND = 150k$ are constants that can be modified by the team.

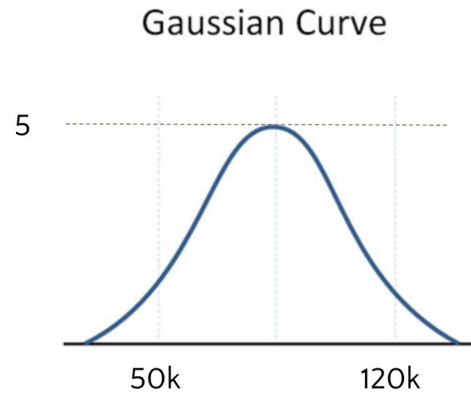


Figure 2: Financing Ressources score function.

4.8. Time Scope

A CUSD project needs to be achievable in a Eboard student rotation lifetime. Some projects happened to fail at CUSD because different EBoard teams took over on the project, causing loss of information between transitions and a change of focus and priorities. For this reason, a long CUSD project should not last more that 3.5 years (42 months). On the other hand, a CUSD project below 1 year would be considered too short. Similarly to the two previous score functions, we model the time scope score function using a gaussian function with a mean of 27 months and a standard deviation of $27-12=42-27=15$ months.

$BEST - DURATION - LBOUND = 12$ and $BEST - DURATION - UBOUND = 42$ are constants that can be modified by the team.

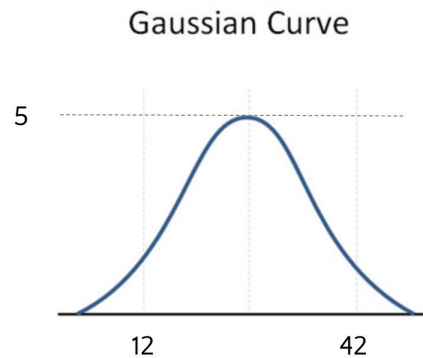


Figure 3: Time scope (in months) score function.

4.9. Professional Advisory

In order to normalize the absolute values collected for professional advisory, we use a method similar to that used in our human skills goal. Instead of dividing skills between those that a project should have and those that a project could have, we are differentiating those areas/fields of expertise that the project is involved with between primary and secondary ones. Primary areas will be assigned more weight as they are core to the project and secondary ones are areas which are related to the field but not in a direct form. The project will only require part time advisory from these experts.

$$PA = \left[\frac{\# \text{ of primary advisors available to CUSD}}{\# \text{ of primary areas/fields the project pertains to}} \times .8 + \frac{\# \text{ of secondary advisors available to CUSD}}{\# \text{ of secondary areas/fields the project pertains to}} \times .2 \right] \times 5$$

For both primary and secondary areas of expertise, we transform the absolute values collected by taking the percent of areas we have an advisor for with regards to the total number of areas the project is subject to. Finally, as per usual, we multiply our formulation by 5 to normalize our score into a 1 to 5 range.

As a wrap up, the different scores are computed using 18 input values: mean score of team on sustainability mission, number of colleges involved in the project, number of degrees involved in the project, mean grade of advisors for design focus goal, mean grade of advisors for academical value, number of recommendations gathered for the stakeholder, mean response time of the stakeholder number of should have skills identified for the project, number of should have skills fulfilled, number of could have skills identified for the project, number of could have skills fulfilled, number of required students for the project, sum of cash pledged for the project, estimation of the duration of the project, numbers of primary areas identified for project, number of primary areas covered by advisors, number of secondary areas identified for the project, number of secondary areas covered by advisors.

One needs to input these values in the scoring and the project will automatically get graded applying the rules discussed above. This choice was made to make it easy to users that are not familiar with these tools.

Moreover, there is a set of 12 constant values that control the scoring functions: Number of Colleges Threshold, Number Degrees Threshold, Max Grade, Number Recommendations Threshold, Best Response Time Threshold, Best Team Size LBound, Best Team Size UBound, Best Duration LBound, Best Duration UBound, Best Financing LBound and Best Financing UBound. As shown in Appendix XX, these constants can be modified in Constants tab.

Summing the above formulas across our 11 holistic goals produces a total final score for each project. These scores can then be interpreted out of 5 and in comparison with one another. Actually, we will use these scores to form a ranking of best to worst projects. Those projects that score close to 5 are excellent projects and those that score below two should be discarded.

5. Conclusion

This document exemplifies the motivation behind each decision taken when creating the infrastructure of this tool in its application to evaluate metrically, potential future projects for Cornell University Sustainable Design. For the implementation of this tool, understanding the motivation behind the build allows for a better user experience. With this being said, so long as the scoring sheet is appropriately filled out, the tool will output final numeric values for the potential success of the projects under investigation. Fulfilling the goal, of creating a systematic and metric approach to evaluating projects, should enable CUSD in choosing exemplary and successful projects, limiting unforeseen failure.