BOWERS SCHOOL RENOVATIONS
RESOURCE ALLOCATION

Jim Homyak
&
Karen Svetz

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Abstract

The Town of Manchester, Connecticut, has appropriated money to renovate one of their many elementary schools, Bowers School. The Facilities Management Unit in the Town must decide which renovation items should be included in the project within the allotted budget. This is not an easy task. There are numerous people who have an interest in what gets accomplished, the principal of the school and the teachers, the parents, the Board of Education, the Town's Board of Directors, the State of CT School Facilities Unit, and the list goes on. There are also requirements to be met to bring the school building up to the latest codes.

An Expert Choice Model was created which allowed the Facilities Management Unit to make decisions on how to allocate resources to the project in a cost effective and rational manner. The outcome describes the recommended items that should be included in the school renovation project given the amount of money available. Information is also provided which describes how well the resources can be allocated for funding scenarios above and below the specified amount.

Introduction

Bowers Elementary School in Manchester, CT, was originally constructed in 1950 with additions built in 1954. In 1989 a major renovation project was completed at which time the Media Center and elevator were added.

Currently a project is underway to renovate Bowers School again, to bring the school up to date with regard to Fire Safety Codes, Building Codes, Health Codes and Handicapped Accessibility Codes.

Additionally, there is a list of other needed improvements, such as painting, new cabinetry, new windows, new lockers etc. While these improvements are not required by any code they are still quite important. It is imperative that the Town gives the school a needed facelift to show the community, taxpayers, teachers, parents, and etc. that a proper renovation has been done, one that not only makes the building safe but also provides a clean and bright environment for the students.

Budget for Renovations

A project budget has been established of $2,500,000. This amount was approved through a bond referendum process and cannot be changed. The budget must cover not only the cost of construction but "soft costs" as well, which include Architect fees, Construction Manager fees, MEP and Structural Engineering fees, Asbestos Abatement fees and other

miscellaneous costs which amount to approximately $750,000. Deducting these costs form the overall budget leaves $1,750,000 for the construction budget.

OBJECTIVES

There are four objectives for this project as follows:

1. **Meet Current Government Standards**
2. **Contribution to Faculty and Students**
3. **Maximize the State of CT Grant Funding**
4. **Long Term Benefits**

Meet Current Government Standards

The Bowers School building does not meet current codes for Fire Safety, Building, Air Quality and Americans with Disabilities Act, ADA.

The National Fire Protection Association, NFPA is the authority regarding Fire Safety in Public Buildings. NFPA sets requirements regarding egress, areas of refuge, sprinklers systems, door fire ratings, fire walls etc. At a minimum sprinklers must be added to Bowers School as well as changes to doors at egress points to ensure that the occupants can quickly and safely exit the building in case of an emergency.

In Connecticut there is a Public Act concerning indoor air quality in schools which requires that in the case of a major alteration, renovation or extension of a building used for public school purposes, the building must be brought up to current standards according to the American Society of Heating, Ventilating and Air Conditioning Engineers Standard 62 entitled “Ventilation for Acceptable Indoor Air Quality”. For this project the “make-up air”, meaning the fresh air coming into the building, must be increased substantially to bring the building up to the required code.

Building Codes are numerous and cover every imaginable item that goes into a construction project whether it is new construction or renovations. Examples of building code items that will be of concern with this project include railings for stairs, electrical requirements such as replacing standard outlets with GFCI outlets, and a kitchen hood requirement to prevent grease fires.

The Americans with Disabilities Act provides standards for accessible design and sets guidelines for accessibility to places of public accommodation and commercial facilities by individuals with disabilities. There are many areas in the building, which are lacking in regard to handicapped accessibility. Bathrooms must be changed to accommodate persons in wheelchairs, practically all of the doors in the building must

have new lever handle hardware as opposed to the existing door knobs, many door widths do not meet the minimums for wheelchair clearance.

Contribution to Faculty and Students

All of the renovations are ultimately to benefit the faculty and students. Some renovations will improve the building, structurally; mechanically and electrically which are less visible improvements to the occupants while others will improve the daily lives of the faculty and students by creating an environment that promotes and advocates learning. These more apparent improvements include fresh paint, new lockers, new cabinetry for storage of supplies that currently give the rooms a cluttered appearance, new visual displays such as white boards and tack boards. The tack boards will also help to give a neater appearance to the rooms where currently many visual items are taped to the walls. New vinyl tile flooring will be installed also; the new tile will be a brighter color than the dark pattern that was used in the past. This accompanied by the new paint will give the classrooms and corridors a bright and cheery feel.

Maximize the State of CT Grant Funding

The Town is eligible for reimbursement by the State of Connecticut Department of Education through a grant process for 60 cents on a dollar spent. The reimbursement covers true renovation costs however it does not cover costs for items that are "maintenance" in nature or "purely cosmetic". The Town must be very careful in their decision making sure that the amount of reimbursement that they receive is maximized. For instance replacement of lockers is something that is not eligible for reimbursement.

Long Term Benefits

There are ten elementary schools in the town, two middle schools and one high school. Each of these schools is in need of renovations, additions or complete rehabilitation. Therefore it will be many years before the Town will be able to spend more money on Bowers School after this renovation. The renovation should provide long-term benefits for the school building. It should be robust enough to make the building structurally and mechanically sound from the standpoint of needing nothing but regular maintenance and upkeep for many years to come.

GOAL

The goal for the Bowers School Renovation Project is to distribute the bond referendum approved monies to renovate the school in the most efficient, prudent and cost effective way.

There are many more items desired for the renovation project than there is money available to cover the cost of these items. The Town of Manchester Facilities Management Unit must determine which renovation items will be included in the project. This must be accomplished in a logical, and systematic manner because there are many people who have different ideas on what should be included in the project. These include the school principals and teacher, parents, Board of Education, the building maintenance staff, taxpayers of the Town and the Board of Directors who must answer to all of their constituents. The Facilities Management Unit must be prepared to explain their methodology and to justify why certain items are included and why others are not.

ALTERNATIVES

We have a clear goal, and all objectives have been outlined. The alternatives that support the objectives fall into three main categories as follows:

1. **Essential Upgrades**
2. **Cosmetic Upgrades**
3. **Mechanical Upgrades**

Essential Upgrades

Essential upgrades are needed to improve the overall quality of the school and to make it accessible to people with disabilities. They include such items as new doors and door hardware, bathroom renovations, handrails for stairs, asbestos abatement, casework, exterior egress, conveying system for stage access and new windows.

Cosmetic Upgrades

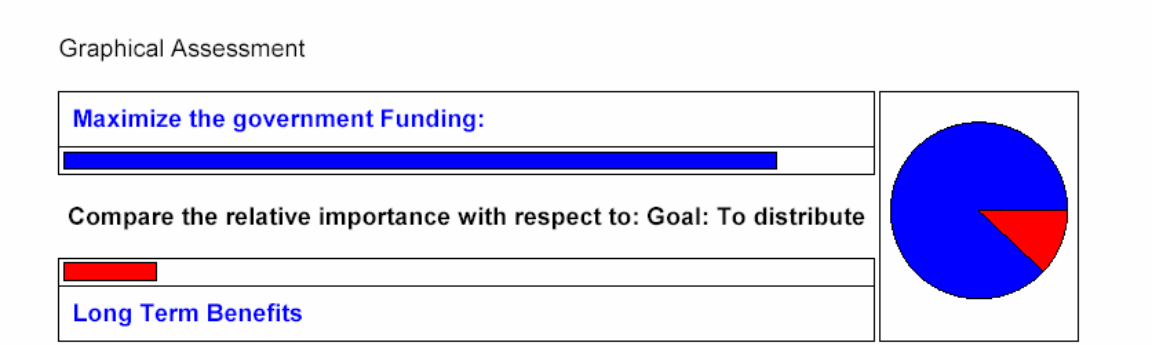
Cosmetic upgrades are needed in part due to the construction being performed, and additionally to add a fresh new look to the school. They include such items as painting, visual displays (i.e. white boards and tack boards), new lockers and updating faculty offices.

Mechanical Upgrades

The mechanical upgrades include resolving fresh air requirements, fire protection, alarms and electrical upgrades.

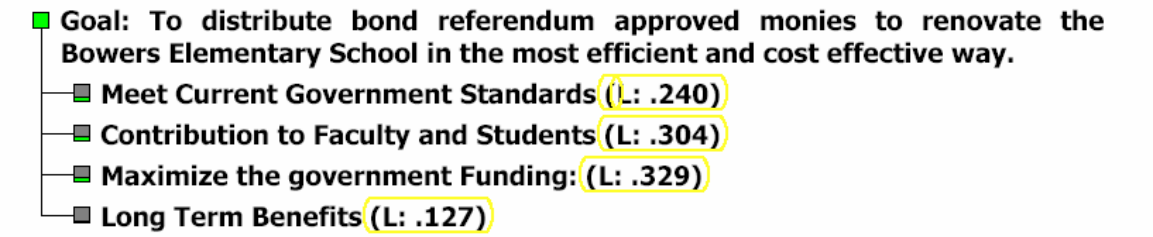
EXPERT CHOICE MODEL

The project goal and objectives were entered into the Expert Choice Software. Pair wise comparisons of the objectives were made as shown by the example below.



For this comparison "Maximize the Government Funding" was considered more important than "Long Term Benefits" by a significant amount using the graphical mode as opposed to verbal or numerical modes.

These pair wise comparisons provided the following priorities for the objectives:



Maximize the Government Funding is given the highest priority. This is consistent with the goal of distributing the money in an efficient and cost-effective manner.

The next step was to enter alternatives and their perspective dollar amounts. The dollar amounts are estimates that were provided by the Construction Manager for the Project.

Alternative	Costs
Mechanicals: Fire Protection	255000
Mechanicals: Misc Replace Kitchen Hood	30000
Mechanicals: Misc Steam Trap Program	12000
Mechanicals: Misc Fire and Smoke Dampers	20000
Mechanicals: Misc Environmental Controls	5500
Mechanicals: Misc Replace HVAC Controls	109000
Mechanicals: FARO Fresh Air Exchanger Only	400000
Mechanicals: FARO Rough for Future AC	500000
Mechanicals: FARO Energy Recovery Units	600000
Mechanicals: FARO Complete Air Conditioning	675000
Mechanicals: EU Electric Service Upgrade	90000
Mechanicals: EU 16 Panel Replacement	96000
Mechanicals: EU Emergency Lighting	10000
Mechanicals: EU Intercom and Clock Replacement	45000
Mechanicals: EU GFCI Outlets	2000
Mechanicals: EU Exit Signs	7500
Mechanicals: EU Air Handling Smoke Detectors	10000
Mechanicals: EU Theatrical Lighting	11000
Mechanicals: Related Mechanical Construction	115544
Mechanicals: Construction Dumpsters	35000

Alternative	Costs
Cosmetic Upgrades: Office Renovations	120569
Cosmetic Upgrades: Paint	56250
Cosmetic Upgrades: Visual Display	31944
Cosmetic Upgrades: Lockers	104834
Essentials: Doors And Hardware	126880
Essentials: Bathroom Renovations	56434
Essentials: Stairs	42785
Essentials: Abatement	124946
Essentials: Casework	91416
Essentials: Exterior Egress	33000
Essentials: Conveying System	24000
Essentials: Windows	200000

Rating of Alternatives

For each objective, a rating system was established. For instance for the objective "Meet Government Standards" the alternatives were rated as either a **yes** or a **no**. As with the alternative to install GFCI Electrical Outlets, this would be rated a yes because it is dictated by a State Building Code; however, the alternative to replace the windows is not required by any particular governmental standard so it is rated a no. The rating system for the objective "Maximize the Government Funding" was also set up in this way.

For the objective "Contribution to Faculty and Students" a different rating system was established. In this case there were five rating selections from Extreme, Significantly, Moderate, Some and Slightly. Each alternative was rated with respect to the objective using these choices.

Extreme	Significantly	Moderate	Some	Slightly
1 (1.000)	2 (.312)	3 (.111)	4 (.060)	5 (.019)

The ratings for this objective were more subjective in nature and could potentially vary depending on who was carrying out the rating.

The rating system for the objective "Long Term Benefits" was also set similarly with its respective derived priorities.

Extreme	Significantly	Moderately	Somewhat	Slightly
1 (1.000)	2 (.429)	3 (.191)	4 (.092)	5 (.051)

We then rated each of the alternatives against each of the objectives. Once completed a benefit for each alternative was derived as can be seen in the "TOTAL" column of the completed data grid below.

AID	Alternative	Total	Costs	Meet Current Government Standards|(L: .240)	Contribution to Faculty and Students|(L: .304)	Maximize the government Funding:|(L: .329)	Long Term Benefits|(L: .127)
A1	Mechanicals: Fire Protection	0.791	255000	Yes	Significantly	Yes	Extreme
A2	Mechanicals: Misc Replace Kitchen Hood	0.627	30000	Yes	Moderate	Yes	Moderately
A3	Mechanicals: Misc Steam Trap Program	0.121	12000	No	Moderate	No	Moderately
A4	Mechanicals: Misc Fire and Smoke Dampers	0.791	20000	Yes	Significantly	Yes	Extreme
A5	Mechanicals: Misc Environmental Controls	0.444	5500	No	Moderate	Yes	Significantly
A6	Mechanicals: Misc Replace HVAC Controls	0.414	109000	No	Moderate	Yes	Moderately
A7	Mechanicals: FARO Fresh Air Exchanger Only	0.718	400000	Yes	Significantly	Yes	Significantly
A8	Mechanicals: FARO Rough for Future AC	0.136	500000	No	Some	No	Significantly
A9	Mechanicals: FARO Energy Recovery Units	0.517	600000	No	Moderate	Yes	Extreme
A10	Mechanicals: FARO Complete Air Conditioning	0.494	675000	No	Extreme	No	Extreme
A11	Mechanicals: EU Electric Service Upgrade	0.657	90000	Yes	Moderate	Yes	Significantly
A12	Mechanicals: EU 16 Panel Replacement	0.657	96000	Yes	Moderate	Yes	Significantly
A13	Mechanicals: EU Emergency Lighting	0.657	10000	Yes	Moderate	Yes	Significantly
A14	Mechanicals: EU Intercom and Clock Replacement	0.505	45000	No	Significantly	Yes	Significantly
A15	Mechanicals: EU GFCI Outlets	0.627	2000	Yes	Moderate	Yes	Moderately
A16	Mechanicals: EU Exit Signs	0.718	7500	Yes	Significantly	Yes	Significantly
A17	Mechanicals: EU Air Handling Smoke Detectors	0.791	10000	Yes	Significantly	Yes	Extreme
A18	Mechanicals: EU Theatrical Lighting	0.212	11000	No	Significantly	No	Significantly
A19	Mechanicals: Related Mechanical Construction	0.381	115544	No	Some	Yes	Slightly
A20	Mechanicals: Construction Dumpsters	0.368	35000	No	Slightly	Yes	Slightly
A21	Cosmetic Upgrades: Office Renovations	0.714	120569	No	Extreme	Yes	Significantly
A22	Cosmetic Upgrades: Paint	0.379	56250	No	Extreme	No	Somewhat
A23	Cosmetic Upgrades: Visual Display	0.391	31944	No	Extreme	No	Moderately
A24	Cosmetic Upgrades: Lockers	0.391	104834	No	Extreme	No	Moderately
A25	Essentials: Doors And Hardware	0.73	126880	Yes	Moderate	Yes	Extreme
A26	Essentials: Bathroom Renovations	0.73	56434	Yes	Moderate	Yes	Extreme
A27	Essentials: Stairs	0.627	42785	Yes	Moderate	Yes	Moderately
A28	Essentials: Abatement	0.73	124946	Yes	Moderate	Yes	Extreme
A29	Essentials: Casework	0.627	91416	Yes	Moderate	Yes	Moderately
A30	Essentials: Exterior Egress	0.657	33000	Yes	Moderate	Yes	Significantly
A31	Essentials: Conveying System	0.121	24000	No	Moderate	No	Moderately
A32	Essentials: Windows	0.444	200000	No	Moderate	Yes	Significantly

Constraints

The following are the constraints for this project.

- Budget of $2,500,000 dollars of which $750,000 is required for soft costs" such as Architect, Construction Manager, MEP and Structural Engineering, Asbestos Abatement fees and other miscellaneous costs. The remaining $1,750,000 is our budget constraint for our part in the resource allocation.
- In order to receive the Federal Funding and support it there are certain renovations which are mandatory, in order to Fire Safety Codes, Building Codes, Health Codes and Handicapped Accessibility Codes. They are as follows.

Mechanicals	Essentials
• Fire Protection • Environmental Controls • Replace HVAC Controls • Fresh Air Requirement Option • Electric Service Upgrade • 16 Panel Replacement • Emergency Lighting • GFCI Outlets	• Doors And Hardware • Bathroom Renovations • Stairs • Abatement • Exterior Egress

• Exit Signs • Air Handling Smoke Detectors • Related Mechanical Construction	

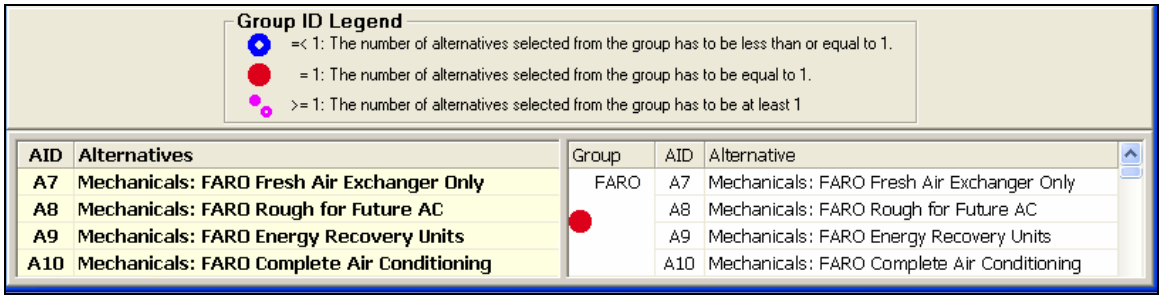
- In regards to the Fresh Air Requirement Options (FARO) listed in the mechanicals section above, an additional constraint is needed due to the fact there are four viable alternatives that meet the requirement for FARO required by the government, and only one of the four can be funded. The options are as follows:

FARO Option	Cost	Benefit
Fresh Air Exchanger Only	$400,000	0.718
Rough for Future AC	$500,000	0.136
Energy Recovery Units	$600,000	0.517
FARO Complete Air Conditioning	$675,000	0.494

Resource Aligner

Next we opened the resource aligner option in Expert Choice entered in the constraints listed above. A budget limit of $1,750,000 was entered in the budget limit field.

Next a group was created for the FARO requirement. We first created the group, and then added the respective alternatives to the group as seen below. We then identified the number of alternatives that can be chosen from the FARO group. In our given scenario one alternative must be chosen from the group in order to meet the requirement for government funding.



We then checked the “Must Field” for all alternatives, which are required to receive Federal funding. See Below

AID	Alternative	Funded	Benefit	Cost	Partial	Must	Must Not
A1	Mechanicals: Fire Protection	NO	.791	255,000	☐	☑	☐
A2	Mechanicals: Misc Replace Kitchen Hood	NO	.627	30,000	☐	☐	☐
A3	Mechanicals: Misc Steam Trap Program	NO	.121	12,000	☐	☐	☐
A4	Mechanicals: Misc Fire and Smoke Dampers	NO	.791	20,000	☐	☑	☐
A5	Mechanicals: Misc Environmental Controls	NO	.444	5,500	☐	☑	☐
A6	Mechanicals: Misc Replace HVAC Controls	NO	.414	109,000	☐	☑	☐
A7	Mechanicals: FARO Fresh Air Exchanger Only	NO	.718	400,000	☐	☐	☐
A8	Mechanicals: FARO Rough for Future AC	NO	.136	500,000	☐	☐	☐
A9	Mechanicals: FARO Energy Recovery Units	NO	.517	600,000	☐	☐	☐
A10	Mechanicals: FARO Complete Air Conditioning	NO	.494	675,000	☐	☐	☐
A11	Mechanicals: EU Electric Service Upgrade	NO	.657	90,000	☐	☑	☐
A12	Mechanicals: EU 16 Panel Replacement	NO	.657	96,000	☐	☑	☐
A13	Mechanicals: EU Emergency Lighting	NO	.657	10,000	☐	☑	☐
A14	Mechanicals: EU Intercom and Clock Replacement	NO	.505	45,000	☐	☐	☐
A15	Mechanicals: EU GFCI Outlets	NO	.627	2,000	☐	☑	☐
A16	Mechanicals: EU Exit Signs	NO	.718	7,500	☐	☑	☐
A17	Mechanicals: EU Air Handling Smoke Detectors	NO	.791	10,000	☐	☑	☐
A18	Mechanicals: EU Theatrical Lighting	NO	.212	11,000	☐	☐	☐
A19	Mechanicals: Related Mechanical Construction	NO	.381	115,544	☐	☑	☐
A20	Mechanicals: Construction Dumpsters	NO	.368	35,000	☐	☐	☐
A21	Cosmetic Upgrades: Office Renovations	NO	.714	120,569	☐	☐	☐
A22	Cosmetic Upgrades: Paint	NO	.379	56,250	☐	☐	☐
A23	Cosmetic Upgrades: Visual Display	NO	.391	31,944	☐	☐	☐
A24	Cosmetic Upgrades: Lockers	NO	.391	104,834	☐	☐	☐
A25	Essentials: Doors And Hardware	NO	.730	126,880	☐	☑	☐
A26	Essentials: Bathroom Renovations	NO	.730	56,434	☐	☑	☐
A27	Essentials: Stairs	NO	.627	42,785	☐	☑	☐
A28	Essentials: Abatement	NO	.730	124,946	☐	☑	☐
A29	Essentials: Casework	NO	.627	91,416	☐	☐	☐
A30	Essentials: Exterior Egress	NO	.657	33,000	☐	☑	☐
A31	Essentials: Conveying System	NO	.121	24,000	☐	☐	☐
A32	Essentials: Windows	NO	.444	200,000	☐	☐	☐

Maximizing Benefits within the given Budget

With the given budget and constraints entered, we then maximized the benefits without exceeding the budget. The results are seen below:

AID	Alternative	Funded	Benefit	Cost	Partial	Must	Must Not
A1	Mechanicals: Fire Protection	YES	.791	255,000	☐	☑	☐
A2	Mechanicals: Misc Replace Kitchen Hood	YES	.627	30,000	☐	☐	☐
A3	Mechanicals: Misc Steam Trap Program	NO	.121	12,000	☐	☐	☐
A4	Mechanicals: Misc Fire and Smoke Dampers	YES	.791	20,000	☐	☑	☐
A5	Mechanicals: Misc Environmental Controls	YES	.444	5,500	☐	☑	☐
A6	Mechanicals: Misc Replace HVAC Controls	YES	.414	109,000	☐	☑	☐
A7	Mechanicals: FARO Fresh Air Exchanger Only	YES	.718	400,000	☐	☐	☐
A8	Mechanicals: FARO Rough for Future AC	NO	.136	500,000	☐	☐	☐
A9	Mechanicals: FARO Energy Recovery Units	NO	.517	600,000	☐	☐	☐
A10	Mechanicals: FARO Complete Air Conditioning	NO	.494	675,000	☐	☐	☐
A11	Mechanicals: EU Electric Service Upgrade	YES	.657	90,000	☐	☑	☐
A12	Mechanicals: EU 16 Panel Replacement	YES	.657	96,000	☐	☑	☐
A13	Mechanicals: EU Emergency Lighting	YES	.657	10,000	☐	☑	☐
A14	Mechanicals: EU Intercom and Clock Replacement	YES	.505	45,000	☐	☐	☐
A15	Mechanicals: EU GFCI Outlets	YES	.627	2,000	☐	☑	☐
A16	Mechanicals: EU Exit Signs	YES	.718	7,500	☐	☑	☐
A17	Mechanicals: EU Air Handling Smoke Detectors	YES	.791	10,000	☐	☑	☐
A18	Mechanicals: EU Theatrical Lighting	YES	.212	11,000	☐	☐	☐
A19	Mechanicals: Related Mechanical Construction	YES	.381	115,544	☐	☑	☐
A20	Mechanicals: Construction Dumpsters	YES	.368	35,000	☐	☐	☐
A21	Cosmetic Upgrades: Office Renovations	NO	.714	120,569	☐	☐	☐
A22	Cosmetic Upgrades: Paint	NO	.379	56,250	☐	☐	☐
A23	Cosmetic Upgrades: Visual Display	YES	.391	31,944	☐	☐	☐
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A25	Essentials: Doors And Hardware	YES	.730	126,880	☐	☑	☐
A26	Essentials: Bathroom Renovations	YES	.730	56,434	☐	☑	☐
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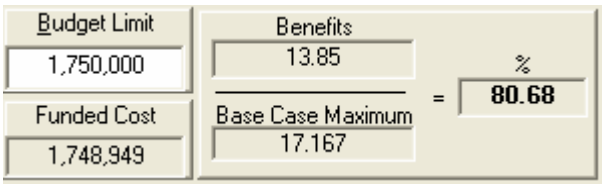
A28	Essentials: Abatement	YES	.730	124,946	☐	☑	☐
A29	Essentials: Casework	YES	.627	91,416	☐	☐	☐
A30	Essentials: Exterior Egress	YES	.657	33,000	☐	☑	☐
A31	Essentials: Conveying System	NO	.121	24,000	☐	☐	☐
A32	Essentials: Windows	NO	.444	200,000	☐	☐	☐

The above alternatives highlighted in yellow are selected as the given alternatives that maximize the benefit within the given budget allotment. As you can see, all of the alternatives checked “MUST” are chosen, and just one alternative from the FARO grouping (A7, A8, A9, A10) was chosen. The resource aligner worked within the given constraints to maximize the benefit as seen below.



At $1,7500,000, we have achieved 80.68% of the best-case scenario provided if we had full funding of over 4 million dollars. Based on our original comparison of objectives with respect to the goal and alternatives rated against the objectives a benefit is derived for each alternative. The resource aligner works within the given constraints and optimizes the sum of each of the individual alternative benefits.

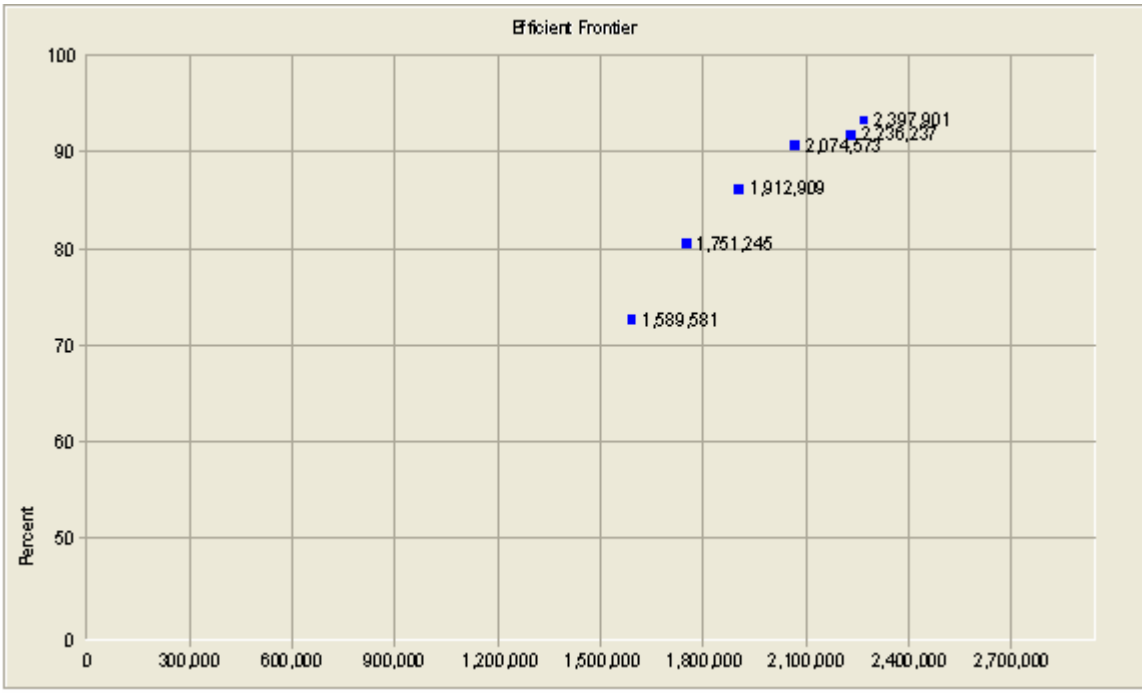
Efficient Frontier

How would the level of benefit be affected if there was additional funding available and or funding was cut. We currently stand at a benefit level of approximately 81% at 1.75 million dollars.

If the budget was cut $200,000 dollars we see the optimized benefit reduced to 72%, a drop of 9 to 10 %. Whereas increasing the budget we find at 1.9 million the optimized benefit to be 86.2 % an increase of benefit of only 5.5%. With an additional $324,573 the benefit could be optimized to 90.7%, an increase of 10%. After the 90% optimized threshold the utility curve levels out signifying a decrease dollar spent per benefit returned percentage.

Increasing Budgets -- Funded by Alternative

Budget	1,589,581	1,751,245	1,912,909	2,074,573	2,236,237	2,397,901
Benefit %	72.6%	80.7%	86.2%	90.7%	91.9%	93.3%



If you look on the above graph you will notice it starts at approximately 72% and 1.5 million dollars. This is because in order to minimally meet the given constraints required without any additional alternatives being chosen, will require $1,504,589 dollars in funding.

Recommendations

At the current funding level the following alternatives are recommended for funding.

• GFCI Outlets • Environmental Controls • Exit Signs Mechanicals: Emergency Lighting • Air Handling Smoke Detectors • Fire and Smoke Dampers • FARO Fresh Air Exchanger Only	• Exterior Egress • Stairs • Bathroom Renovations • Electric Service Upgrade • 16 Panel Replacement • Replace HVAC Controls • Related Mechanical Construction	• Abatement • Doors And Hardware • Fire Protection • Theatrical Lighting • Replace Kitchen Hood • Visual Display • Construction Dumpsters • Casework • Intercom and Clock Replacement

With the given budget of $1,750,000 and the constraints, the above alternatives optimized the benefit received at 80.68%.

Another Iteration

After the first allocation of resources we found one of ratings for the alternatives was incorrect. Originally we had “Meet Government Standards” and “Maximize Government Funding” as a Yes or No value with a derived priority of 1.0 and .11 respectively. After further review it was deemed they should be 1.0 and 0.0 respectively. The “No” value should have no derived priority because the alternative can not provide any benefit at all if it is a “No”. The result of the second model is shown below

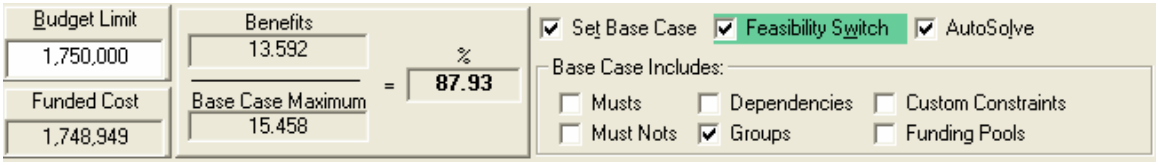
Effect on Benefits Provided per Alternative

All of respective alternatives for Meeting the government standards and the requirements for government funding which were valued at “NO” were set to zero instead of 0.11 effecting the benefit derived for each of the respective alternatives between .026 and .063. (Please see chart below)

	Ideal mode			RATINGS	RATINGS	RATINGS	RATINGS
AID	Alternative	Total	Costs	Meet Current Government Standards |(L: .240)	Contribution to Faculty and Students |(L: .304)	Maximize the government Funding: |(L:.329)	Long Term Benefits: I(L: .127)
A1	Mechanicals: Fire Protection	0.791	$255,000	Yes	Significantly	Yes	Extreme
A2	Mechanicals: Misc Replace Kitchen Hood	0.627	$ 30,000	Yes	Moderate	Yes	Moderately
A3	Mechanicals: Misc Steam Trap Program	0.058	$ 12,000	No	Moderate	No	Moderately
A4	Mechanicals: Misc Fire and Smoke Dampers	0.791	$ 20,000	Yes	Significantly	Yes	Extreme
A5	Mechanicals: Misc Environmental Controls	0.418	$ 5,500	No	Moderate	Yes	Significantly
A6	Mechanicals: Misc Replace HVAC Controls	0.387	$109,000	No	Moderate	Yes	Moderately
A7	Mechanicals: FARO Fresh Air Exchanger Only	0.718	$400,000	Yes	Significantly	Yes	Significantly
A8	Mechanicals: FARO Rough for Future AC	0.073	$500,000	No	Some	No	Significantly
A9	Mechanicals: FARO Energy Recovery Units	0.49	$600,000	No	Moderate	Yes	Extreme
A10	Mechanicals: FARO Complete Air Conditioning	0.431	$675,000	No	Extreme	No	Extreme
A11	Mechanicals: EU Electric Service Upgrade	0.657	$ 90,000	Yes	Moderate	Yes	Significantly
A12	Mechanicals: EU 16 Panel Replacement	0.657	$ 96,000	Yes	Moderate	Yes	Significantly
A13	Mechanicals: EU Emergency Lighting	0.657	$ 10,000	Yes	Moderate	Yes	Significantly
A14	Mechanicals: EU Intercom and Clock Replacement	0.479	$ 45,000	No	Significantly	Yes	Significantly
A15	Mechanicals: EU GFCI Outlets	0.627	$ 2,000	Yes	Moderate	Yes	Moderately
A16	Mechanicals: EU Exit Signs	0.718	$ 7,500	Yes	Significantly	Yes	Significantly
A17	Mechanicals: EU Air Handling Smoke Detectors	0.791	$ 10,000	Yes	Significantly	Yes	Extreme
A18	Mechanicals: EU Theatrical Lighting	0.149	$ 11,000	No	Significantly	No	Significantly
A19	Mechanicals: Related Mechanical Construction	0.354	$115,544	No	Some	Yes	Slightly
A20	Mechanicals: Construction Dumpsters	0.342	$ 35,000	No	Slightly	Yes	Slightly
A21	Cosmetic Upgrades: Office Renovations	0.688	$120,569	No	Extreme	Yes	Significantly
A22	Cosmetic Upgrades: Paint	0.316	$ 56,250	No	Extreme	No	Somewhat
A23	Cosmetic Upgrades: Visual Display	0.328	$ 31,944	No	Extreme	No	Moderately
A24	Cosmetic Upgrades: Lockers	0.328	$104,834	No	Extreme	No	Moderately
A25	Essentials: Doors And Hardware	0.73	$126,880	Yes	Moderate	Yes	Extreme
A26	Essentials: Bathroom Renovations	0.73	$ 56,434	Yes	Moderate	Yes	Extreme
A27	Essentials: Stairs	0.627	$ 42,785	Yes	Moderate	Yes	Moderately
A28	Essentials: Abatement	0.73	$124,946	Yes	Moderate	Yes	Extreme
A29	Essentials: Casework	0.627	$ 91,416	Yes	Moderate	Yes	Moderately
A30	Essentials: Exterior Egress	0.657	$ 33,000	Yes	Moderate	Yes	Significantly
A31	Essentials: Conveying System	0.058	$ 24,000	No	Moderate	No	Moderately
A32	Essentials: Windows	0.418	$200,000	No	Moderate	Yes	Significantly

Maximizing the Benefits within the give budget

With the NO value set to zero, we achieve a benefit of 82.62%, and when setting a best case scenario, and checking groups 87.93% of the best case possible.



With the given budget and constraints entered in, we then maximized the benefits without exceeding the budget. The results are seen below.

AID	Alternative	Funded	Benefit	Cost	Partial	Must	Must Not
A1	Mechanicals: Fire Protection	YES	.791	255,000	☐	☑	☐
A2	Mechanicals: Misc Replace Kitchen Hood	YES	.627	30,000	☐	☐	☐
A3	Mechanicals: Misc Steam Trap Program	NO	.058	12,000	☐	☐	☐
A4	Mechanicals: Misc Fire and Smoke Dampers	YES	.791	20,000	☐	☑	☐
A5	Mechanicals: Misc Environmental Controls	YES	.418	5,500	☐	☑	☐
A6	Mechanicals: Misc Replace HVAC Controls	YES	.387	109,000	☐	☑	☐
A7	Mechanicals: FARO Fresh Air Exchanger Only	YES	.718	400,000	☐	☐	☐
A8	Mechanicals: FARO Rough for Future AC	NO	.073	500,000	☐	☐	☐
A9	Mechanicals: FARO Energy Recovery Units	NO	.490	600,000	☐	☐	☐
A10	Mechanicals: FARO Complete Air Conditioning	NO	.431	675,000	☐	☐	☐
A11	Mechanicals: EU Electric Service Upgrade	YES	.657	90,000	☐	☑	☐
A12	Mechanicals: EU 16 Panel Replacement	YES	.657	96,000	☐	☑	☐
A13	Mechanicals: EU Emergency Lighting	YES	.657	10,000	☐	☑	☐
A14	Mechanicals: EU Intercom and Clock Replacement	YES	.479	45,000	☐	☐	☐
A15	Mechanicals: EU GFCI Outlets	YES	.627	2,000	☐	☑	☐
A16	Mechanicals: EU Exit Signs	YES	.718	7,500	☐	☑	☐
A17	Mechanicals: EU Air Handling Smoke Detectors	YES	.791	10,000	☐	☑	☐
A18	Mechanicals: EU Theatrical Lighting	YES	.149	11,000	☐	☐	☐
A19	Mechanicals: Related Mechanical Construction	YES	.354	115,544	☐	☑	☐
A20	Mechanicals: Construction Dumpsters	YES	.342	35,000	☐	☐	☐
A21	Cosmetic Upgrades: Office Renovations	NO	.688	120,569	☐	☐	☐
A22	Cosmetic Upgrades: Paint	NO	.316	56,250	☐	☐	☐
A23	Cosmetic Upgrades: Visual Display	YES	.328	31,944	☐	☐	☐
A24	Cosmetic Upgrades: Lockers	NO	.328	104,834	☐	☐	☐
A25	Essentials: Doors And Hardware	YES	.730	126,880	☐	☑	☐
A26	Essentials: Bathroom Renovations	YES	.730	56,434	☐	☑	☐
A27	Essentials: Stairs	YES	.627	42,785	☐	☑	☐
A28	Essentials: Abatement	YES	.730	124,946	☐	☑	☐
A29	Essentials: Casework	YES	.627	91,416	☐	☐	☐
A30	Essentials: Exterior Egress	YES	.657	33,000	☐	☑	☐
A31	Essentials: Conveying System	NO	.058	24,000	☐	☐	☐
A32	Essentials: Windows	NO	.418	200,000	☐	☐	☐

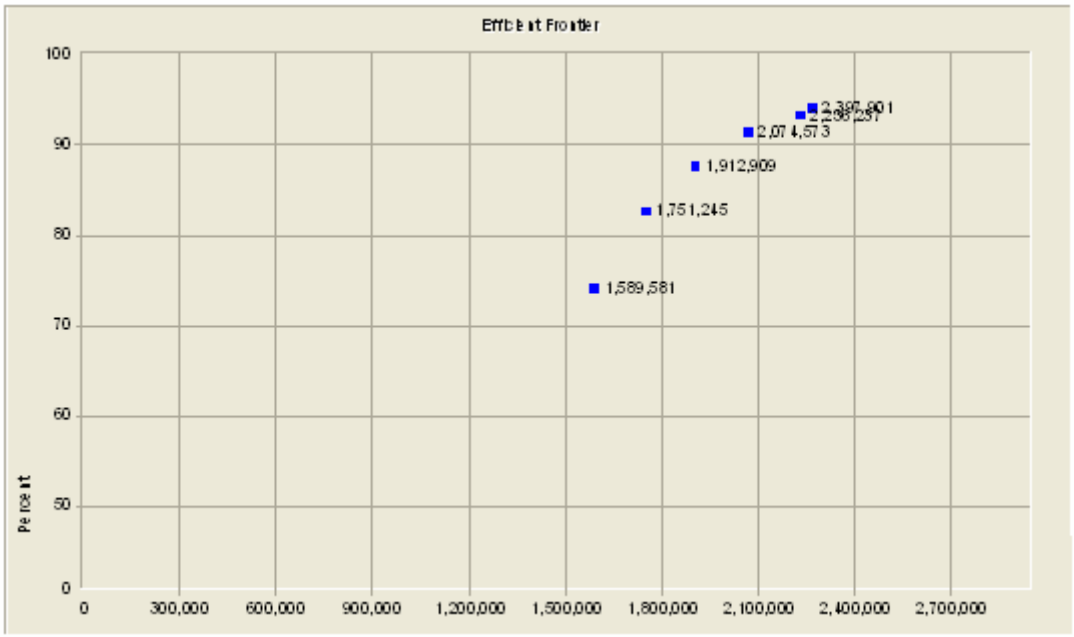
Efficient Frontier

After a second iteration the level of benefit has been affected. A benefit of 82.62%, and when setting a best case scenario, and checking groups 87.93% of the best case possible. If additional funding is available and or funding was cut, how could the benefit be increased or decreased?

If the budget was cut $161,664 dollars we see the optimized benefit reduced to 74.2%, a drop of 8.4 %. Whereas increasing the budget by the same respective amount increases the optimized benefit to 87.5% an increase of benefit of only 4.9%. With an additional $323,328 the benefit could be optimized to 91.4%, an increase of 8.8%. After the 90% optimized threshold the utility curve levels out signifying a decrease dollar spent per benefit returned percentage.

Increasing Budgets -- Funded by Alternative

Budget	1,589,581	1,751,245	1,912,909	2,074,573	2,236,237	2,397,901
Benefit %	74.2%	82.6%	87.5%	91.4%	93.3%	94.%



At the current funding level the following alternatives are recommended for funding.

• GFCI Outlets • Environmental Controls • Exit Signs • Emergency Lighting • Air Handling Smoke Detectors • Fire and Smoke Dampers • FARO Fresh Air Exchanger Only	• Exterior Egress • Stairs • Bathroom Renovations • Electric Service Upgrade • 16 Panel Replacement • Replace HVAC Controls • Related Mechanical Construction	• Abatement • Doors And Hardware • Fire Protection • Theatrical Lighting • Replace Kitchen Hood • Visual Display • Construction Dumpsters • Casework • Intercom and Clock Replacement

With the given budget of $1,750,000 and the constraints, the above alternatives optimized, we achieve a benefit of 82.62%, and when setting a best case scenario, and checking groups 87.93% of the best case possible.

The identical selection of alternatives has been arrived at after the second iteration. The recommended items to include in the renovation project will be presented by the Facilities Management Unit to the Town's Board of Directors and Board of Education

along with an explanation of the Expert Choice Methodology that was used to arrive at the recommendation.

Once each of the boards gives their approval, the Facilities Management Unit, together with the Construction Manager will prepare construction plans and documents for the work and then proceed to solicit contractors to perform the construction activities. After bids are received for the work, the Facilities Management Unit will know exactly how much the different items will cost, where during the planning process the cost of these items was estimated. At that point the dollar amounts can be re-entered into the software to see what effect the change will have on the model. There may be need to add or remove items to the project depending on how the actual costs vary from the estimated costs.