The George Washington University Hospital

Capital Investment for 2006

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Abstract

The George Washington University is currently exploring improvement options for the year 2006. The budget has been set at $2 million for these expenditures. The Executive Administration Team has identified and agreed upon a list of eleven budget items that will be further explored. Six major objectives are identified that are monumental in deciding how to allocate resources for this fiscal year. The budget allocation will be made with the assistance of the Expert Choice decision software.

Introduction

In 2002, The George Washington University Hospital (GWUH) opened one of the most advanced hospitals in the country. The new hospital has millions of dollars of the "state of the art" medical equipment and superb patient accommodations. The Hospital is a part of an academic medical center of GWUH and it serves as a training site for many healthcare professionals.

As in most organizations, departments within the hospital have specific needs and desires. The challenge of allocating resources within the hospital requires insight and direction from a multitude of sources, all with different objectives and view points. This information must be combined and processed to deliver results that will be in the best interest of the hospital, the employees, and ultimately the public.

The Executive Administration Team of the hospital is composed of the Chief Executive Officer, the Chief Operations Officer, the Chief Financial Officer and their direct subordinates. One of the authors is currently employed as a "Hospital Operation Supervisor" for the GWUH administration. The role of the Hospital Operation Supervisor (HOS) is to monitor and manage the daily operations of the hospital and make a formal report on operations to the COO at the end of each shift. Therefore, he will not be directly involved in the allocation of resources, however, much of information that the Executive Team uses to make their decisions is filtered through the HOS. Also, since the HOS is the "eyes and ears" of the executive team, their viewpoints have salience.

Goal

The goal of this process is to allocate a budget of $2 million in a way that will maximize the highest level of utility for the hospital. This will be applied for the 2006 budget cycle.

Objectives

Improve Quality of Care

As a hospital, one of the core goals is to provide its customers with the highest possible level of care. This is a complicated objective because there are many variables that are involved in producing care. Also, there are varying opinions about the optimal level of care that should be provided. The components that are involved in caring for customers range from the type of staff the hospital employs to the type of equipment that the hospital maintains.

Patient Satisfaction

The hospital's customers are comprised of external and internal customers. The external customers are the patients that are treated at the hospital. It is obviously in the hospital's best interest to not only provide customers with the highest level of care, but to also provide customer satisfaction. A trip to the hospital is very rarely a desired event; however, the hospital should work tirelessly to produce an environment that is as pleasant and accommodating as possible.

Broaden Services Offered

The GWUH is continually evaluating new services and technology that come onto the market. It is obviously in the hospital's best interest to provide the most current resources available that will enable the hospital to treat patients with rare or difficult cases. This is one of the main ways in which hospitals distinguish themselves among their competitors. The desired goal is that with the right services and technology offered patients from around the country and around the world will come to GWUH for

treatment. But this is only achieved if the hospital can differentiate itself from other hospitals.

Attract Top Tier Staff

The internal customers consist of the personnel that the hospital employs, including doctors, physician's assistants, nurses, radiologists and other healthcare providers. As mentioned earlier, one of the goals of the hospital is to attract patients with a wide range of diagnoses. The primary reason that patients will seek out a particular hospital is because of the reputation of physician's who make up the medical staff. Therefore, attracting doctor's with experience in particular groundbreaking fields, doctor's with high rates of success with difficult procedures, and doctor's who have experience with new medical technologies are highly sought after. If GWUH is successful in attracting these types of doctors, the patients will follow, hopefully increasing the profit margin for the hospital.

Alternatives

Eleven choices have been made as possible alternatives in relation to the goal of determining capital improvements for the GWU Hospitals. These alternatives are listed in Figure 1.

Bar code technology
Cardiac monitors
Upgrade information system – 100%
Expand the Operating Room
Buy a SPECT Scanner
Off-site outpatient surgery
Buy a Da Vinci robot
Improve nurse-patient ratios
Physician recruitment campaign
Expand dietary offerings
Upgrade information system – 60%

Figure 1

Bar code technology

The first alternative listed in Figure 1 is a possible investment in bar code technology. This is a new technology that has been used successfully to decrease medication errors in the hospital setting. To accomplish this, all patients are given a UPC code on their identification bracelet upon being admitted to the hospital. The bracelet is checked by two licensed personnel and the patient or patient representative.

This UPC code then must be scanned before any sort of medication is given. The scanner relays a message to the pharmacy database. The pharmacy computer identifies whether this medication is indicated for this patient or not. If the medicine is indicated, the system will allow the healthcare professional to access the drug in the dispenser. If the drug is not indicated, the drug will not be dispensed and the healthcare provider must reconcile the problem with the pharmacist on duty.

Cardiac monitors

The next alternative listed in Figure 1 is to upgrade the cardiac monitoring. Traditionally, patients who have cardiac monitoring in place are monitored in the department where they are located. The nurses take turns watching the monitors and when emergencies arise, the monitors are often unmonitored.

To upgrade this system, a central monitoring station will be set up to watch these patients. The advantages will be the continuity of service provided by a licensed monitor technician who monitors these patients at all times. Whenever there is a change in the heart rhythm, the monitor technician will contact the nurse or physician caring for the patient.

Upgrade information system (100%)

Another alternative listed in Figure 1 is to make 100% upgrades in information systems. Currently, there are five separate information systems that hold different data for each patient. These five systems contain separately are radiology, laboratory, current history, past history and physician transcriptions. This upgrade would integrate

all of these separate systems and allow healthcare providers to access this data at any computer in the hospital.

Upgrade information system (60%)

The alternative to upgrade the information systems by 60% is also listed in Figure 1. This alternative would combine the laboratory, radiology and current stay information into a single database. This database could be accessed at all computer terminals in the hospital.

Expand the Operating Room

The alternative to expand the operating department is also listed in Figure 1. This would increase the current level of operating (OR) rooms from 18 to 22. There is currently a two week wait for time in the OR for elective surgeries. This increase could decrease this to less than one week.

Off-site patient outpatient surgery center

To combat this lack of OR time, another alternative has been put forth. This alternative is to build an off-site outpatient surgery center (see Figure 2). This would relieve the burden of the extra surgeries and allow staff members to specialize in a less acute or more acute setting. This setting would be “upscale” and cater to the profitable elective surgeries.

The two alternatives of increasing the operating department or building an outpatient surgery center are mutually exclusive events. That is to say, if one alternative is chosen, the other would not be used.

SPECT Scanner

Another option for capital improvements at the GWU Hospital is to purchase a single proton emission computed tomography (SPECT) scanner (See Figure 1). This device is the most advanced piece of radiology equipment currently available on the

market. It has advanced diagnostic capabilities that allow physicians to better diagnose and treat patients in many cases.

Da Vinci robot

The option of buying a Da Vinci robot is another alternative for capital improvements for GWU Hospital (See Figure 1). The GWU Hospital currently has one Da Vinci robot. But, the demand from the surgeons is so great that they all can not be accommodated. A Da Vinci robot is the most advanced surgery tool available on the market. This robot is used by the surgeon to do minimally invasive surgeries that were previously done with large, open incisions. This reduces the risk and the recovery time for patients after surgery.

Improve nurse-patient ratios

Another option for capital improvements at the GWU Hospital is to improve nurse-patient ratios. These ratios are different in different departments in the hospital based on patient acuity. By increasing the amount of nurses present, more attention can be given to the patients.

Physician recruitment campaign

A physician recruiting campaign is another alternative for the GWU Hospital (See Figure 1). Physicians with specialties that GWU Hospital has the resources to accommodate will be targeted. This “target” may at different levels based on what other alternatives that are chosen. By bringing more physicians to the GWU Hospital, we will be able to handle the increased volume we are expecting in 2006.

Improve dietary offerings

The last option for capital improvements listed in Figure 1 for the GWU Hospital is to improve dietary offerings. This increase would be for patients that are staying in the hospital. Currently, the GWU Hospital has a choice of two or three entrees per meal. This upgrade would allow the patient to personalize their choices, within a list of

their dietary constraints. An extra dietician and two extra kitchen staff would be hired to help with this new program.

Methodology

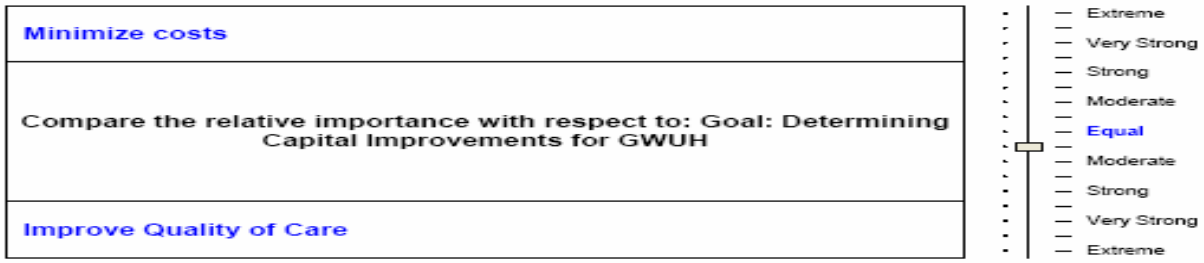
Dr. Thomas Saaty developed the Analytic Hierarchy Process (AHP) in the mid 1980s as a model for achieving multi-criteria decision making. AHP is designed to help the decision maker set priorities and reduce the complexity of the decision into smaller parts by using a hierarchy approach. The complexity is reduced from goal to objective, then to sub-objective while applying alternatives towards the objectives and sub-objectives. In addition, AHP gives the user the ability to derive priorities by combining both tangible and intangible information. For resource allocation decisions, AHP, along with the Expert Choice software, is helpful because it can identify and prioritize competing objectives. The EC software is capable of optimizing the greatest benefit to cost scenario for the decision.

The first step in using the Expert Choice software is to develop a hierarchy by constructing a problem into three major components. These three components of the problem are goal, objectives and alternatives.

To best understand which objectives best support the goal, each objective and sub-objective were evaluated using pair-wise comparisons. Pair-wise comparison is performed by evaluating each objective against another objective to derive its relative priority. This process is continued until each objective has been evaluated to each other objective then each sub-objective is evaluated against each other sub-objective until every pair of has been evaluated. In turn, the sub-objectives are evaluated as to how they contribute to their respective objectives (again using pairwise comparisons). Finally, alternatives are assessed using intensity ratings to determine how much they contribute to their lowest, respective sub-objective. Pairwise comparisons were not used for assessment of the alternatives because of the rather large number of individual pair comparisons required to perform this operation—a rating scale was used instead and this scale was also developed using pairwise comparisons.

Decision Hierarchy

The first pairwise comparisons are made between the goal and the objectives and their respective sub-objectives. This is done by making verbal comparisons. These verbal comparisons are made between each objective relative to the overall goal. As seen in Figure 2 improving quality of care is slightly more salient than minimize costs relative to the goal.



	Minimize co	Maximize re	Improve Qu	Patient Sati	Broaden Se	Attract Top	Depreciatio
Minimize cost		(2.0)	(2.0)	(3.0)	1.0	(2.0)	2.0
Maximize retu			3.0	2.0	5.0	4.0	4.0
Improve Quali				(2.0)	3.0	2.0	2.0
Patient Satisf					4.0	4.0	2.0
Broaden Serv						(2.0)	(2.0)
Attract Top Ti							(2.0)
Depreciation	Incon: 0.05						

Figure 2

Once all pairwise comparisons between the objectives, their sub-objectives, and the goal are made by the decision makers, numerical priorities are derived by the Expert Choice software. As seen in Figure 3, the number next to each objective and sub-objective is the derived priority relative to the goal. Maximize returns has the highest priority with 0.315.

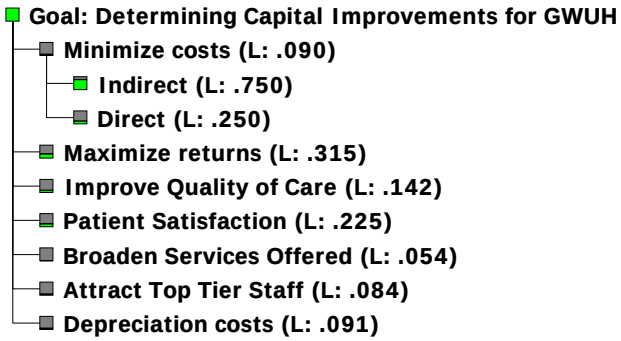


Figure 3

Once the priorities are derived for the objectives and sub-objectives relative to the goal, the priorities of the objectives relative to the alternatives will be made. Since there is a large amount of pairwise comparisons to be made, a simple verbal scale is constructed. This is done by developing a series of five verbal comparisons and then making verbal pairwise comparisons to each other. This gives a derived priority for each that can be seen in Figure 4.

Significant	1.000
Considerably	.676
Somewhat	.416
Tad	.182
None	.000

Figure 4

These verbal comparisons listed in Figure 4 are then used to make pairwise comparisons between the alternatives and objectives. This can be seen in Figure 5.

	Ideal mode	RATINGS	RATINGS	RATINGS	RATINGS	RATINGS
AID	Alternative	Minimize costs Indirect (L: .760)	Minimize costs Direct (L: .260)	Maximize returns (L: .316)	Improve Quality of Care (L: .142)	Patient Satisfaction (L: .225)
A4	Bar Code Technology	significant	somewhat	significant	considerably	tad
A5	Cardiac Monitors	somewhat	considerably	tad	somewhat	tad
A8	Upgrade Information System	considerably	tad	somewhat	considerably	considerably
A9	Expand the Operating Room	none	none	considerably	somewhat	tad
A10	Buy a SPECT scanner	somewhat	tad	somewhat	somewhat	tad
A11	Off-site outpatient surgery center	tad	none	somewhat	tad	somewhat
A12	Buy a Da Vinci Robot	tad	tad	somewhat	tad	tad
A13	Improve Nurse-Patient Ratios	considerably	tad	tad	significant	significant
A14	Physician recruiting campaign	tad	considerably	somewhat	tad	tad
A15	Expand Dietary Offerings	none	somewhat	tad	none	somewhat
A16	Upgrade information system 60%		somewhat	tad	somewhat	somewhat

	Ideal mode	RATINGS	RATINGS	RATINGS
AID	Alternative	Broaden Services Offered (L: .064)	Attract Top Tier Staff (L: .084)	Depreciation costs (L: .091)
A4	Bar Code Technology	tad	tad	somewhat
A5	Cardiac Monitors	tad	tad	somewhat
A8	Upgrade Information System	tad	somewhat	considerably
A9	Expand the Operating Room	considerably	considerably	tad
A10	Buy a SPECT scanner	considerably	significant	somewhat
A11	Off-site outpatient surgery center	somewhat	considerably	tad
A12	Buy a Da Vinci Robot	somewhat	somewhat	somewhat
A13	Improve Nurse-Patient Ratios	none	considerably	none
A14	Physician recruiting campaign	somewhat	somewhat	none
A15	Expand Dietary Offerings	none	none	none
A16	Upgrade information system 60%	tad	tad	considerably

Figure 5

After the priorities are derived for the objectives and alternatives, the monetary costs of each alternative are entered into the Resource Aligner portion of the Expert Choice software. For this model, the time period being examined is one year. To accommodate the different pay structures for one time purchases and alternatives that require indefinite payments, we used the "book" life of capital assets as set forth by the IRS. We then used a straight line cost of payments over theses assts life. An example of this is the Da Vinci robot actually costs $4,000,000, but the price $400,000 is reflected in the asset allocation because it has a ten year expected life. These costs take into account the cost of payments per year for length of its "book" life.

Constraints are built in to the model. As seen in Figure 6, expanding the Operating Room or building the outpatient Surgery Center depends on completing a physician recruiting campaign. This is so there will be enough staff to fully utilize the new facilities.

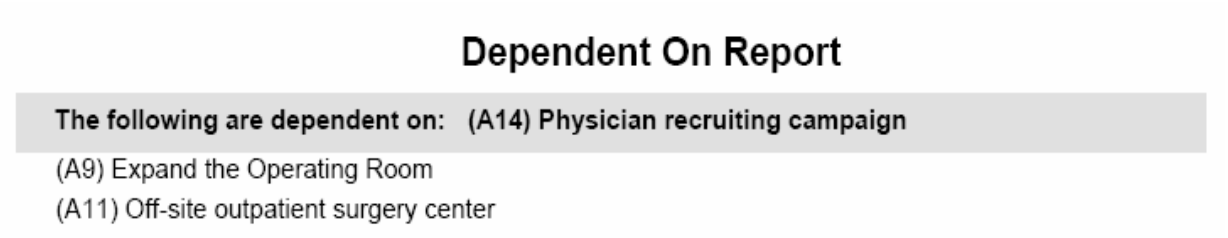


Figure 6

Another constraint built into the model is mutually exclusive events. For example, if the decision to build the Outpatient Surgery Center is decided upon, it would preclude the expansion of the Operating Room. This can be seen in Figure 7.

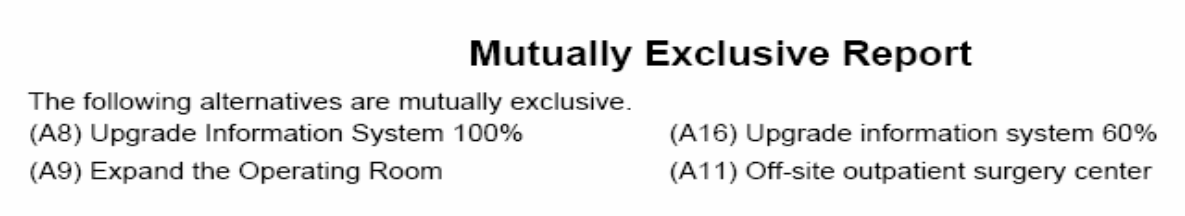


Figure 7

The benefit of each alternative is calculated by the software which represents the relative contribution of each of the alternatives. These are measured on a ratio scale priority. Each alternative contributes towards the objectives. In addition to the costs of each alternative, the risks are also entered for each alternative. The probability of success is calculated from the corresponding risk for each alternative. For example, the level of risk associated with buying a Da Vinci robot is estimated to be 15%, therefore, the probability of success is 85% for this expenditure.

Once the risks are entered into the model, the expected benefit for each alternative changes. The expected benefit is the product of the benefit and the probability of success. The risks and expected benefits for some of the alternatives in this model are shown below in Figure 8.

AID	Alternatives	Benefits	Risks	Probability	Expected
A4	Bar Code Technology	.592	0.05	0.95	.562
A5	Cardiac Monitors	.264	0.05	0.95	.251
A8	Upgrade Information System 100%	.535	0.2	0.8	.428
A9	Expand the Operating Room	.431	0.3	0.7	.302
A10	Buy a SPECT scanner	.421	0.2	0.8	.337
A11	Off-site outpatient surgery center	.361	0.1	0.9	.325
A12	Buy a Da Vinci Robot	.309	0.25	0.75	.232
A13	Improve Nurse-Patient Ratios	.545	0.25	0.75	.409
A14	Physician recruiting campaign	.292	0.3	0.7	.204
A15	Expand Dietary Offerings	.203	0.1	0.9	.183

Figure 8

The budget limit was entered into the model and the software then computed the optimal combination of alternatives. This allocation of resources is the best combination of alternatives that will reach the highest level of benefit but still do not exceed any of the constraints such as the budget amount, the ability or inability to partially fund alternatives, and the dependency of some alternatives on others.

Results

The results of the resource allocation model allow the entire budget of $2 million to be spent. The items which will be funded include:

Bar code technology
Cardiac monitors
SPECT scanner
Off-site outpatient surgery center
Improve nurse-patient ratio (partially funded)
Physician recruitment campaign
Expand dietary offerings
Upgrade information system by 60%

Figure 9 illustrates each alternative, which alternatives are funded, the benefit from those alternatives, and the cost associated with each. At the top of this figure, the budget limit of two million can be seen, as well as the benefit percentage.

Expert Choice Resource Aligner

Budget Limit	Cost		Benefits	/	Base Case Maximum	=	Percent
2,000	2,000		2.253	/	3.538	=	63.67

Defined:	Musts ☐	Must Nots ☐	Custom Constraints ☐	Dependencies ☑	Groups ☑	Funding Pools ☐	Risks ☑

AID	Alternative Name	Funded	Benefit	Cost	Partial	Must	Must Not
A4	Bar Code Technology	YES	.5624	40	☐	☐	☐
A5	Cardiac Monitors	YES	.2508	170	☐	☐	☐
A8	Upgrade Information System 100%	NO	.4280	250	☐	☐	☐
A9	Expand the Operating Room	NO	.3017	100	☑	☐	☐
A10	Buy a SPECT scanner	YES	.3368	500	☐	☐	☐
A11	Off-site outpatient surgery center	YES	.3249	150	☐	☐	☐
A12	Buy a Da Vinci Robot	NO	.2318	400	☐	☐	☐
A13	Improve Nurse-Patient Ratios	.208	.4088	2,000	☑	☐	☐
A14	Physician recruiting campaign	YES	.2044	100	☑	☐	☐
A15	Expand Dietary Offerings	YES	.1827	500	☑	☐	☐
A16	Upgrade information system 60%	YES	.3060	125	☐	☐	☐
				4,335			

Figure 9

Improving the nurse-patient ratio was only funded partially at almost 21%. This explains why the entire budget is able to be utilized. If no projects were partially fundable, the likelihood of exactly $2 million being spent would be very low. The base case maximum is 3.5382, which is the maximum benefit possible if there was no constraint on resources. However, because there is a restraint on resources, the expected benefit of this particular combination of spending is 2.2528. When these two numbers are divided into each other, the percentage of expected benefit is 63.67%.

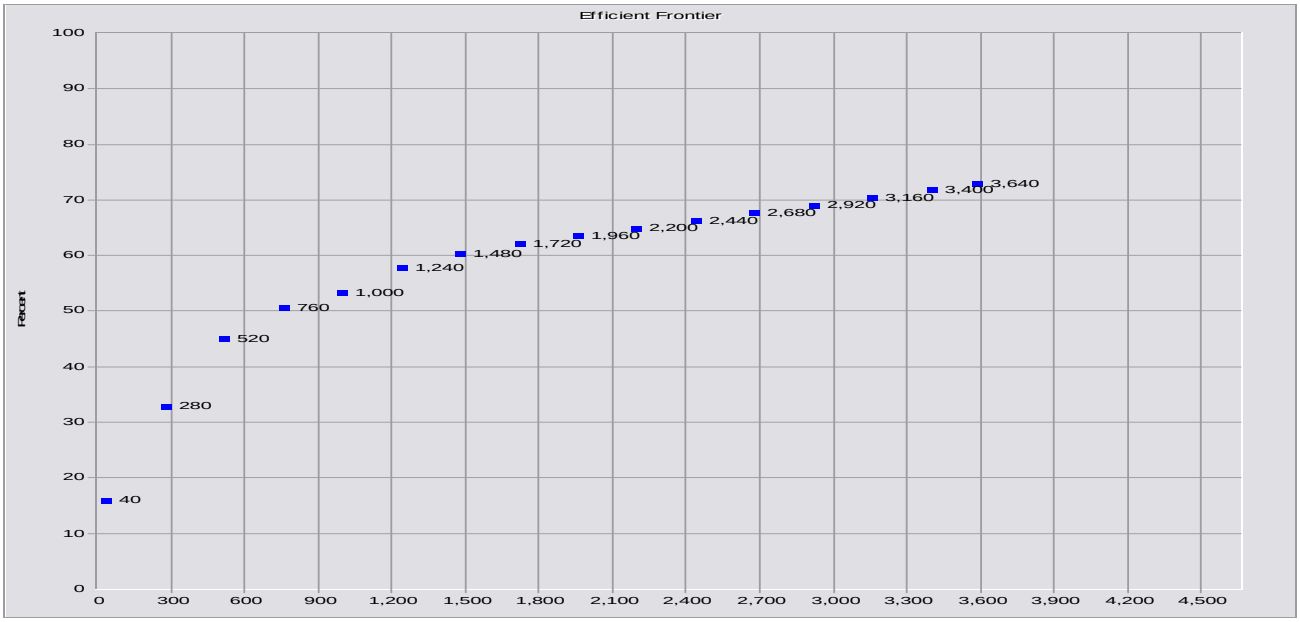


Figure 10

A Pareto Chart, shown in Figure 6, illustrates the benefit percentages that would occur if the budget was increased. The graph shows incremental budget changes, until it reaches the total cost and expected benefit if all the projects were funded. The percent benefit does not increase dramatically. It can be seen that if the budget is increased from $2.2 million to $3.6 million, the percentage of benefit is raised from approximately 65% to 73%.

Conclusion

Based on the comparative analysis that we made, we conclude that funding bar code technology, cardiac monitors, SPECT scanner, outpatient surgery center, physician recruiting campaign, expand dietary offerings and upgrade the information system by 60% are fully funded. Improving nurse-patient ratios are partially funded at 20.8%. This is because these alternatives give us the best tradeoff of priorities for our objectives and our allotted resources. These benefits can be seen on the Pareto graph in Figure 6.

This conclusion leaves the alternatives of a 100% upgrade in the information system, upgrade the Operating Department and the purchase of a Da Vinci robot as not funded.

These results were presented to the decision makers at GWU Hospital on December 2nd, 2004. The general consensus was that the alternatives chosen were in line with their own assumptions. The decision makers were split, however, on whether the Operating Room should be expanded or to build the Outpatient Surgery Center.

On review, these two gave relatively similar expected benefits in the model and we could expect this difference in opinions in cases such as these. We proposed that the evidence of the Expert Choice model could act as the deciding factor in the decision and the Outpatient Surgery Center being built instead of expanding the Operating Room.