# “Determining the Level of Security to provide at The George Washington University Hospital”

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## Abstract

Security has become a top concern for the management of the George Washington University Hospital due to several reasons. These include the threat of terrorist attacks, increased theft within the hospital and the general safety of our internal and external customers. We have identified the goal of providing adequate security for the hospital as a salient problem that we will address. Three alternatives have been selected to achieve this goal. The first is to maintain security measures at current levels. The second alternative is to increase security measures moderately. The last alternative is to dramatically increase security measures. We will use the decision-making software "Expert Choice" to assist us in choosing the best alternative.

## 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.

Recent developments such as direct terrorist threats and an increase in hospital related theft has prompted the George Washington University Hospital (GWUH) to address the level of security that they provide. This problem is multi-faceted and must be addressed at the highest levels of management due to the unique nature of the hospital environment.

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. While this position does not directly make any policy decisions, the HOS's serve as the "eyes and ears" of the executive team.

## Goal

The goal of the GWU Hospital is to determine what would be the best alternative regarding future security measures GWUH. Under normal circumstances, decisions such as these would be made by the chief of security and approved by the Chief Operating Officer. Due to the multi-faceted ramifications associated with this goal, it will be addressed by the executive team at the hospital.

## Objectives

The objectives of GWUH, with respect to the goal stated above, are listed below in the Expert Choice display (Figure 1).

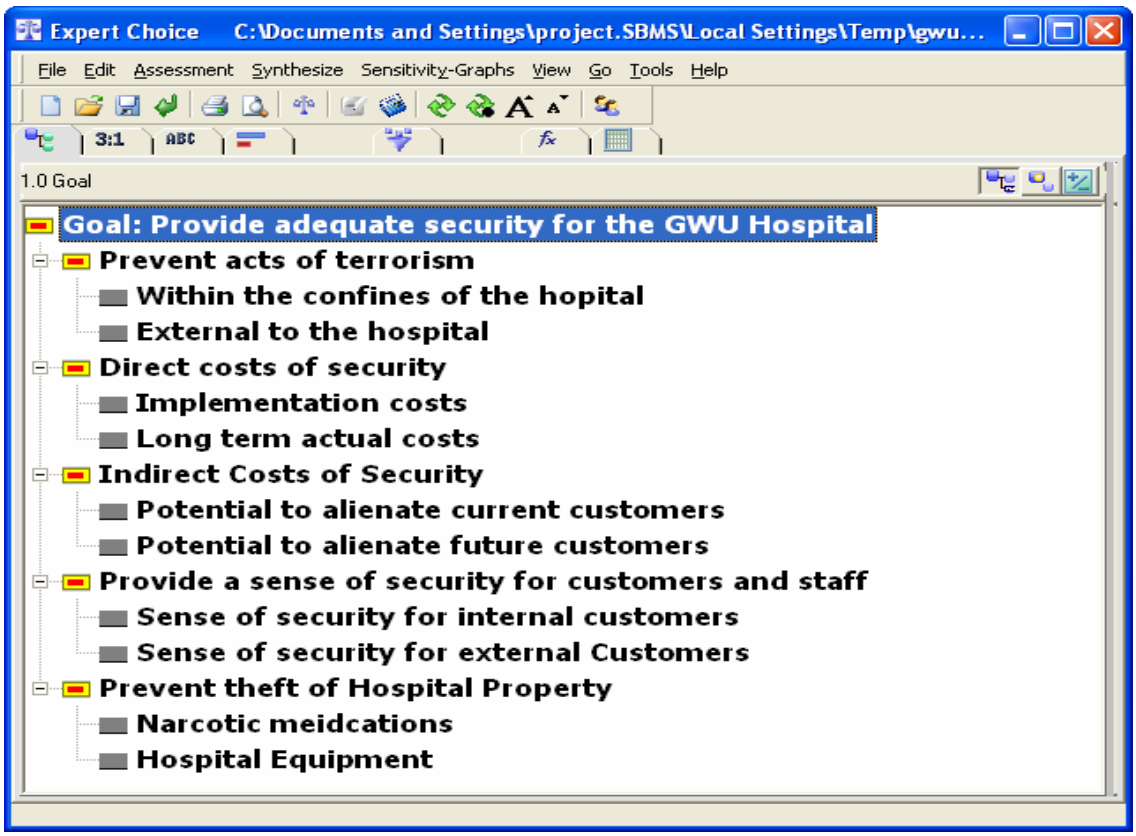


Figure 1 – Expert Choice Decision Hierarchy Tree / Objectives

Prevention of terrorist acts is an objective of the GWUH. We can see this listed as the first objective in Figure 1. The hospital has been contacted by the state department and informed that local DC hospitals are a high priority for terrorists. Also, the hospital has received several suspicious phone calls from unidentified people, who are probing into the Hospital's available resources in the event of a disaster.

The hospital is concerned with preventing terrorist acts both internally and externally to the hospital (See Figure 1). We can see that these are listed as sub-objectives under the objective of prevent terrorist acts in Figure 1. External to the hospital includes the area immediately around the hospital where a terrorist attack could affect the operations of the hospital. An example of this could be a car bomb at the main entrance of the hospital. An internal terrorist attack would be defined at an attack within the confines of the hospital.

A second objective for the GWUH is to contain the costs of the potential security measures (See Figure 1). This is salient due to the razor thin margins that local hospitals are working with. These costs include solely the direct costs of the security measures. This objective includes separate costs of implementation and long-term costs associated with these security measures (See figure 1).

A third objective is to contain the indirect costs of the security system (See Figure 1). A hospital is a service-oriented business where the image of the hospital can greatly affect business there. If security is seen as too stringent or lax, it could adversely affect the relationship between the hospital and the customer.

This "customer" is defined separately as the internal and external customer (See Figure 1). Internal customers include staff members, vendors and

contractors. This also includes physicians who are in partnerships with hospitals. The external customer includes inpatients and outpatients who use the GWUH for health care.

A fourth objective for the GWUH is to provide a sense of security for hospital customers (See Figure 1). This objective is focused on customers having the feeling that they are in a safe environment. This objective also includes the internal and external customers.

A fifth objective for the GWUH is to prevent theft of hospital property (See Figure 1). Theft of controlled medications has recently become more prevalent in DC metropolitan area hospitals. A possible reason for this is a recent cut in pharmaceutical benefits paid by the DC Alliance insurance. The DC Alliance insurance is provided by the DC government for indigent residents.

Prevention of hospital equipment theft has also become an objective of GWUH (See Figure 1). This has become a major issue in recent years due to the booming second-hand hospital equipment industry. This new market has made it easier and more profitable to sell hospital equipment in the open market.

## Alternatives

Three choices have been identified as alternatives for the goal of providing adequate security for GWUH. These are shown in Figure 2 and include a status quo of security measures, a moderate increase in security, and a large increase in security.

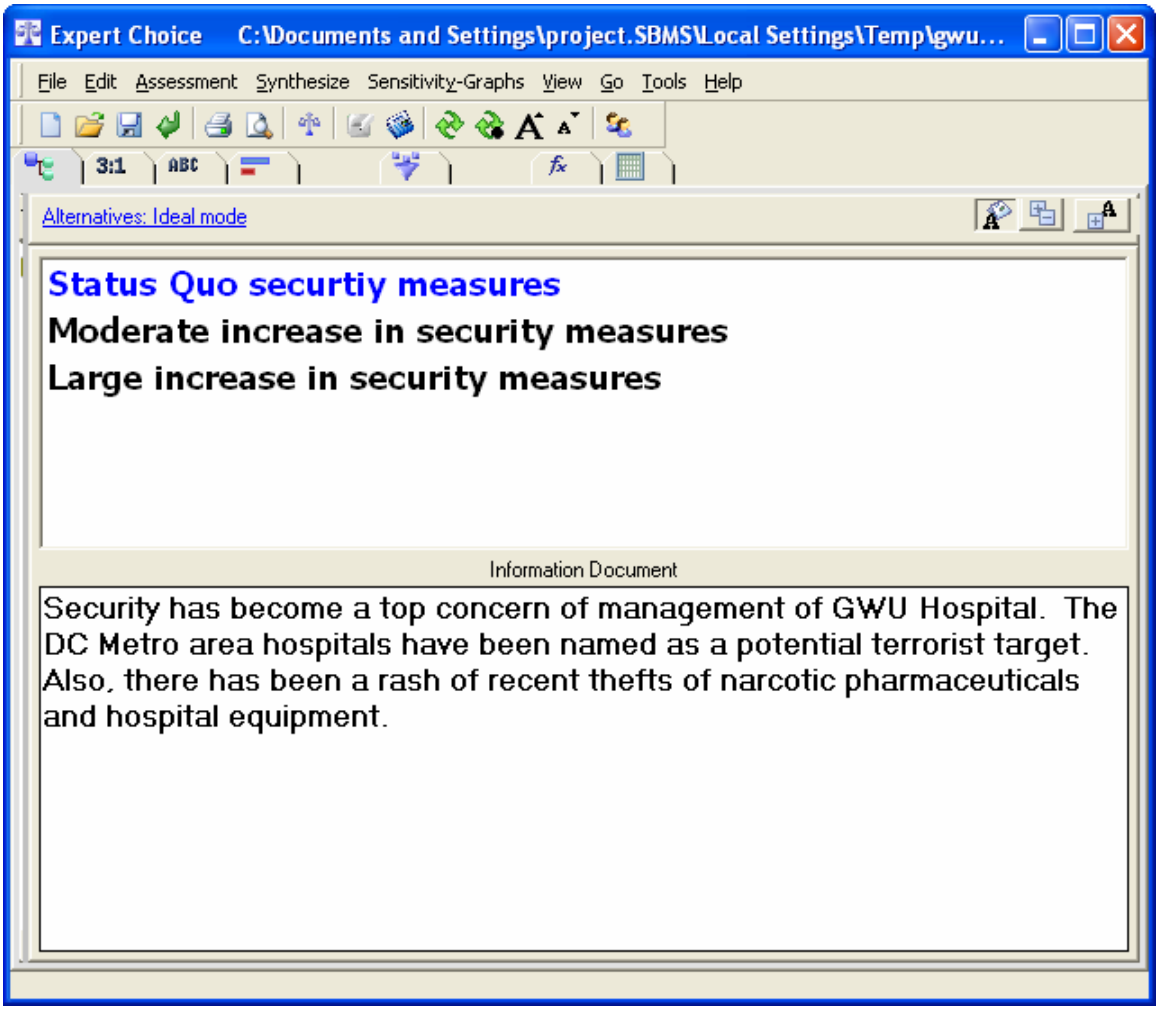


Figure 2 – Expert Choice Decision Hierarchy Tree / Alternatives

The status quo for security includes three security guards being on duty 24-hours a day (See Figure 2). The first security guard monitors the security cameras within the hospital at all times. The second guard monitors the entrances. There are three entrances open during the day and the Emergency Department entrance is the only entrance open during off-hours. One visitor is allowed to spend the night in each non-critical patient's room. Visitors are signed in by a volunteer who are posted by each entrance during normal business hours. These volunteers are not present on off-hours. Hand held metal detectors are used on suspicious individuals only.

For the moderate increase in security measures alternative, there will be an extra security guard for a total of four on duty (See Figure 2). There will only be two open entrances during normal hours. There will be a guard stationed at each, who signs in all visitors into the hospital. No visitors will be allowed to enter the hospital during hospital off hours. Hospital staff will be trained to spot suspicious activity and the appropriate actions to take in the case of this suspicious activity.

For the large increase in security measures all of the moderate increase alternatives will be used in addition to the following (See Figure 2). First, there will be a total of five guards on duty at all times. This extra guard will be used to "round" on the external premises of the hospital at all times. Walk through metal detectors will be placed at both open entrances during the day and the open entrance at night. Every person who is not identified as a hospital employee will need to surrender their identification to gain entrance into the hospital. Visiting hours will end at 8:00 PM and visitors will not be allowed to spend the night in patient rooms.

## Viewpoint of Decision Makers

Before we approach our problem, we will weigh-in on the opinions of the decision-makers in this process. There are three executives who will pick the best alternative and then pass it on for final approval by the CEO. These three executives are the CFO, Director of Patient Care Services and the COO. Short, five minute interviews were conducted with each of these decision makers. We were able to discuss viewpoints, but due to lack of availability of these executives, we were unable to obtain in-depth analysis from them.

The CFO, Rick Davis, was the first decision maker interviewed. His stance was to maintain security measures at the status quo. He believes none of

the security measures will stop a terrorist attempt. He believes the resource cost is too great and business could suffer from stringent security measures.

Quinn Collins, the Director of Patient Care Services, is in favor of a large increase in security measures. She believes that the patients will be the safest with these large increases in security and it will not adversely affect business. She also believes it will almost completely stop theft within the hospital.

Jim Richardson, the Chief Operating Officer, believes there must be a balance of the two extreme views of Mr. Davis and Mrs. Collins. He believes that alternative of a moderate increase in security measures will be the best option. In his view this alternative will meet all of the objectives that have been set forth.

## Methodology

To decompose the problem and chose the best alternative relative to our goal, our team will use the decision making software called Expert Choice. Expert Choice is a multi-objective decision support software tool based on the Analytical Hierarchy Process (AHP). AHP is a mathematical theory developed by Thomas L. Saaty, which uses a comprehensive methodology designed to facilitate decision making process by using empirical data and subjective judgments of decision-maker. AHP also assists the process by providing structure to organize and evaluate the importance of various objectives and the preference of alternative solutions to a 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. We will then use the software make pairwise comparisons to derive priorities. These derived

priorities will accurately reflect perceptions and values of all parties involved in this decision-making process.

There are two approaches that are used to construct the model. They are the “Top-down” and “Bottom-up” approaches. The decision model will be constructed by using the Bottom-Up approach.

The Bottom-up Approach focuses on evaluating each of the alternatives relative to the objective before evaluating the importance of each objective. The pairwise comparisons will begin with the goal and work down to the alternatives.

In contrast to the “Bottom-up” analysis, the “Top-down” Approach focuses on identifying and organizing the objective before evaluating alternatives. Then the pairwise comparisons start with alternatives and work up to the goal.

There are three pairwise comparisons assessment modes that can be used within the Expert Choice software. These assessment modes are verbal, graphical and numerical. Our team will use the graphical assessment mode by adjusting the relative length of two bars to derive the relative importance of pairs of variables.

There are three different types of paired comparisons. These include importance, preference, and likelihood comparisons. Our team will use importance comparison when comparing objectives or criteria and preference comparisons when comparing alternatives with respect to their covering objectives.

Once we develop and build decision model, Expert Choice will be used to synthesize the priorities that were derived for each part of the problem to obtain the overall priorities for the alternatives. This information is synthesized to achieve an overall preference relative to the goal. The process ranks each of the

objectives relative to the goal, as well as each alternative to each objective and sub-objective. After the synthesis of our goal is complete, we will analyze these results and make a recommendation for the best alternative.

## Decision Hierarchy

Below is the Expert Choice decision hierarchy tree that shows the alternatives and the objectives with respect to goal.

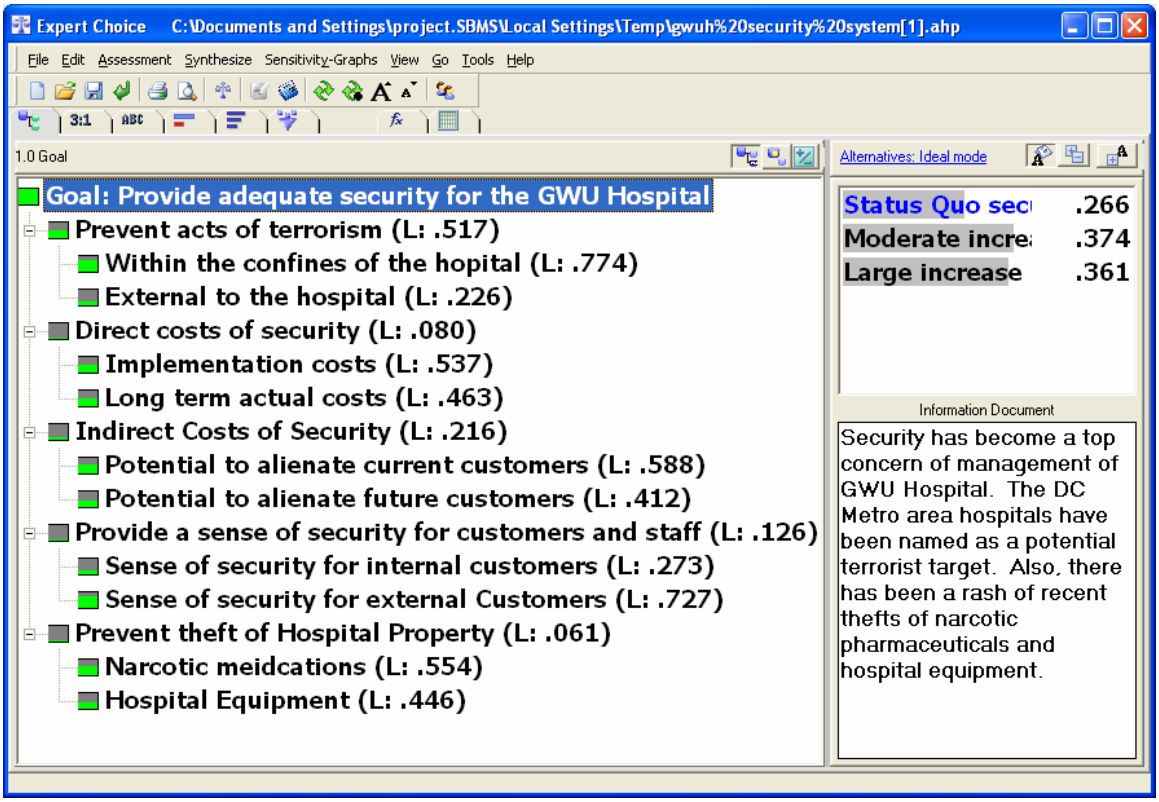


Figure 3 – Expert Choice Decision Hierarchy Tree

The numbers beside the objectives give the relative derived weights of each objective in relation to the goal. The objective of preventing acts of terrorism is the overwhelming priority of the objectives with a derived weight of 0.517 out of a total of 1. Prevention of theft has the lowest derived priority of 0.061.

Under each objective we see the sub-objectives. We see that two sub-objectives have high derived priorities in relation to their respective objectives. The sub-objective of prevent terrorism within the confines of the hospital has a derived weight of 0.774. Also, to provide a sense of security for external customers has a derived weight of 0.727.

The alternatives are listed in the upper right-hand pane of figure 3. Each alternative has derived weight that is in respect to the goal. The derived weights assigned to each alternative will be discussed in the synthesis section.

As mentioned before in the methodology section we have used the Bottom-up Approach. This approach is good because the insights that we gain about the tradeoffs among the alternatives that helps in making judgments about the importance of the objective. First we made judgments about the alternatives with respect to the one of the objective shown in the figure 4.

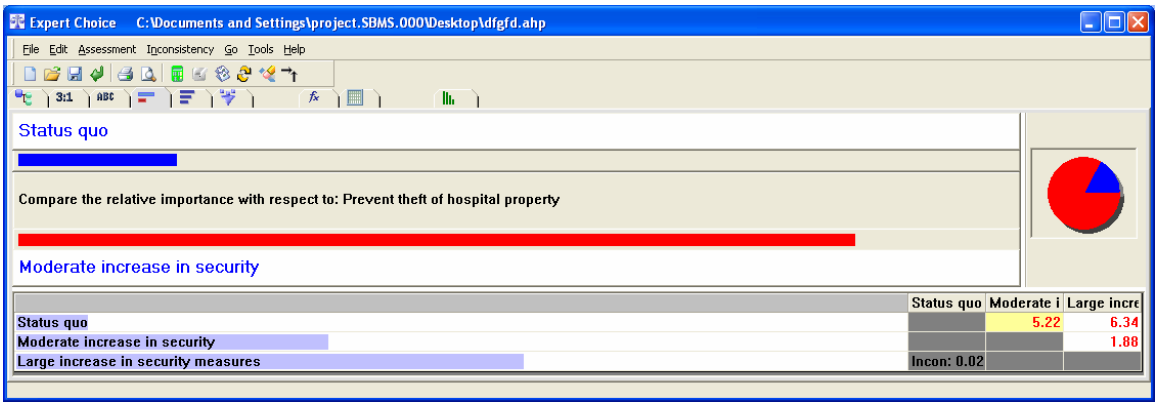


Figure 4 - Graphical Comparison Window

The numbers represented in the boxes gives the relative magnitude of importance between the two comparisons. By dragging the top bar to the right you are saying that the element on bottom, in our model Status quo is more important than the element on the top, which is Moderate increase in security in

proportion to the relative lengths of the bars. If the number is in red, as it is in this case, it indicates that the column element is preferred to the row element.

Next we made judgments about the relative importance of sub-objective made with respect to parent node in the hierarchy. As you can see in the figure 5, we have derived priorities for the objective Prevent act of terrorism with respect to the sub-objectives as shown in the figure 5. Sub-objective Within the confines of the hospital is 3.42 times more important compared to the sub-objective External to the hospital.

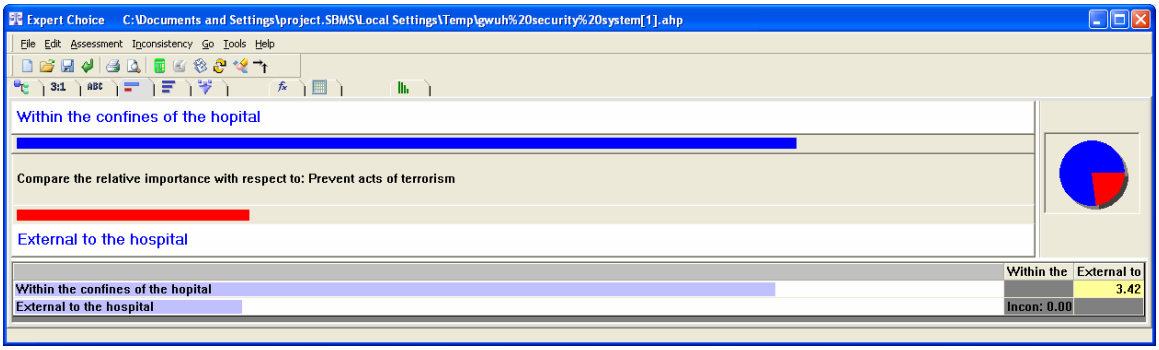


Figure 5 - Graphical Comparison Window

The graphical representation in the top of figure 5 represents the pairwise comparison that is highlighted in yellow. By dragging the top bar to the right you are saying that the element on top, in our model Within the confines of the hospital, is more important than the element on the bottom, which is External to the hospital, in proportion to the relative lengths of the bars. The numerical representation of the graphical judgment is entered into the cell matrix by the software and as mentioned earlier in our model sub-objective Within the confines of the hospital is 3.42 times more important compared to the sub-objective External to the hospital.

Finally we made judgments about the relative importance of objective made with respect to the goal. As you can see in the figure 6, we have derived priorities for the goal Provide adequate security for the GWUH with respect to the

objectives as shown in the figure 6. Objective Prevent act of terrorism is 6.76 times more important compared to the objective Direct cost of security. Here we can also see the example of red number indicating that objective Indirect cost of security column element is preferred to the row element Direct cost in security.

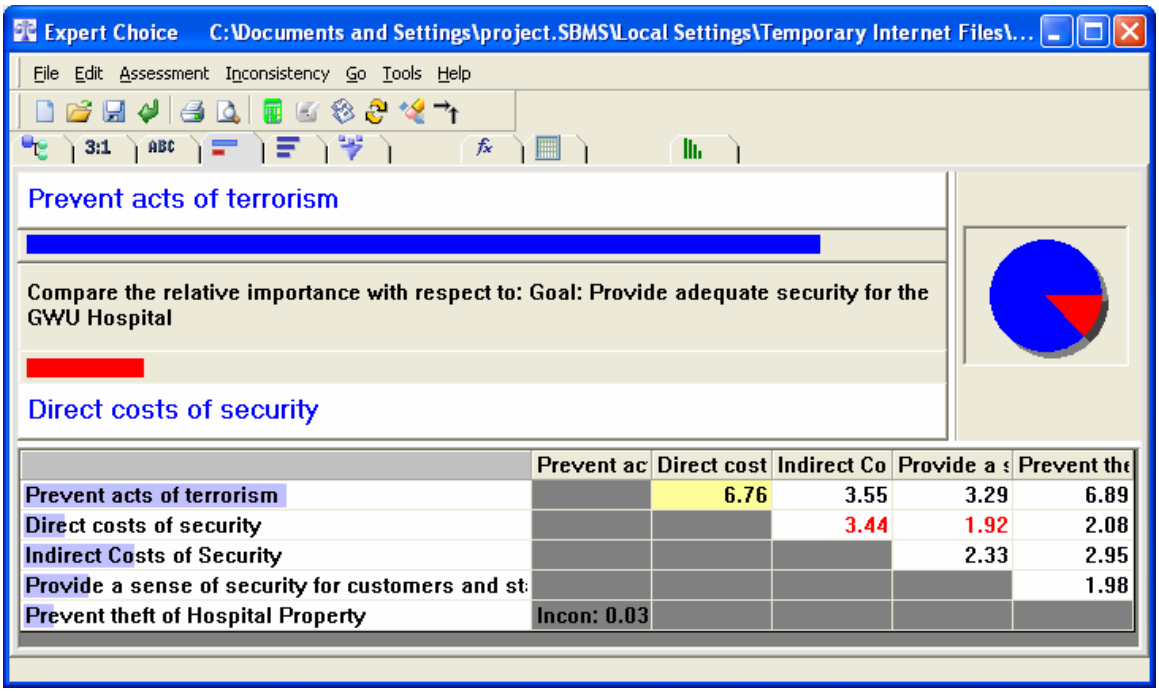


Figure 6 - Graphical Comparison Window

## Synthesis

Once decision model is built, information is synthesized to achieve overall priorities for the alternatives that we have derived. The synthesis, using the ideal mode, assigns the full weight of each covering objective to the alternative for each covering objective. Priorities for the alternatives are derived under each covering objective proportionate to their priority relative to the best alternative under each covering objective. The priorities for all the alternatives are then normalized so they sum to 1.0. From figure 7, we can see that the Moderate

increase in security measures alternative has the highest priority of .374. Large increase in security measures is just behind with value of .361, and Status Quo thereafter with respective value of .266.

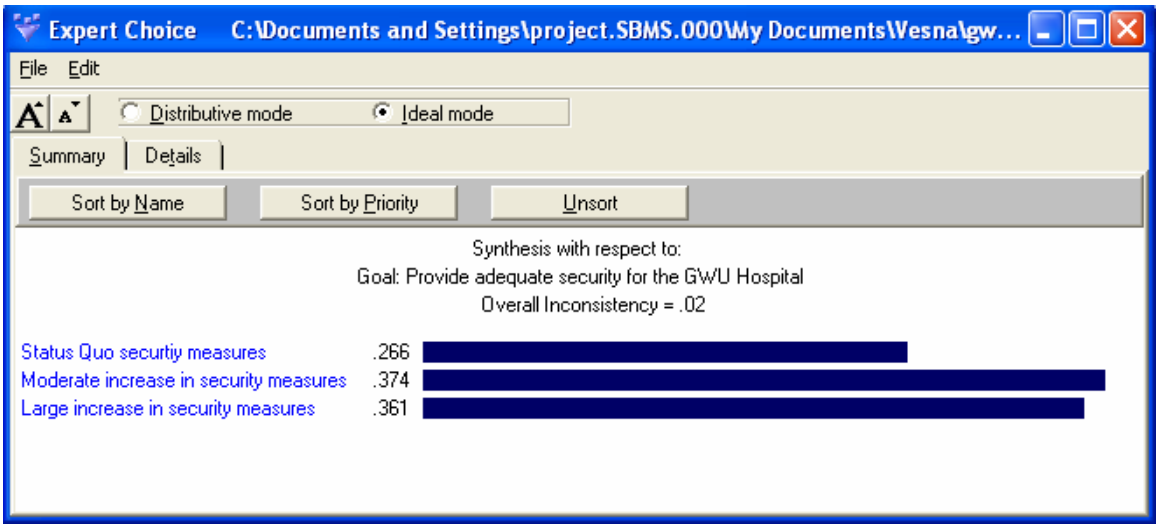


Figure 7 – Expert Choice Synthesis

Another very useful measure that Figure 7 reflects is overall inconsistency for the model equal to .02. The inconsistency measure is useful for identifying possible errors in judgments as well as actual inconsistencies in the judgments themselves. The general rule-of-thumb for a consistent model is for the inconsistency ratio to be less than 0.1.

## Sensitivity Analysis

Sensitivity analyses show the sensitivity of the alternatives with respect to all the objectives below the goal. It can also be performed from the nodes under the goal if the model has more than three levels. This is to show the sensitivity of the alternatives with respect to an objective or sub-objective. In the Expert Choice software there are five types of sensitivity analysis and those are:

1. Dynamic
2. Performance
3. Gradient
4. Head to Head
5. Two-Dimensional (2D Plot)

1. Dynamic Sensitivity analysis is used to dynamically change the priorities of the objectives to determine how these changes affect the priorities of the alternative choices.

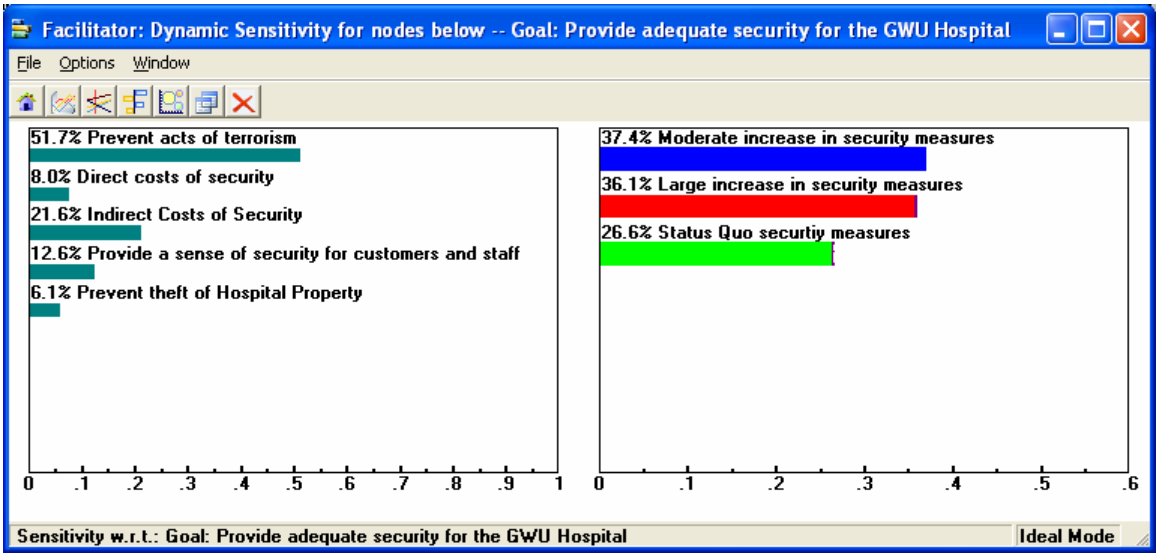


Figure 8 – Dynamic Sensitivity Graph

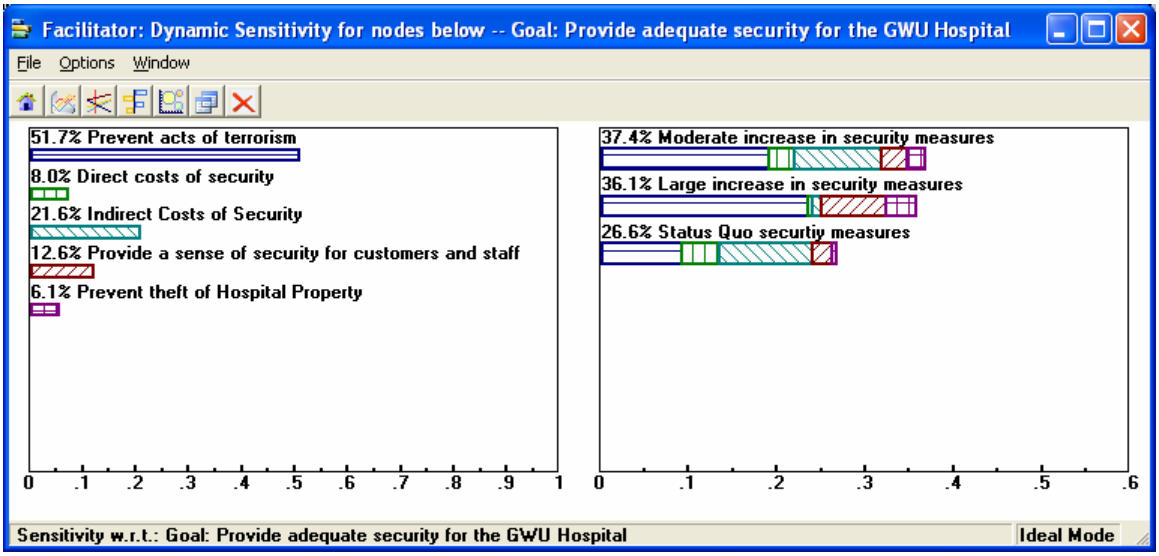


Figure 9 – Dynamic Sensitivity with Component Option Selected

2. Performance Sensitivity shows the relative importance of each of the objectives as bars, and the relative preference for each alternative with respect to each objective as the intersection of the alternatives' curve with the vertical line for each objective.

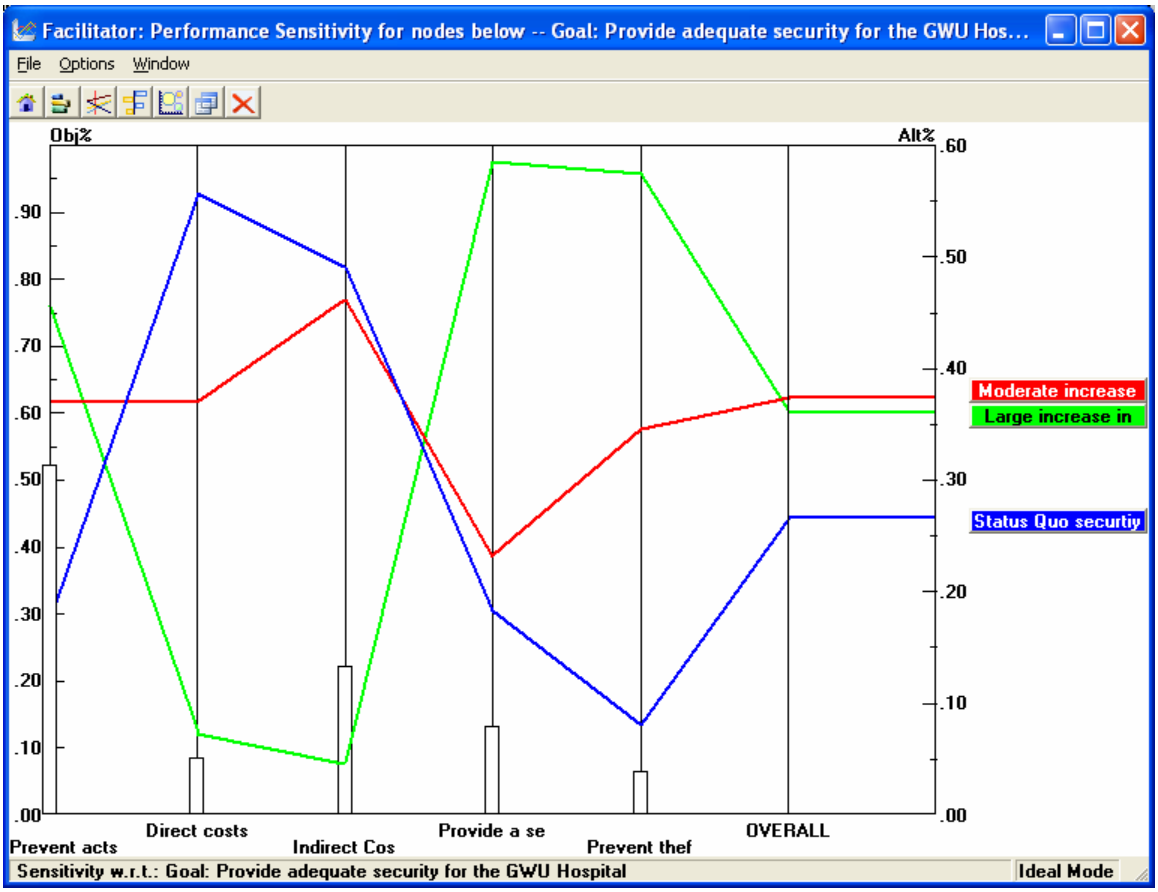


Figure 10 – Performance Sensitivity

The performance sensitivity gives us a "dashboard" view of the alternatives and their derived weight relative to the objectives. As seen in figure 10, we can see that the moderate alternative choice is a slightly better choice than the large increase alternative. We can also see that the moderate increase in security measures has less variability relative to the other two objectives.

By viewing figure 10, we can see that if the objective, provide a sense of security had a higher derived weight in relation to the goal; it would be the best overall alternative. This is due to the large derived weight it has in relation to the goal.

3. Gradient Sensitivity shows the alternatives' priorities with respect to one objective at a time. The gradient graph in figure 11 shows that the large increase in security alternative is the best choice for the highest derived weight objective of preventing terrorist acts. This exhibits the fact, that while this is the best solution for the highest priority objective, it is not always the best overall alternative.

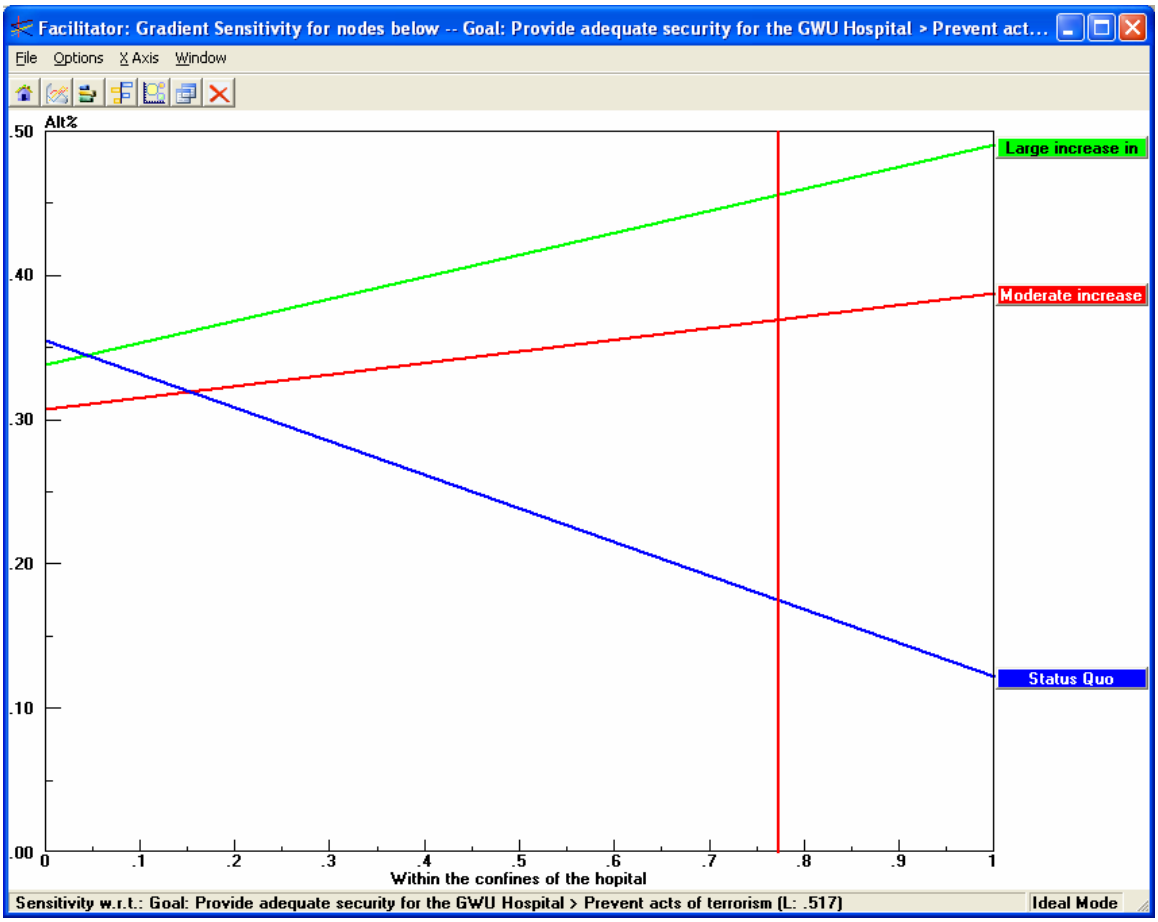


Figure 11 – Gradient Sensitivity Graph

4. Head to Head Sensitivity in figure 12 shows how two alternatives compared to one another against the objectives in a decision model. The

first alternative, a moderate increase in security measures, is listed on the left side of the graph. A second alternative, a large increase in security measures, is listed on the right. The alternative on the left is fixed while the alternative on the right can be varied. Down the middle of the graph the objectives are listed. If the left-hand alternative is preferred to the right-hand alternative with respect to an objective, a horizontal bar is displayed towards the left. In our model, there is shift moderate increase insecurity for direct costs and indirect costs. If the right-hand alternative is better, the horizontal bar will be on the right side. In our model, this is clear for the objectives of prevent the act of terrorism, provide a sense of security for customers and staff, and prevent theft of hospital property. If the two choices are equal, no bar is displayed. The overall result is displayed at the bottom of the graph and shows the overall percentage by which one alternative has a derived weight that is better than the other. This overall percentage is called the composite difference and in our model it is for the Moderate increase in security measures by 1.3%.

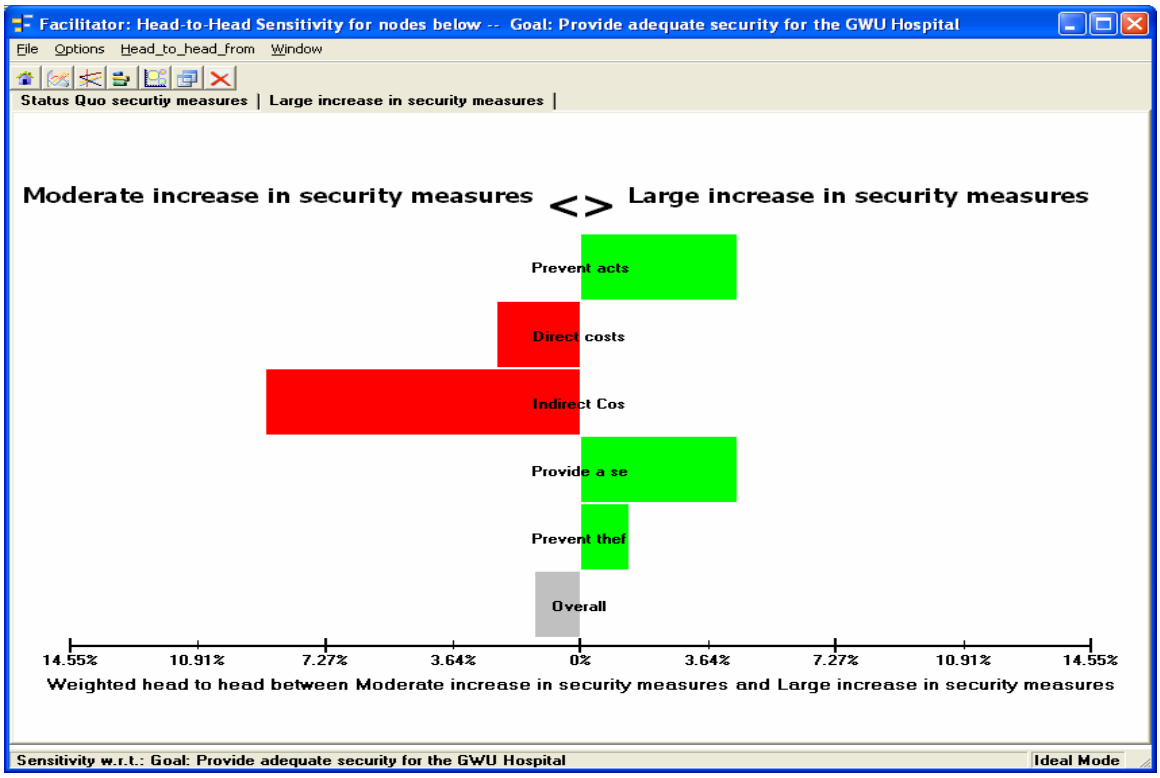


Figure 12 – Head to Head Graph

5. Two-Dimensional sensitivity graph in figure 13 shows the alternatives' priorities with respect to two objectives at a time. The area of the 2D plot is divided into quadrants. The most favorable alternatives with respect to the objectives on the two axes will be shown in the upper right quadrant. The least favorable alternatives will be shown in the lower left quadrant which in our model it is Status Quo. Alternatives located in the upper left and lower right quadrants indicate key tradeoffs where there is conflict between the two selected objectives. We can see that the moderate increase in security alternative represents the best alternative, relative to the two objectives listed.

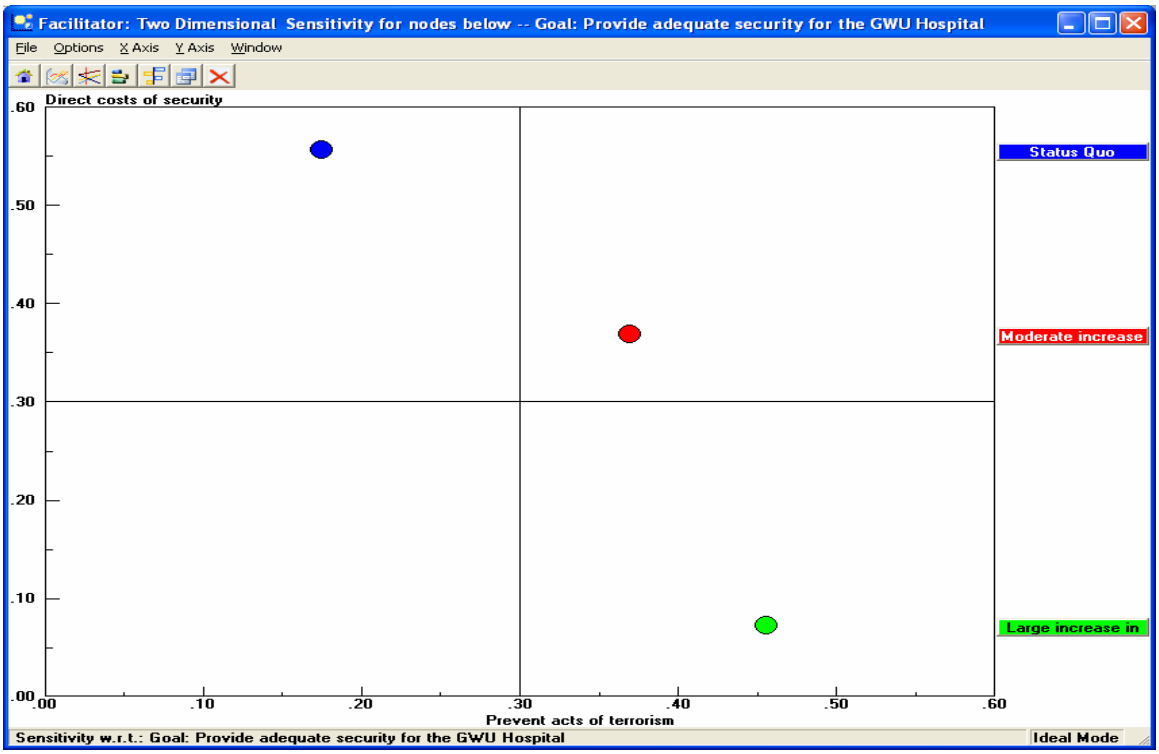


Figure 13 – 2D Graph

## Conclusion

Based on the comparative analysis that we made, we conclude that a moderate increase in security measures is the best alternative for GWUH. This is because this alternative gives us the best tradeoff of priorities for our objectives. This can be seen on the performance sensitivity graph in Figure 6. We see that the moderate increase in security measures does not have the highest priority in any single objective, but does have the highest priority in relation to the goal.

This is not always the intuitive choice. Two of the three decision makers for this goal picked other alternatives than the one chosen. The proposed reason for this is the complexity of this issue. With the assistance of the Expert Choice Software, we were able to model the complex goal, derive our priorities and synthesize the results. This approach gave us a more precise answer than intuition can.

These results were presented to the decision makers at GWUH on November 1st, 2004. The consensus of the decision makers was that they concurred with the results. The alternative of a moderate increase in security measures has since been adopted by GWUH. The security measures are currently being implemented and have a proposed “live” date of December 15th, 2004.