Road Closure at Los Alamos National Laboratory

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Abstract

In February 2001 the prime construction contractor for a new building at the Los Alamos National Laboratory informed the Laboratory's Project Director that there was a significant safety concern regarding the location of the construction site. The contractor's contention was that, because the construction activities would be conducted within a few feet of a major roadway through the Laboratory, and that there is very little room for materials, the road would have to be used as a staging area. This solution would cause significant mixing of large trucks and private automobiles. This could promote a condition that could cause injury to personnel and/or equipment. The contractor strongly urged that the road be closed to through traffic during construction.

The Laboratory's Project Director passed the request to close the road during construction to the Traffic Engineer, with the recommendation that the road be closed. The Laboratory, however, does not have a systematic method for making decisions. Decisions are based upon politics and who will be most inconvenienced.

The Project Director would like to be able to predict the most likely decision the Traffic Engineer would make. This information could allow him to anticipate the decision and be prepared to take other actions, as needed, to ensure the safety of the people and equipment.

After meeting with the principles involved in either providing information or making the decision on the road closure the results were synthesized and put into the Expert Choice software. In this software the various options, objectives, and sub-objectives were evaluated using the weighted comparisons provided by those involved in the decision. The results from the evaluation were reviewed with the people who had provided input and then the weighted comparisons were modified base on this review. The final evaluation revealed that the most likely decision would be to not close the road.

Approximately two weeks after the study was completed the project received a letter from the manager in charge of the site infrastructure stating that the road would not be closed during construction. The reasons given were that the road closure would exasperate an already difficult traffic situation and would therefore cause a greater safety hazard than if the road was left open. This decision was reviewed by the project personnel and then sent on to the prime contractor.

Introduction

The Los Alamos National Laboratory is being refurbished to remove old and unserviceable buildings and replace them with modern facilities. To this end, two new structures are being built in close proximity to one another. They both take up the entire block they are built on. The first building to start construction permanently closed two roads; one road providing east-west access and the other providing north-south access. These closures leave only two other roads, within the Laboratory core, to handle all the traffic within the central part of the Laboratory. The road providing east-west access, sits astride the construction site for the second building and the access to the building site is from this road only.

The construction contractor for the second building (initials H-P) has started to excavate the building site. At the same time, plans are being finalized for the construction of the remainder of

the second building. During this planning activity, it was discovered that the site was not big enough to allow delivery trucks access to the site in order to off load their goods. The trucks will have to park on the roadway and be unloaded using the construction crane. This means that the crane's boom will traverse and carry materials above the road. This off loading operation presents some hazards due to the nature of the work i.e., dropping a load of materials or having an unbalanced load hit something or someone.

H-P informed the Laboratory's Project Director of this situation and recommended that the road adjacent to the site be closed during construction. The Project Director forwarded the request, with his recommendation to close the road, to the Laboratory's Traffic Engineer. Several brainstorming meetings were conducted and possible resolutions presented. It became obvious that this was an emotional issue with the Traffic Engineer and his manager. Information came out in the meetings that the first project closed the two roads against the Traffic Engineer's wishes. It was noted, that during the initial planning for the two projects, the Traffic Engineer's approval was based upon an agreement that no roads would be closed during construction. No decision regarding the road closure was made at these meetings.

After the meetings, the key people involved in the decision process were informally canvassed to obtain their ideas about what factors had to be considered in making the decision. Additionally, some observations were made of the actions of the people at the Laboratory. The purpose of this was to discover their true attitudes regarding their own safety. Finally, some observations were made of the traffic flow patterns at various times of the day, to verify some of the Traffic Engineer's thoughts about the alternatives. These conversations and observations helped in evaluating the relative weights of the parameters under consideration.

Goals

This study intended to examine the decision making process used at the Laboratory, what factors affected the decision, and how the various factors were weighed in order to come to a judgment. Also, it was intended to provide information to the Project Director so that he would be as knowledgeable as possible concerning the possible outcomes. Lastly, it was to determine if using the AHP process might have some relevance to the Laboratory and help in making the decisions more justifiable to our clients.

Background

The situation that precipitated the need for this decision is multi-faceted. The closure of the two roads by the first project had a significant effect upon the Traffic Engineer and his manager. Other factors included the increased traffic on already stressed vehicle arteries, a poorly planned infrastructure system, concerns over how the increased costs would be paid, and the toll on the individuals that would be impacted.

Two projects being built at the same time is not something to consider, if you are familiar with large construction projects. However, if there were little or no exposure to this type of activity, the coordination of services would be a daunting task. The services group at the Laboratory is very familiar with small, short-term projects and responds very well to the inconveniences that these cause. In this scenario, there are two major projects being performed at the same time and

the length of time that the construction activities are performed spans years. This is a new, and somewhat threatening, reality the services group has to adapt to. Changes to accepted norms come with concerns of being lost and unsure of what the future holds. This is not an optimal situation. Careful attention to the concerns of those that are not adept to managing major changes can cause concerns that have long lasting repercussions.

In this scenario, there were two major changes that affected individual peoples lives on a personal level. The first change was that the first project closed two roads that were heavily used. The second change was that the first project closed a centralized parking lot. The closures forced people who had developed certain access and egress patterns over many years to change to a far less comfortable environment. The employees now have to drive further to get to a parking place and have to walk farther to get to their work place.

The Los Alamos National Laboratory employs some of the brightest scientists and engineers from around the world. The working environment is designed to be much like a college campus. A great deal of effort is expended to ensure that their creative genius is allowed free reign. As a result, many important developments have emerged from the Laboratory. This degree of freedom has consequences. One example of the creativity-centric policy is everybody's opinion counts. As a result, some people get upset if their opinion is not accepted in exactly the way that it was intended. When a major decision is made and all points of view are not accepted, egos get bruised. The next time that a decision needs to be made, the opinions are much deeper rooted and cooperation suffers.

Decisions

There are three feasible alternatives that can realistically be made regarding this situation. Many variations are possible, but they all relate to one of the three. The three decisions to be evaluated are

1. Close the Road (during construction)
2. Close one Lane (during construction)
3. Status Quo

The other alternatives included using flag persons to control traffic, using an adjoining parking lot as a temporary road, building a temporary by-pass road through an empty space across the road from the construction site, and building an access to the site from a second road. None of these alternatives relieves the congestion on the primary road.

In the event that the road is closed, the traffic currently using the road would have to be re-routed to other roads within the Laboratory. The alternate routes do not meet New Mexico Department of Transportation requirements and are not considered safe in their current configuration. The access and egress points for the remaining roads are all "choke" points where vehicles are backed up during heavy use periods. More time and resources would have to be expended in order for the current traffic flow patterns and volumes to be maintained. While this is workable, it will cause an increase in frustration levels of the drivers due to longer waits at access points and increase the volume of vehicles on the roads.

The advantages of this decision would be a reduced risk to the safety of the vehicles, construction equipment, and pedestrians that use the road. It would also cause a gain in efficiency for the construction contractor, allowing a better chance to meet the schedule.

The decision to close one lane would get some increase in safety, would cost less than the other two options, would create some efficiency for the construction, would help the schedule, and it would be a compromise for all sides, on the plus side. However, it would cause some frustration for the current users of the road, and cause the alternative routes to become somewhat more crowded. This decision would probably not please anyone and would be resented by all. This would be a "lose" – "lose" situation.

A decision to do nothing has many advantages for the Laboratory employees, but none for the contractor. The risk to the personnel, vehicles, and construction equipment will increase exponentially as the number of trucks using the road increases. The schedule will remain somewhat at risk for completion on time and the cost of construction may increase.

One idea that was not discussed at any of the meetings was the liability issue. By disregarding the advice of the construction contractor and the Project Director, the Laboratory has accepted the liability if an accident happens on the road that is related to the construction of the building. It is not clear why this was not an issue.

The Model

During the various meetings, the major areas of concern were discussed. These areas of concern became the parameters for the Expert Choice Decision Making Software model. Expert Choice Decision Making software is a program that allows the user to input various decision factors, and based on the user's determination regarding priority and level of importance, objectifies the data. This data can then be used to evaluate and determine a course of action regarding the decision. The parameters used in this model include:

- Safety
- Cost
- Schedule
- Politics
- Alternative Routes
- Human Factors.

Top Level View

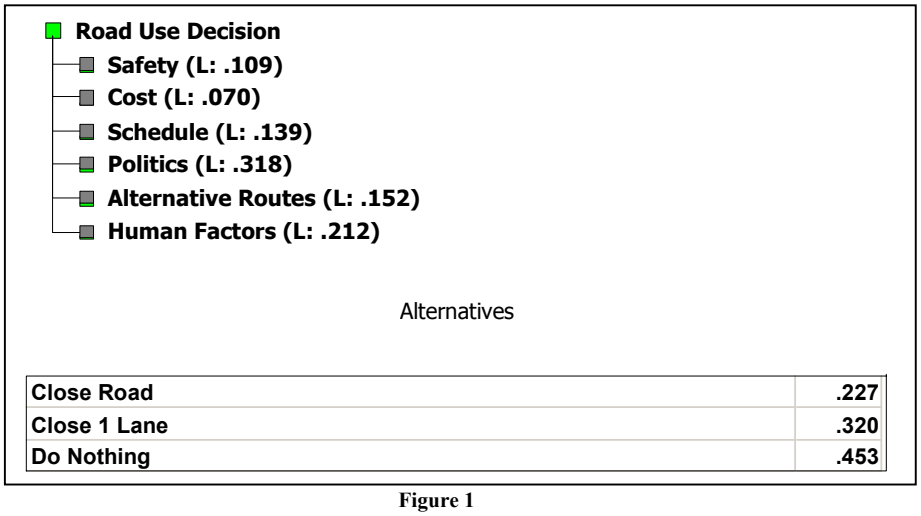

Figure 1

After reviewing the objectives, it seemed that there were some other supporting factors that would affect each of those parameters. These factors were added as sub-objectives to each parameter. At this time, information was entered at each level of the model, in the Information Document feature of the Expert Choice Decision Making software, to keep track of the various meetings and discussions that related to each objective and sub-objective. This feature allows the user to input explanations or thoughts concerning each parameter, further expanding the available information available to the decision maker. The complete model is shown below.

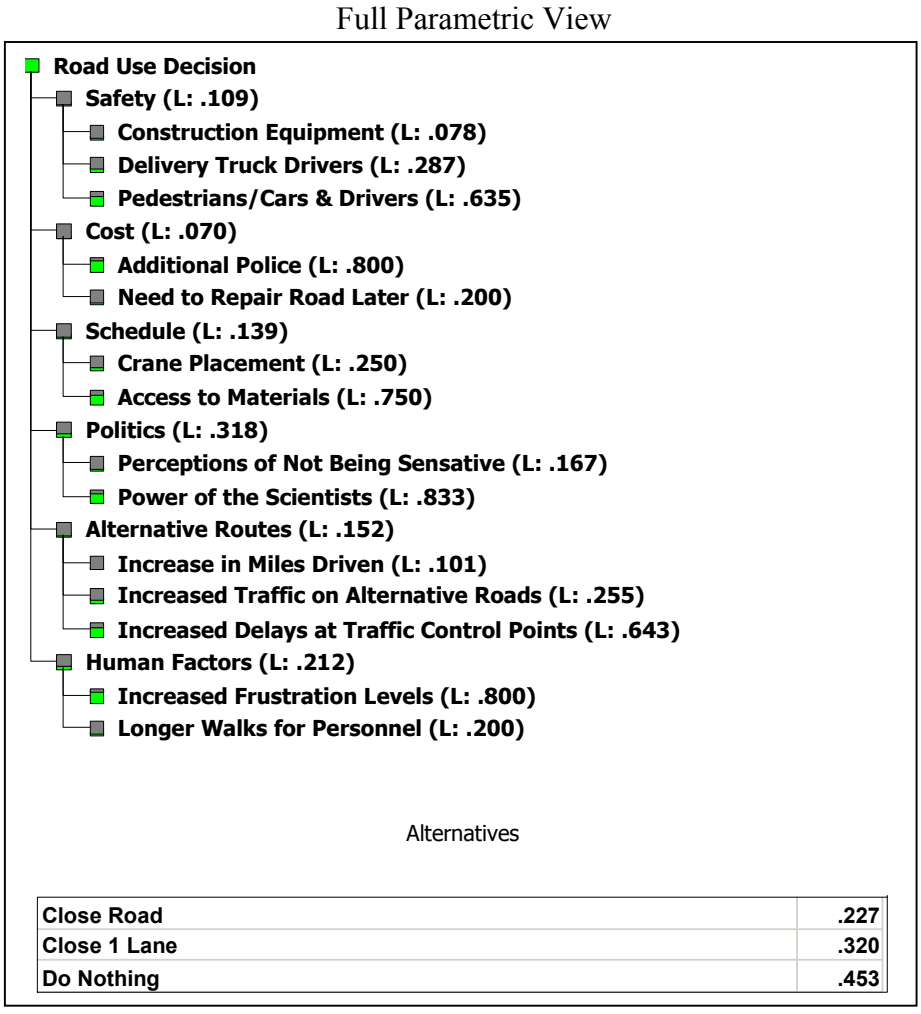

Figure 2

Measurements

In the Expert Choice software relative importance of the objectives and sub-objectives are evaluated by comparing all of the possible decisions by judging which of any two pairs of objectives has more influence than the other. This is called pairwise assessments. Pairwise assessment is a technique that compares each parameter against another, asking the decision-maker to rate the importance or significance of one parameter against the other. The resulting

determination is given a quantitative value allowing an objective determination to be measured and evaluated. In making the pairwise assessments, the Info Docs were used to obtain a degree of the orders of magnitude differences made in the meetings. The pairwise assessment technique is a better method of translating the thoughts and concerns of the decision makers into a ratio assessment. This is based upon the work of Dr. Saaty who found that words used to compare ideas more accurately described the relative differences than when numbers were used. The end result was very surprising, in that the safety of the personnel was not the highest priority. Political and personal preference was the most important factors.

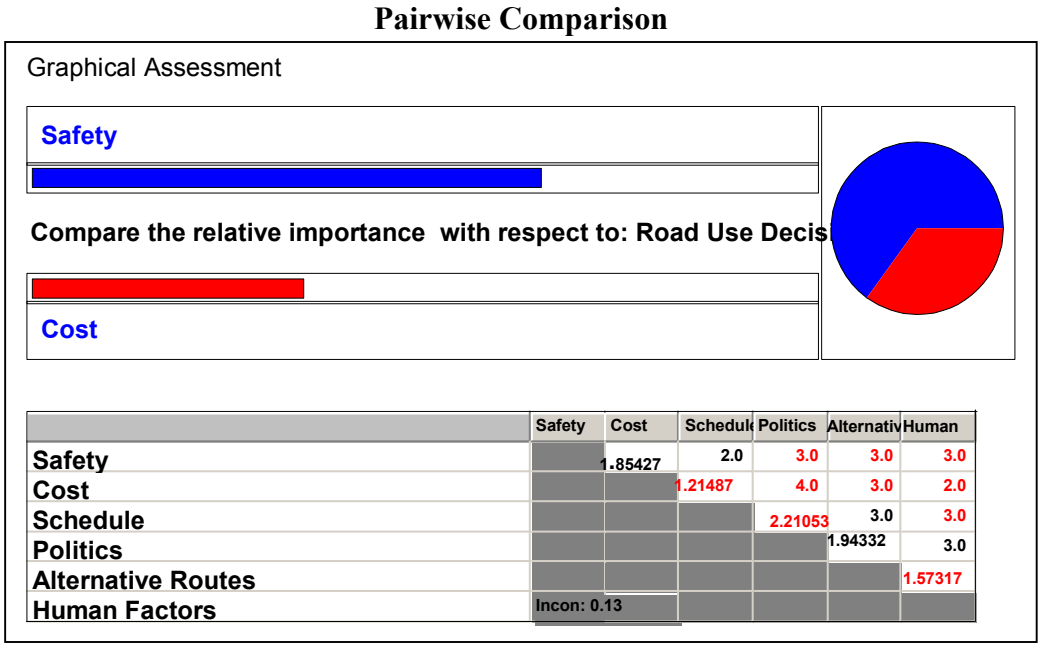

Figure 3

One example of pairwise comparison can be made in the construction industry, in the comparison of safety vs. cost and schedule. In the construction industry it is generally assumed that safety is much more important than cost and schedule on a project. This is true for many reasons, not the least of which, is that workers have the right to return home in the same condition from which they left. Pairwise comparison allows the decision-maker to truly compare the merits of safety vs. other factors, enabling him to prioritize according to reality as it relates to the current decision.

Regarding the Los Alamos decision as it relates to safety as a factor, the Laboratory has been noted, by the author and others, that personal safety is not an idea that is accepted by all people at the laboratory. Some at the Laboratory routinely ignore safety warnings and put themselves at risk in order to have convenient access to where they want to go. People have been observed walking past signs that say “Danger – Construction Area” and lift the warning tape in order to enter the area. In some cases personnel have had to be escorted out of a construction area. In other instances, when a sidewalk is closed, some people walk in the street even though there was a sidewalk on the other side of the street. Two people who were walking along the street were stopped and asked if they knew why the sidewalk was closed. They did not know and had not considered crossing the street.

Results

Once the information regarding this decision was gathered, put into the software, reviewed, and further refined the most likely out come, based upon the stated objectives and their relative importance, was predicted. The software calculated the relative weights of all the objectives and sub-objectives against the most likely choices and predicted a most likely outcome. The most likely outcome was that the road would not be closed. The next most likely outcome was that one lane would be closed and the least likely outcome was that the road would be closed.

Priorities Bar Chart

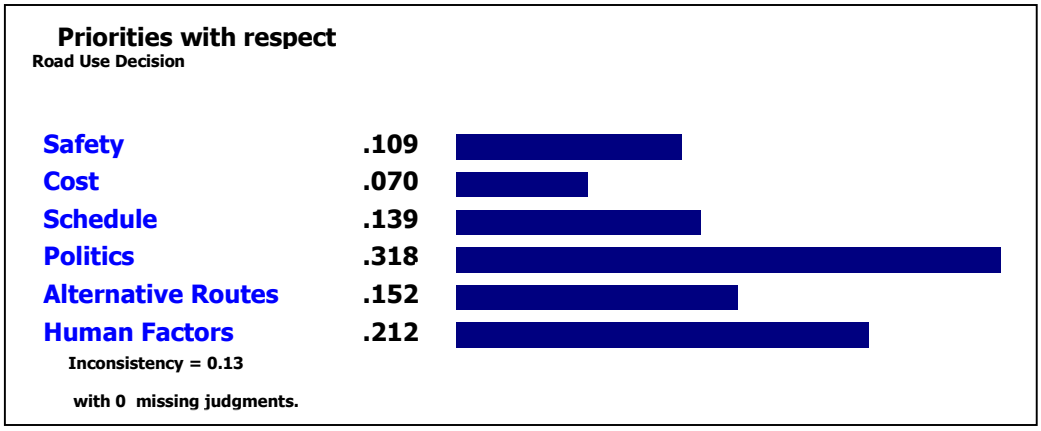

Figure 4

Sensitivities Chart

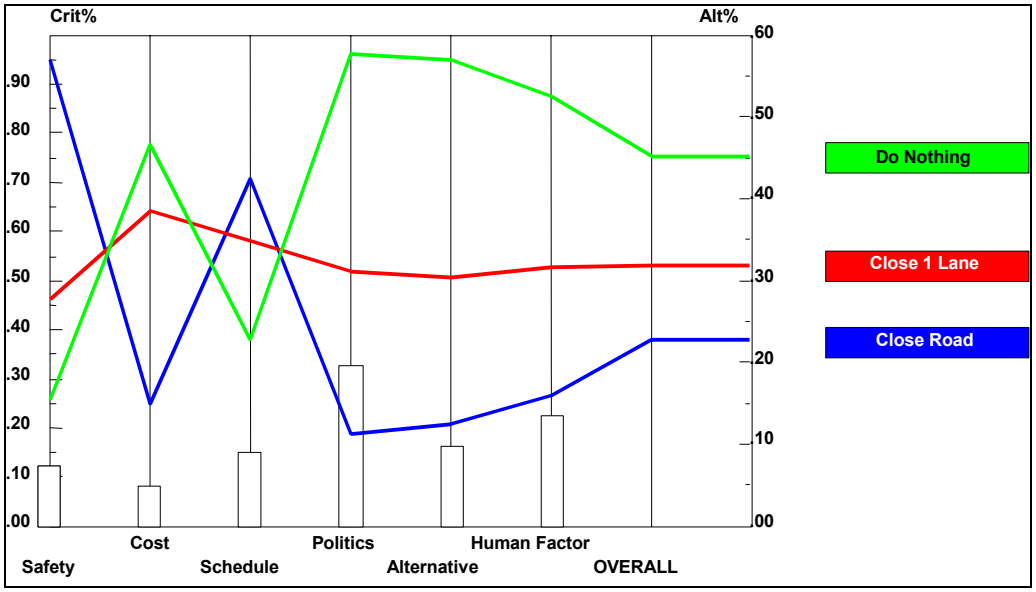

Figure 5

What Next

The analysis and synthesis of the decision and how the relative weights were determined was discussed with the Project Director. The decision would have been somewhat more refined if more people had access to the Expert Choice software and could have provided more input, but it was agreed that the results would not be different. This program and the various components were discussed with the Project Management Division Director. He was pleased with the discussion and would like to get some more information so that other decisions made could have a better basis than that which currently exists.