EXECUTIVE DECISION MAKING

DISTRIBUTION OF U.S.DOT/FTA BUDGET FOR THE CPMO PROGRAM

PREPARED BY
R.L."Rick" Rye and Sajjad Haider
THE GEORGE WASHINGTON UNIVERSITY
School of Business and Public Management

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PROJECT "B" REPORT

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Abstract: This study project is related to resource allocation of contract funds for the U.S.DOT/Federal Transit Administration (FTA) Capital Project Management Oversight (CPMO) Program. Contract proposals exceed the budget cap that FTA is allowed to obligate for oversight consultants in 15 regions in the U.S. An Analytical Hierarchy Process (AHP) was used for developing a resource allocation methodology. Expert Choice (TeamEC) software was the platform used for building an AHP resource decision model and Excel was used to perform an optimization exercise to maximize benefits.

INTRODUCTION

The U.S.DOT/Federal Transit Administration (FTA) administers federal funds to state and local transportation agencies for the design, construction, maintenance and operation of transportation systems. Transit systems that are funded and administered by FTA are typically commuter railways, subway systems, marine transportation, bus systems, and the infrastructure to support these systems. FTA project grants typically range between 30 and 80 percent of the total cost of a capital project (GAO, 2000 February). Local matching funds make up the difference between the federal grant and the total project budget. Local funding can come from the state, city, toll fares or any combination of these. Examples of major transit projects that receive FTA funding include the Washington Metro, extensions and connections to the New York City subway system (New Start), modernization and upgrades to the Long Island Rail Road (Transit Mods), and project development of a new light rail system as in Baltimore (Transit EPC).

Background To Resource Allocation Study Project

Among 15 regions throughout the U.S., the FTA will obligate grants between years 2000 and 2005 that total approximately $7.5 billion dollars for major capital projects. For each of these regions, the FTA contracts with engineering and project management consultants through the Capital Program Management Oversight (CPMO) program to provide oversight and technical assistance to major capital projects. A major capital project is typically over $100 million. The CPMO consultant's monitor transit programs and projects on a continuing basis and report to the FTA regional and Washington offices on the status of the programs cost, schedule and performance. The consultants' role can also be viewed as the FTA's emphasis on monitoring the compliance with statutory and administrative requirements. The CPMO program is financed by setting aside approximately 0.75 percent of the funds Congress makes available each year for transit programs (DOT, 1989). The current consultant acquisition will span for five years, 2000 to 2005 (FTA, 2000).

THE STUDY PROJECT PROBLEM

The President's approved FFY 2000 budget allows the U.S. DOT to allocate $40 million for the FTA CPMO program. Distributive amounts of the $40 million will be obligated to 15 CPMO consultants by professional service's contracts. The specific amount allocated to each region is based on the major capital projects that are assigned in that specific region and correspondingly to the CPMO consultant. However, the estimates received from all 15 consultants, for the period 2000 to 2005, total to $49.7 million, thus resulting in a $9.7 million overrun for the intended program. The U.S. DOT has stated that additional funds will not be allocated for FFY 2000-2005, therefore contracts with the 15 CPMO consultants must be conformed to a total of $40 million (FTA, 2000). This resource allocation study problem is to identify those regions that provide the best benefit to the CPMO program.

FTA Decision Maker and Consultant Support

Reconciliation of the CPMO budget and the resource decision are the responsibilities of the FTA Engineering and Program Management Division in Washington DC. This division works directly with the CPMO consultant's and make the final decision for consultant selection and where they are assigned. All 15 CPMO consultants have been requested to evaluate their individual budget plans and make suggestions to the division office on budget reductions. Because Mr. Rye represents the Fluor

Daniel consulting contract with the FTA CPMO program in Region 2, our study team was provided with the estimates and assignments currently being evaluated by FTA. Figure 1 below show the profile of the FTA region to the consultant's current estimate (FTA, 2000).

FTA REGION	CONSULTANT	ID	CONSULTANT ESTIMATE (MILLIONS)	% OF TOTAL
REGION 1	Day & Zimmerman	DZ	$ 4,003	8%
REGION 2	Fluor Daniel F	FD	$ 10,534	21%
REGION 3	Delon Hampton	DH	$ 3,561	7%
REGION 4	Carter Burgess	CB	$ 1,420	3%
REGION 5	Stone and Webster	SW	$ 3,378	7%
REGION 6	Frederic R. Harris	FH	$ 999	2%
REGION 7	Urban Engineers	UE	$ 1,672	3%
REGION 8	Morrison/Knudsen	MK	$ 2,731	5%
REGION 9	Sverdup	SV	$ 5,312	11%
REGION 10	DMJM	DM	$ 1,214	2%
REGION 11	DeLeuw Cather	DC	$ 1,382	3%
REGION 12	PBDQ	PB	$ 10	0.02%
REGION 13	Hill International	HI	$ 4,969	10%
REGION 14	STV	ST	$ 4,913	10%
REGION 15	Gannett Fleming	GF	$ 3,636	7%
			$ 49,734	100%

Figure 1: FTA Region and CPMO Consultant Estimates

THE DECISION MAKING PROCESS

This resource allocation project looks at sorting and allocating the budgeted amount of $40 million among the 15 CPMO consultants. We performed an alternative resource allocation exercise by AHP benefit/cost ratio using Expert Choice (TeamEC) software. We will further maximize the benefits by resource optimization using Excel Solver Add-ins.

The Analytic Hierarchy Process (AHP)

This study project suggests that using an AHP model for resource allocation, the FTA can make more rational and objective decisions. As we have learned in our management science studies, the key for using the AHP methodology is to focus on objectives, rather than alternatives or attributes. Expert Choice is highly effective for making resource decisions in a rational way based on the relative effectiveness for achieving the organization's overall objectives (Expert Choice, 2000). These objectives should provide a yardstick with which a particular candidate can be measured by (Forman, 2000 Spring). The process helps remove discretion, but take into consideration the collection of subjectivity that decision-makers can quantify.

TeamEC is the software used for modeling and processing the AHP methodology in this study. The application of TeamEC software was conducted by a team of two graduate students at the George Washington University (Rye and Haider) representing a decision making process that can also be used by the FTA resource decision makers. FTA decisions are increasingly being made by groups and by consensus, rather than through unilateral administrative decisions.

Expert Choice (TeamEC) Resource Decision Modeling

TeamEC uses a process that rates the alternatives for a benefits/cost distribution. By using the TeamEC model, the objectives were placed into a structured hierarchy and pairwise analysis performed to determine relative importance of the different objectives. In this study, we used exclusively verbal judgements for determining the weighed value of objectives. The software used these qualitative judgements to compute the quantitative priorities leading to the best choice.

Expected Results From The AHP Process

The expected results by this process study, is to derive a priority of the alternatives that can be considered to make the greatest benefit/cost contribution to the FTA oversight program. As a result of the TeamEC synthesis and ratings, the best priority is used with confidence for evaluating the best alternatives. The TeamEC pairwise judgements are used to derive priorities using the principle right hand eigenvector of the comparison matrix in each cluster of the hierarchy. The TeamEC synthesis combines these priorities to determine the overall alternative priorities (Forman, 2000). We also expect to recommend to the FTA decision-makers the use of the AHP methodology to help enhance the quality of their decision making process. Unfortunately, we found that FTA is commonly confronted with unstructured decisions related to the CPMO program.

BUILDING THE TeamEC HIERARCHY

With the AHP methodology, which forms the basis of TeamEC decision support software, our objectives, alternatives, and intensities were arranged in a hierarchical structure. We built a relative model to evaluate the alternatives for assigning the CPMO consultants. The goal of the resource allocation methodology is to find those regions that consultants should be funded, within the $40 million budget constraint, in order to produce the best overall result for FTA's oversight program. After we agreed upon the model a combination of subjective and objective factors were included in the hierarchy. Facilitated by TeamEC we compared all the elements pairwise throughout, including the

alternatives. We then synthesized our personal judgements and intuition to obtain the results of a sensitivity analysis. The TeamEC hierarchy model is shown in Figure 2. The TeamEC alternatives are the 15 FTA regions.

The TeamEC Model Objectives

The primary objectives that FTA considers to be important when evaluating the assignments include the technical and administrative demands that each major capital program will make on the consultants. Our resource allocation model include seven of FTA's criteria, which include; transit engineering, systems engineering, program/project management, systems safety, federal acquisition, capital program budgeting, and quality management.

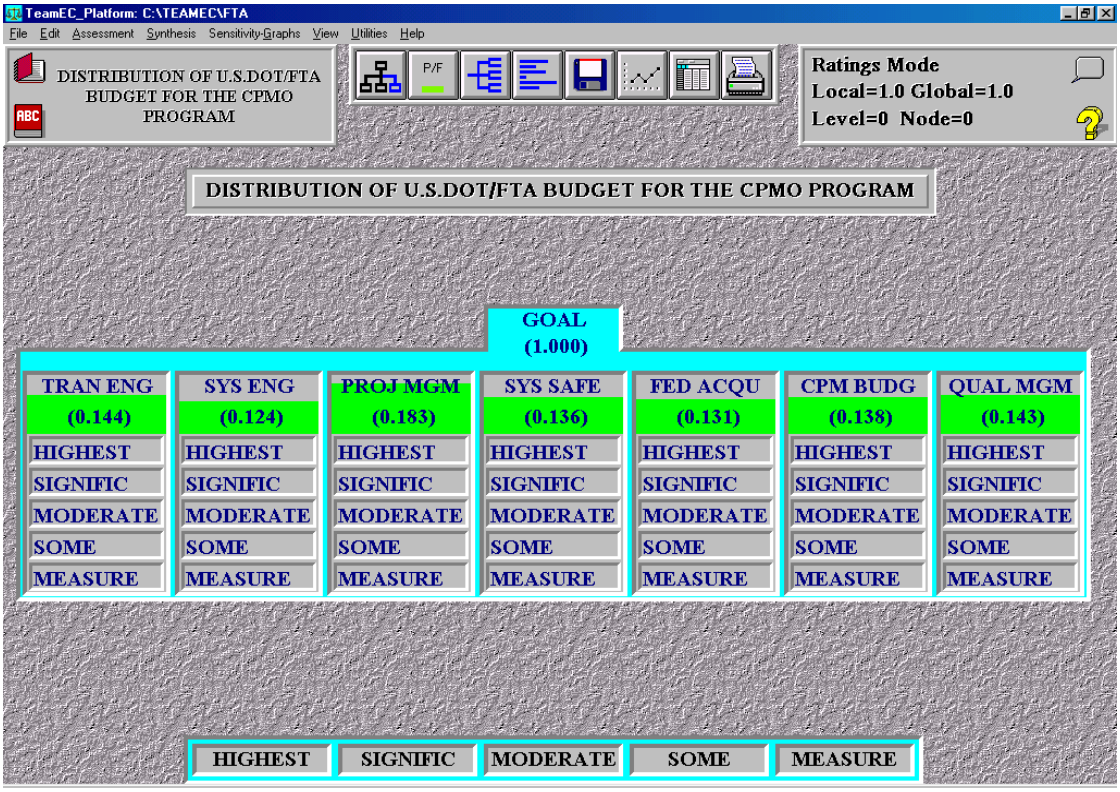


Figure 2: Overall TeamEC Hierarchy Model by TeamEC.

The seven objectives that can also be seen on the hierarchy model in Figure 2 are the driving force behind allocating the budget resources. Following are definitions and descriptions for the objectives that FTA uses for evaluating assignments.

- **Transit Engineering:** Capital projects in the FTA regions will be major transit New Start construction that can include new alignments, tunneling, track installment, new signal systems,

and a new service start up. The project construction operations my cause interruptions to an existing transit service as well as impact existing ridership schedules. The CPMO consultant must have engineering skills to deal with a broad spectrum of new construction issues.

- **Systems Engineering:** Many FTA funded programs include systems upgrades and modernization of existing transit signal and control systems. The advancements made in new technologies have created significant opportunities to improve safety and efficiencies of existing out-dated systems. All design and construction planning much focus on mitigating as much impact to existing operations as possible. The CPMO consultant must have a high degree of technical skills to order to be effective for these modernization programs.

- **Program and Project Management:** Some capital programs are so large and/or complex that a large integrated program management organization structure is necessary. Such programs are characteristic for New Start projects such as the LA Metro, New York City Transit and Long Island Rail Road. The FTA emphasis is placed on the organizational control and effectiveness. The consultant must have strong organizational skills and must be able to communicate effectively with many different levels of people.

- **Systems Safety Engineering: System** safety consists of issues related to people and property safety associated with the guideway system. Shared corridors are rail alignments that are shared between commuter trains and commercial or freight trains. These guide ways can present particular safety problems. FTA gives special attention to these particular types of projects. The CPMO consultant must also have special knowledge of federal rules related to shared corridors, the safety issues involved and operations efficiencies.

- **Federal Acquisition Rules:** Some federally funded capital programs require special acquisition rules for the purchasing or contracting of equipment and materials. For example, rolling stock procurement may include special buy America rules, some programs can continue for up to ten years requiring special acquisition rules, or unique construction methods like design/build or joint development also require special federal rules. FTA will give significant emphasis on these rules and will expect the consultant to have the in-house resources available for management of these issues.

- **Capital Program Management Budgeting:** The New York region has special issues related to budget planning and management. For example, the New York MTA can make application for federal grants to contribute to capital programs valued as much as $500 million. Budget allocations fluctuate from year to year and priorities shift from New Start projects to Transit Mods. These regional issues have to be monitored closely and managed effectively.

- **Quality Management:** One standing criteria for all major capital programs is to have an effective quality management program in place. Many capital programs have special quality issues that require special attention by the FTA and CPMO consultants.

The TeamEC Model Alternatives:

The alternatives for benefit/cost analysis are the 15 consultants' identified correspondingly with FTA regions. For example, Fluor Daniel (FD) is assigned to Region 2, Urban Engineers (UE) is assigned to Region 7, etc. The corresponding lists between the FTA region and the oversight consultant can be referenced again in Figure 1.

DISCUSSING AND ANALYZING THE MODEL

Pairwise Comparisons

We performed the pairwise comparisons using the top down approach, by first entering the judgment for the objectives with respect to the intensities, then the intensities with respect to the goal. TeamEC guided our exercise by identifying the objectives and intensities on which the alternatives are judged. Using our judgments, we then weighed the relative importance of each criterion and alternative. Once the model was complete, TeamEC posed a series of simple comparisons of the alternatives in relation to our criteria and objectives. We chose to use verbal judgements as represented in Figure 3 below. In this way, TeamEC made the complex decision of weighing among the seven objectives, with the interrelationships of alternatives and intensities easily manageable. Additionally, the intensities below each of the objectives were also prioritized with pairwise comparisons. As shown in Figure 4, the intensities are quite different for each objective.

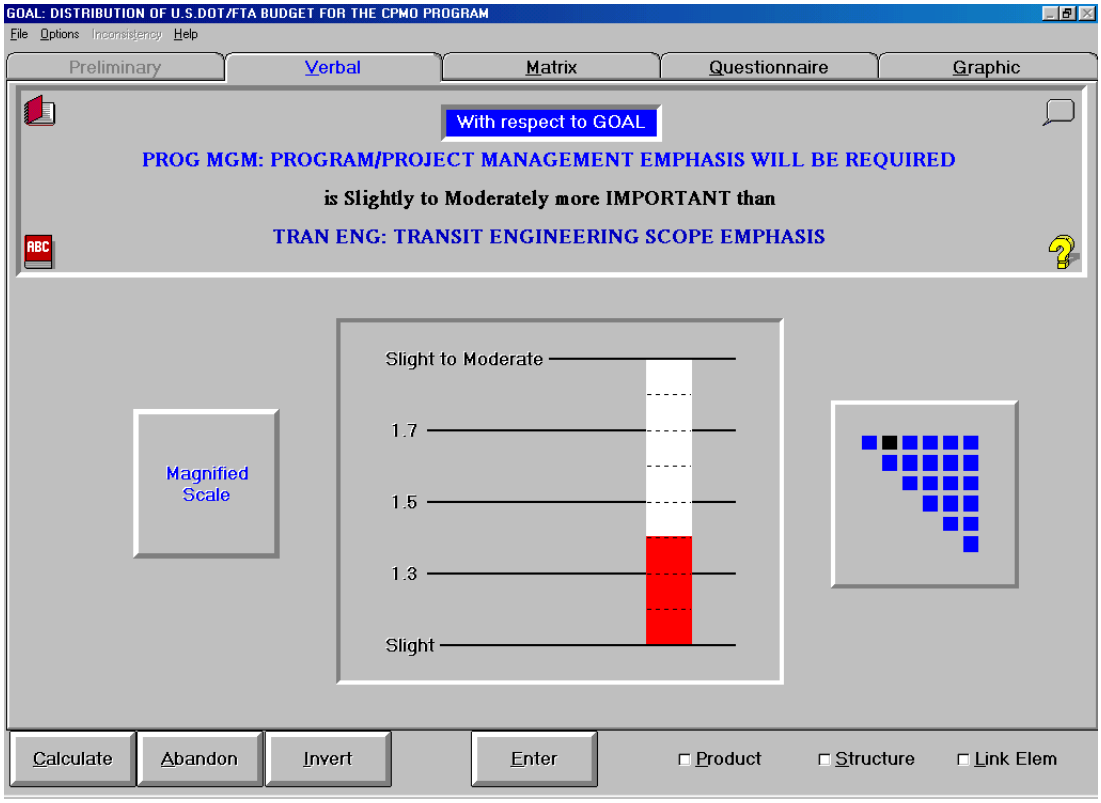


Figure 3: Pairwise Comparisons using verbal judgements using TeamEC.

Comparative Ratings Analysis

Once we made all of our comparisons, TeamEC processed the data, synthesized our judgments, and calculated the priorities that show how we ranked the objectives and intensities. When the ratings analysis was performed, the various alternatives were rated against each other according to the intensities. The results of the assessments are presented in Figure 4, by comparing the different priority measurements, that is, the sensitivity analysis measurements are compared with respect to each major objective. The interval between the Highest intensity and the Significant intensity is approximately 2.5 times. The interval between Significant and Moderate, Moderate and Some intensities calculate to be approximately 2 times. However, the magnitude of intensity between the Highest and Measurable is 10 times.

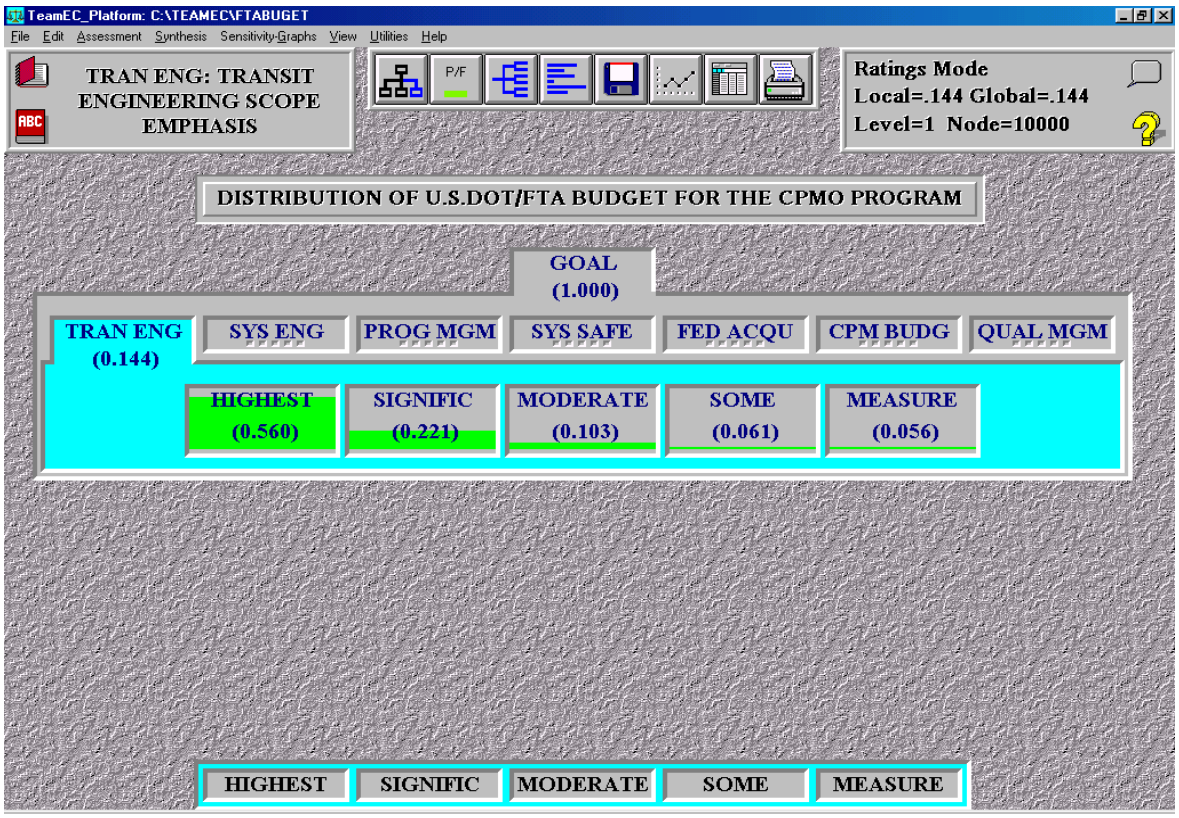
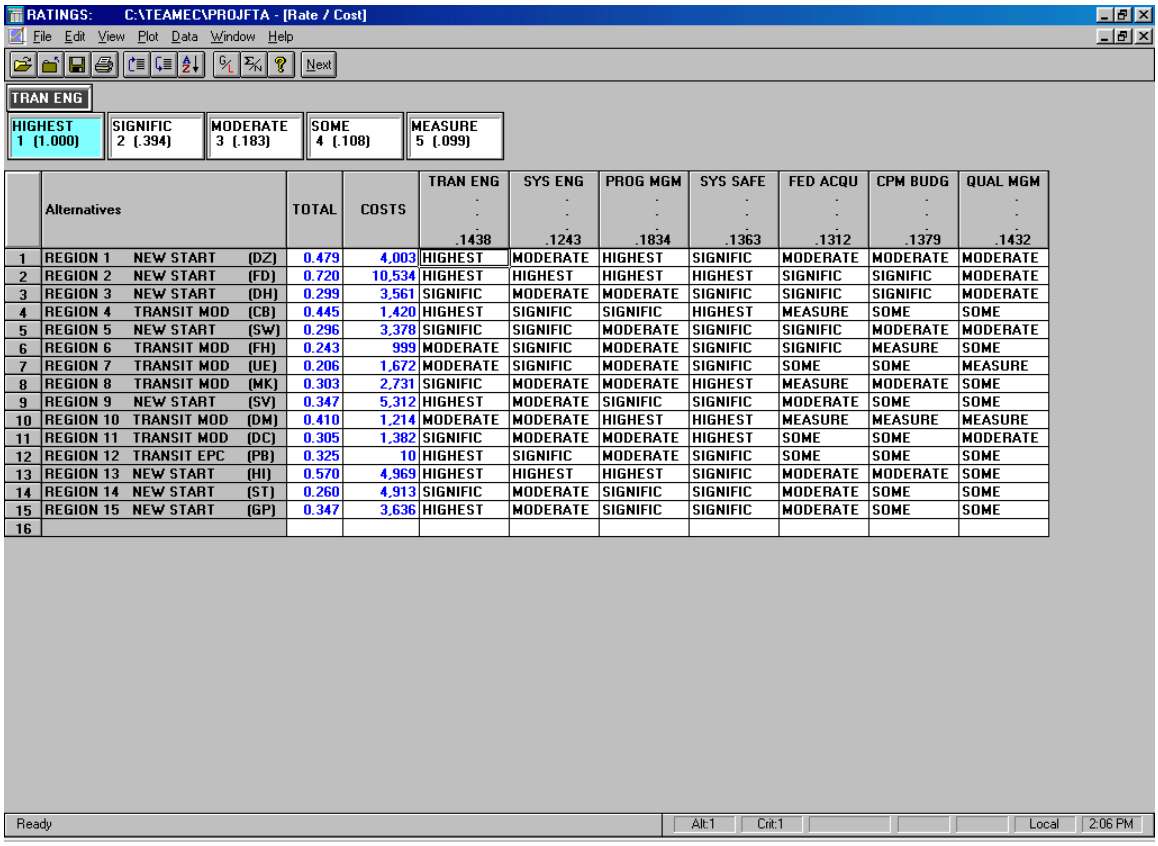


Figure 4: Intensity Scale by TeamEC.

Rating Scale Analysis

We use the TeamEC software to develop the Ratings matrix that is shown in Figure 5. The intensity descriptions are entered in the columns corresponding to each objective. The TeamEC software processes the ratio scale value correspondingly, which are represented as a decimal value in the Total column. The ratio scale value for Region 2 of 0.720 is 2.77 times larger than the lowest ratio scale of 0.260 calculated for Region 14. These ratio scale measurements also are considered to represent the contribution each region's capital programs make to the overall objective of the FTA CPMO program.



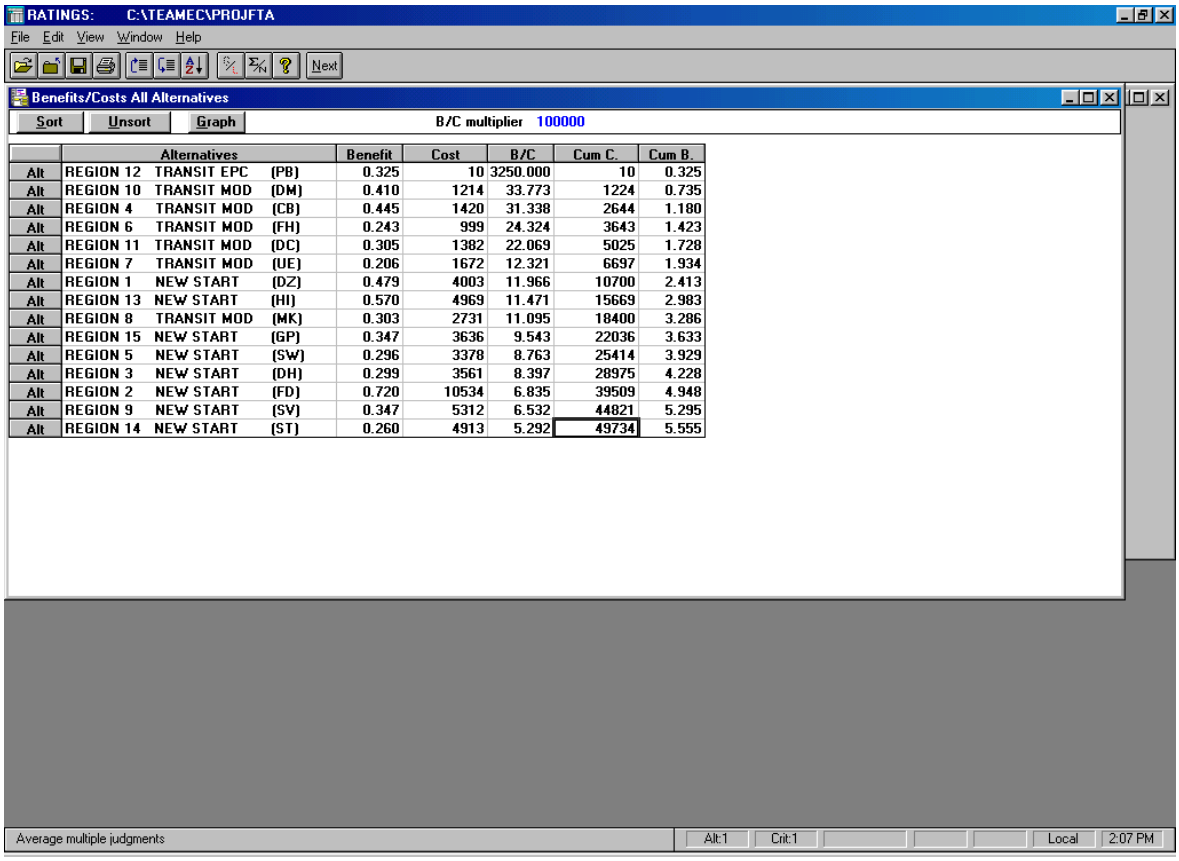
	Alternatives			TOTAL	COSTS	TRAN ENG .1438	SYS ENG .1243	PROG MGM .1834	SYS SAFE .1363	FED ACQU .1312	CPM BUDG .1379	QUAL MGM .1432
1	REGION 1	NEW START	(DZ)	0.479	4,003	HIGHEST	MODERATE	HIGHEST	SIGNIFIC	MODERATE	MODERATE	MODERATE
2	REGION 2	NEW START	(FD)	0.720	10,534	HIGHEST	HIGHEST	HIGHEST	HIGHEST	SIGNIFIC	SIGNIFIC	MODERATE
3	REGION 3	NEW START	(DH)	0.299	3,561	SIGNIFIC	MODERATE	MODERATE	SIGNIFIC	SIGNIFIC	SIGNIFIC	MODERATE
4	REGION 4	TRANSIT MOD	(CB)	0.445	1,420	HIGHEST	SIGNIFIC	SIGNIFIC	HIGHEST	MEASURE	SOME	SOME
5	REGION 5	NEW START	(SW)	0.296	3,378	SIGNIFIC	SIGNIFIC	MODERATE	SIGNIFIC	SIGNIFIC	MODERATE	MODERATE
6	REGION 6	TRANSIT MOD	(FH)	0.243	999	MODERATE	SIGNIFIC	MODERATE	SIGNIFIC	SIGNIFIC	MEASURE	SOME
7	REGION 7	TRANSIT MOD	(UE)	0.206	1,672	MODERATE	SIGNIFIC	MODERATE	SIGNIFIC	SOME	SOME	MEASURE
8	REGION 8	TRANSIT MOD	(MK)	0.303	2,731	SIGNIFIC	MODERATE	MODERATE	HIGHEST	MEASURE	MODERATE	SOME
9	REGION 9	NEW START	(SV)	0.347	5,312	HIGHEST	MODERATE	SIGNIFIC	SIGNIFIC	MODERATE	SOME	SOME
10	REGION 10	TRANSIT MOD	(DM)	0.410	1,214	MODERATE	MODERATE	HIGHEST	HIGHEST	MEASURE	MEASURE	MEASURE
11	REGION 11	TRANSIT MOD	(DC)	0.305	1,382	SIGNIFIC	MODERATE	MODERATE	HIGHEST	SOME	SOME	MODERATE
12	REGION 12	TRANSIT EPC	(PB)	0.325	10	HIGHEST	SIGNIFIC	MODERATE	SIGNIFIC	SOME	SOME	SOME
13	REGION 13	NEW START	(HI)	0.570	4,969	HIGHEST	HIGHEST	HIGHEST	SIGNIFIC	MODERATE	MODERATE	SOME
14	REGION 14	NEW START	(ST)	0.260	4,913	SIGNIFIC	MODERATE	SIGNIFIC	SIGNIFIC	MODERATE	SOME	SOME
15	REGION 15	NEW START	(GP)	0.347	3,636	HIGHEST	MODERATE	SIGNIFIC	SIGNIFIC	MODERATE	SOME	SOME
16												

Figure 5: Ratings Matrix by TeamEC.

Benefits/Cost Ratios Allocations

Subsequent to building the Ratings matrix we used the TeamEC software to perform a benefits/cost ratio analysis. The process resulted in a Benefit column giving a calculated decimal value to each alternative region, as shown in Figure 6. What this produces is a gradient list of benefits/cost values for funding each of the 15 regions with the total estimate of $49.7 million. However, by using the cumulative cost column (Cum B.), we found that Regions 9 and 14 should not be funded in order to stay within the $40 million budget constraint.

Usually FTA allocates up to the limit of the budgeted resources they have. A discretionary adjustment will be made for resource leveling considering all regions, based on the percent of value calculated from the total budgeted amount (FTA, 2000). Thus, cost has traditionally been the objective and this objective becomes the target. In contrast, by using the TeamEC hierarchy model, the objectives are the focus of our resource decision making.



	Alternatives			Benefit	Cost	B/C	Cum C.	Cum B.
Alt	REGION 12	TRANSIT EPC	(PB)	0.325	10	3250.000	10	0.325
Alt	REGION 10	TRANSIT MOD	(DM)	0.410	1214	33.773	1224	0.735
Alt	REGION 4	TRANSIT MOD	(CB)	0.445	1420	31.338	2644	1.180
Alt	REGION 6	TRANSIT MOD	(FH)	0.243	999	24.324	3643	1.423
Alt	REGION 11	TRANSIT MOD	(DC)	0.305	1382	22.069	5025	1.728
Alt	REGION 7	TRANSIT MOD	(UE)	0.206	1672	12.321	6697	1.934
Alt	REGION 1	NEW START	(DZ)	0.479	4003	11.966	10700	2.413
Alt	REGION 13	NEW START	(HI)	0.570	4969	11.471	15669	2.983
Alt	REGION 8	TRANSIT MOD	(MK)	0.303	2731	11.095	18400	3.286
Alt	REGION 15	NEW START	(GP)	0.347	3636	9.543	22036	3.633
Alt	REGION 5	NEW START	(SW)	0.296	3378	8.763	25414	3.929
Alt	REGION 3	NEW START	(DH)	0.299	3561	8.397	28975	4.228
Alt	REGION 2	NEW START	(FD)	0.720	10534	6.835	39509	4.948
Alt	REGION 9	NEW START	(SV)	0.347	5312	6.532	44821	5.295
Alt	REGION 14	NEW START	(ST)	0.260	4913	5.292	49734	5.555

Figure 6: Benefits/Cost for all Alternatives by TeamEC.

Efficiency Frontier

Figure 7 shows the benefit/cost efficient frontier graph produced with TeamEC. The curve resulted in a concave shape indicating that diminishing marginal benefit is achieved as additional regions are selected with lower benefit/cost ratios. This indicates that any increase in benefit is an improvement and the solution that maximizes total benefit is better.

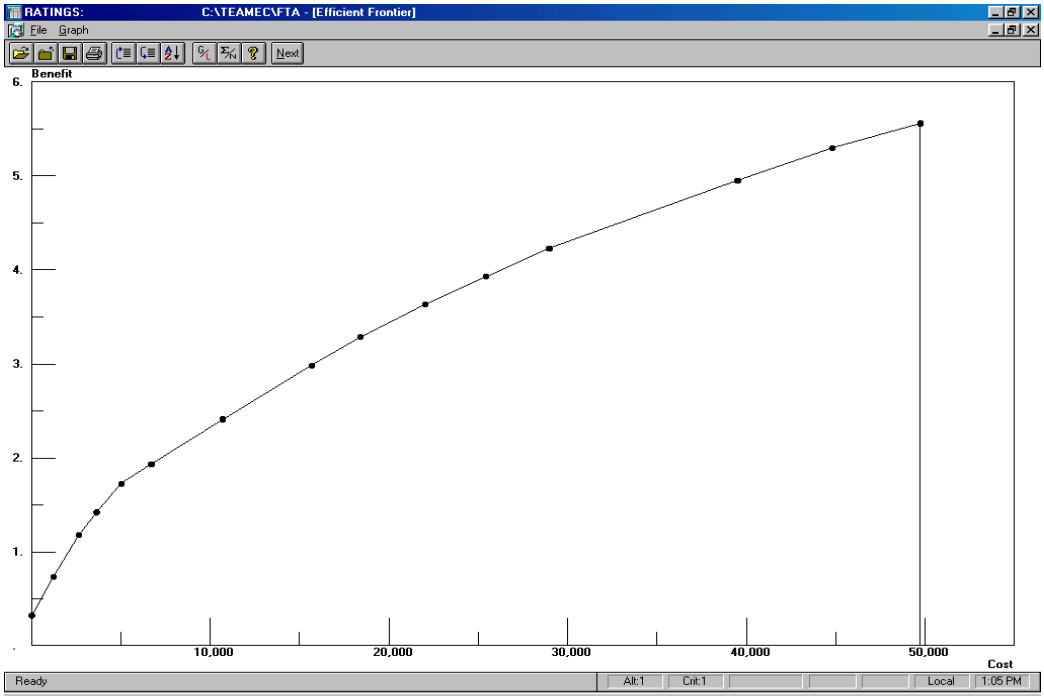
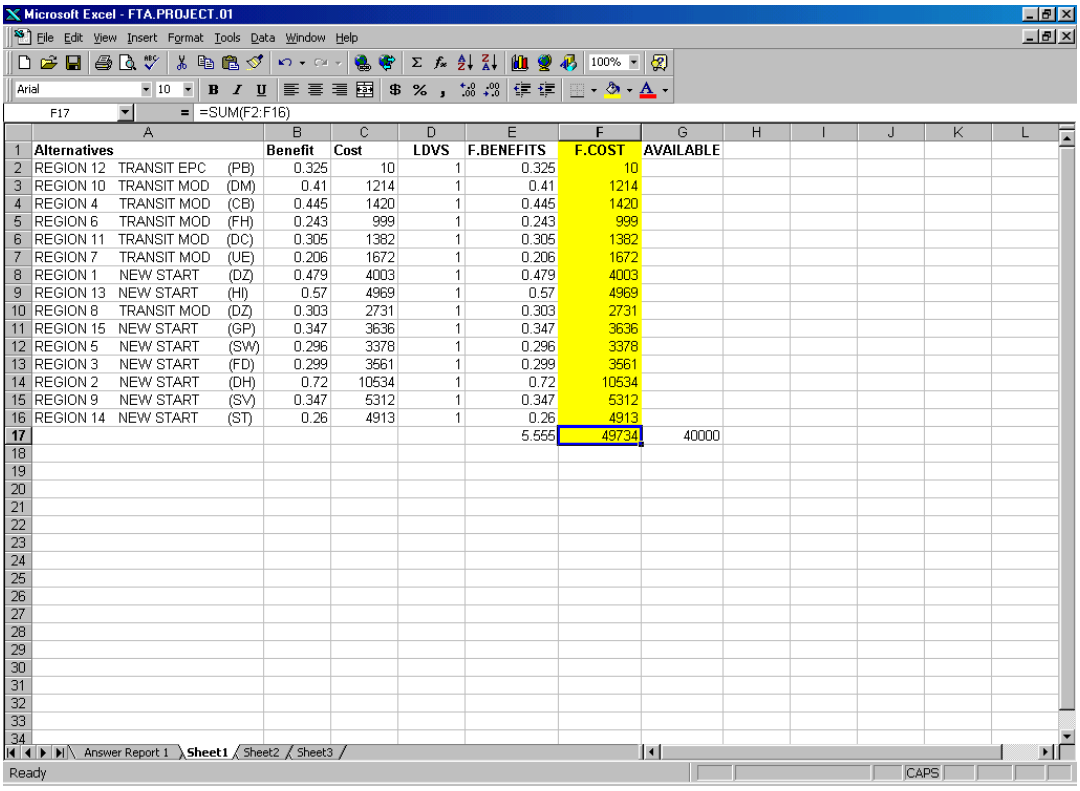


Figure 7: Efficiency Frontier Graph By TeamEC

Maximizing Benefits by Optimization

Decision quality means using a logical, systematic process that provides identification and improvement of key attributes of a decision, leading to clear and compelling action by the decision-maker (Forman, 2000). Before accepting the benefit/cost allocation by TeamEC as the resource decision, another resource allocation method was performed using Excel Solver Parameters. Using the spreadsheet to calculate the values and maximizing benefits is a rather straightforward process as shown in Figure 8. The Level of Decision Variable's (LDVS) is the constant column for setting up the equations for determining the funded cost (F.Cost) and the funded benefits (F.Benefits).

Figure 9 shows the Excel Solver Parameter dialog box containing the constraints expressed in numerical values that maximize the benefits of the alternative regions.



	A			B	C	D	E	F	G
1	Alternatives			Benefit	Cost	LDVS	F.BENEFITS	F.COST	AVAILABLE
2	REGION 12	TRANSIT EPC	(PB)	0.325	10	1	0.325	10	
3	REGION 10	TRANSIT MOD	(DM)	0.41	1214	1	0.41	1214	
4	REGION 4	TRANSIT MOD	(CB)	0.445	1420	1	0.445	1420	
5	REGION 6	TRANSIT MOD	(FH)	0.243	999	1	0.243	999	
6	REGION 11	TRANSIT MOD	(DC)	0.305	1382	1	0.305	1382	
7	REGION 7	TRANSIT MOD	(UE)	0.206	1672	1	0.206	1672	
8	REGION 1	NEW START	(DZ)	0.479	4003	1	0.479	4003	
9	REGION 13	NEW START	(HI)	0.57	4969	1	0.57	4969	
10	REGION 8	TRANSIT MOD	(DZ)	0.303	2731	1	0.303	2731	
11	REGION 15	NEW START	(GP)	0.347	3636	1	0.347	3636	
12	REGION 5	NEW START	(SW)	0.296	3378	1	0.296	3378	
13	REGION 3	NEW START	(FD)	0.299	3561	1	0.299	3561	
14	REGION 2	NEW START	(DH)	0.72	10534	1	0.72	10534	
15	REGION 9	NEW START	(SV)	0.347	5312	1	0.347	5312	
16	REGION 14	NEW START	(ST)	0.26	4913	1	0.26	4913	
17							5.555	49734	40000

Figure 8: Excel Spreadsheet for Maximizing Benefits by Optimization

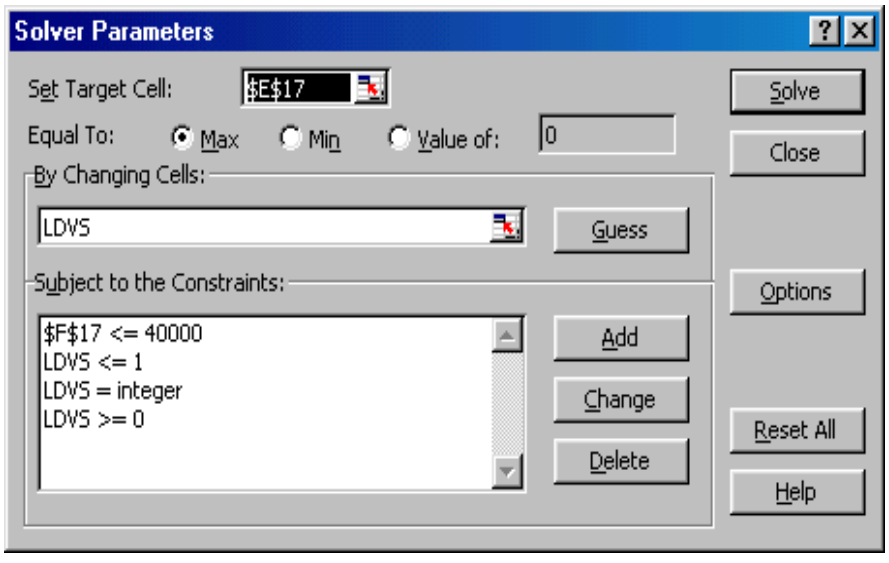
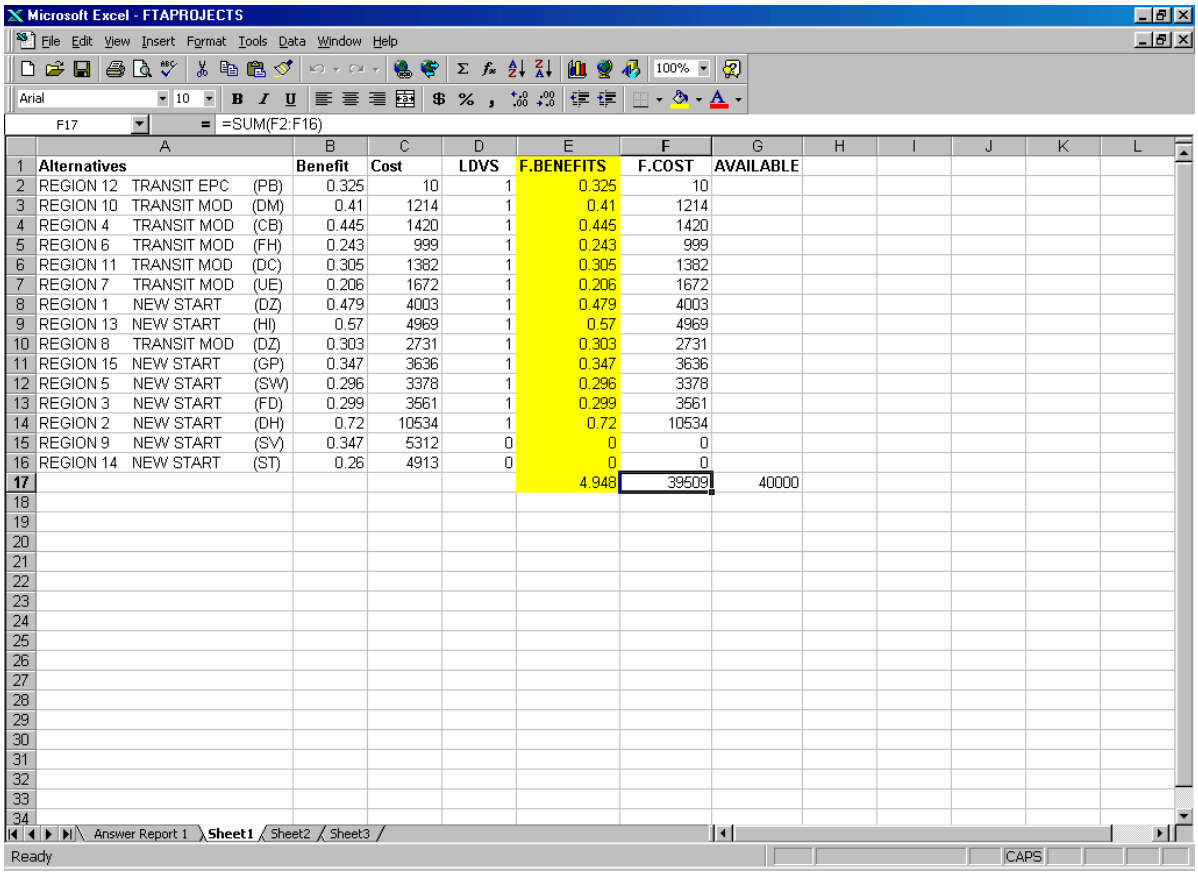


Figure 9: Excel Solver Parameter.

Derived Optimization

The derived priorities for the best choices of the alternative with respect to meeting the FTA goal is represented by the Solver Results graph shown in Figure 10. The results are the same as those derived using TeamEC. The total funded cost is optimized at approximately $39.5 million compared to the FTA available budget of $40 million. However, as determined from the TeamEC ratings calculation funding for Region 9 and 14 must be eliminated in order to stay under the budgeted amount.



	A	B	C	D	E	F	G
1	**Alternatives**	**Benefit**	**Cost**	**LDVS**	**F.BENEFITS**	**F.COST**	**AVAILABLE**
2	REGION 12 TRANSIT EPC (PB)	0.325	10	1	0.325	10	
3	REGION 10 TRANSIT MOD (DM)	0.41	1214	1	0.41	1214	
4	REGION 4 TRANSIT MOD (CB)	0.445	1420	1	0.445	1420	
5	REGION 6 TRANSIT MOD (FH)	0.243	999	1	0.243	999	
6	REGION 11 TRANSIT MOD (DC)	0.305	1382	1	0.305	1382	
7	REGION 7 TRANSIT MOD (UE)	0.206	1672	1	0.206	1672	
8	REGION 1 NEW START (DZ)	0.479	4003	1	0.479	4003	
9	REGION 13 NEW START (HI)	0.57	4969	1	0.57	4969	
10	REGION 8 TRANSIT MOD (DZ)	0.303	2731	1	0.303	2731	
11	REGION 15 NEW START (GP)	0.347	3636	1	0.347	3636	
12	REGION 5 NEW START (SW)	0.296	3378	1	0.296	3378	
13	REGION 3 NEW START (FD)	0.299	3561	1	0.299	3561	
14	REGION 2 NEW START (DH)	0.72	10534	1	0.72	10534	
15	REGION 9 NEW START (SV)	0.347	5312	0	0	0	
16	REGION 14 NEW START (ST)	0.26	4913	0	0	0	
17					4.948	39509	40000

Figure 10: Derived Benefits Using Excel Solver

CONCLUSION

Our study found that FTA's focus is on the fit of the resource allocation decision with the organization's goals in mind, but the organization did not demonstrate a focus on identifying which regions' projects provide the most overall value or contain the highest risk. We did not find that FTA uses a structure or methodology to measure or quantify benefits in their decision making. We know from our management science studies that such a situation can impede sound decision making for resource allocation issues.

Based on the results of our TeamEC rating analysis and the Excel Solver and the confidence we have learned to have in the AHP methodology, the result of this study project was shared with the FTA Engineering and Program Management Division. We recommended that FTA consider funding regions based on their benefit/cost ratio that where derived by our ratings analysis. We also recommended that FTA recognize the relationships that our study indicates may exist between the objectives for successful evaluation of resource allocation.

FTA Comments, Feedback and Discussion

We provided drafts of this report and our findings to FTA Engineering and Program Management Division for review and comment. The AHP methodology was explained and the Windows based software, TeamEC, was demonstrated. FTA did not offer overall judgement on the report, our recommendation or methodology, but the director of the CPMO program questioned the effectiveness of prioritizing the objectives – an AHP model concept that we strongly support.

The director supported his question on the premise that FTA decisions often involve ambiguity, conflicting goals due to the multiple objectives, trade-offs and frequently more than one decision-maker. He further states that in governmental or public service domains, the objectives can be more social or political rather than financial or functional. The director indicated that when making important FTA decisions, all objectives are typically considered to have equal value of importance in order to compromise dissimilar beliefs and opinions.

In response to the director's comments and concerns related to prioritizing objectives, we offered additional information about the advantages of eginvector practices. We discussed how AHP helped us to prioritize the objectives on a verbal scale and synthesize the many factors involved for making the resource decision. The director began to realize how resource decision analysis not only provides a structured way to think about decisions, but also more fundamentally provides a structure within which the decision-makers can develop beliefs and feelings, those subjective judgements that Clemens discuss are critical for a good solution (Clemens, 1996).

Final Observations

FTA expressed an overall interest in the TeamEC software, accepting the results of our study as something to evaluate further. Additionally, FTA provided follow-on information about the size and complexity of projects assigned to Regions' 9 and 14. The projects are not considered by FTA to be

high risk or complex, and acknowledged that Regions 9 and 14 could be eliminated from the oversight program, given the benefit/cost ratio produced by our study. Although FTA made no commitments, we felt as a study team that our project presentation made an impression on the benefits from using an AHP methodology on a software platform such as TeamEC.

Lessons Learned From This Study Project

The AHP methodology and model deriving a performance measure from the rating analysis achieved the overall goal of "Distribution of U.S.DOT/FTA Budget for the CPMO Program." Our study analyzed the FTA investment in regional consultants and identified those that could be expected to contribute the greatest benefits in the most cost-effective manner. By using the AHP methodology, we found the results to be as Skinner suggest, that is the decision of evaluating regional distribution of funding resulted in higher quality, justifiable decision in less time and with reduced complexity (Skinner, 1999). The TeamEC model and the Excel Solver allowed a priority ranking based on the sensitivity performance analysis. The TeamEC platform provided an easy to use framework in which the resource decision could be defined. We feel also that FTA was convinced that a decision considering the tradeoff of criteria resulted in higher confidence of making a better choice.

APPENDIX I: References

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