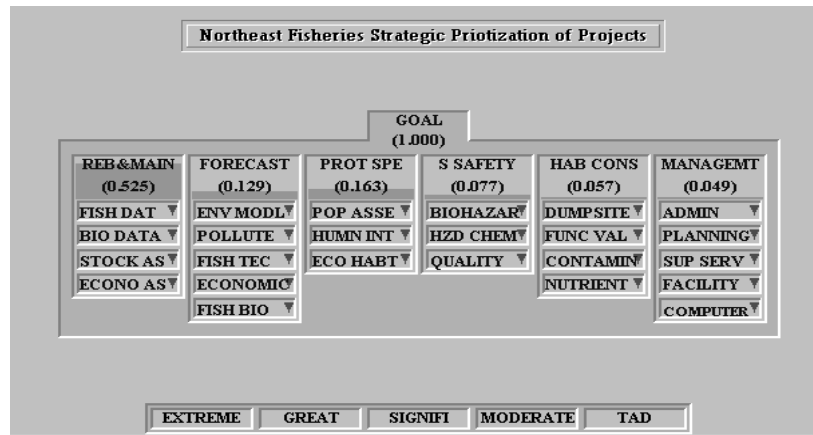# Resource Allocation

By Thomas Saaty

Allocating Resources to Projects

for

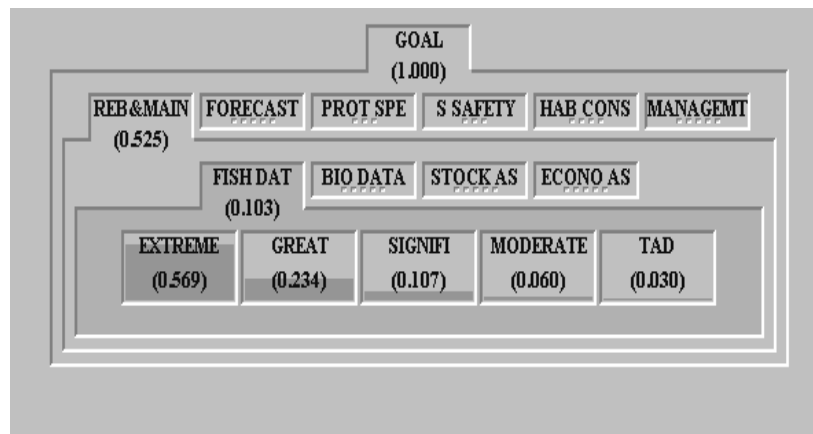The United States Northeast Fisheries,
Woods Hole, Massachusetts

Steps for Resource Allocation

- Determine the organization's strategic objectives and prioritize them
- Break the objectives down into sub-objectives as necessary and prioritize them in turn
- Establish the Ratings Categories for each lowest level objective and prioritize them

Hierarchy of Strategic Objectives and Sub-objectives

Northeast Fisheries Strategic Priotization of Projects

GOAL (1.000)

REB&MAIN (0.525)	FORECAST (0.129)	PROT SPE (0.163)	S SAFETY (0.077)	HAB CONS (0.057)	MANAGEMT (0.049)
FISH DAT	ENV MODL	POP ASSE	BIOHAZAR	DUMPSITE	ADMIN
BIO DATA	POLLUTE	HUMN INT	HZD CHEM	FUNC VAL	PLANNING
STOCK AS	FISH TEC	ECO HABT	QUALITY	CONTAMIN	SUP SERV
ECONO AS	ECONOMIC			NUTRIENT	FACILITY
	FISH BIO				COMPUTER

EXTREME   GREAT   SIGNIFI   MODERATE   TAD

Establish Ratings Categories and Prioritize for Each Lowest Level Objective

GOAL (1.000)

REB&MAIN (0.525)   FORECAST   PROT SPE   S SAFETY   HAB CONS   MANAGEMT

FISH DAT (0.103)   BIO DATA   STOCK AS   ECONO AS

EXTREME (0.569)	GREAT (0.234)	SIGNIFI (0.107)	MODERATE (0.060)	TAD (0.030)

Rate each Project for its contribution to each objective, using these Ratings Categories, and sum to get its Total.

REB&MAI- | FISH DAT

| EXTREME 1 (1.000) | GREAT 2 (.411) | SIGNIFI 3 (.188) | MODERATE 4 (.106) | TAD 5 (.052) |

	Alternatives	TOTAL	COSTS	REB&MAI-FISH DAT . .0542	BIO DATA . .1002	STOCK AS . .3397	ECONO AS . .0310	FORECAST-ENV MODL . .0147	POLLUTE . .0060	FISH TEC . .0340
1	131 PopDyL-1	0.384	25	GREAT	MODERATE	EXTREME				MODERATE
2	132 Branch Needs	0.140	40			GREAT				
3	132 Calibrate	0.173	15			GREAT				EXTREME
4	132 Eval Effort	0.139	35			GREAT				
5	132 Modeling	0.037	10			TAD				SIGNIFI
6	132 Sampling Dat	0.149	35			GREAT				SIGNIFI
7	133 Add Species	0.018	30			TAD				
8	133 Ecosys Impac	0.027	9							
9	133 Ethernet	0.025	7			TAD				MODERATE
10	133 Rec Data	0.139	20			GREAT				
11	161 Pop. Assess.	0.019	6							
12	162 Human Intera	0.012	6							
13	163 Ecosy Intera	0.003	10							
14	171 Survey 1	0.107	10		EXTREME					
15	172 Survey 2	0.011	6		MODERATE					
16	173 Survey 3	0.005	10		TAD					
17	181 Fishbio 1	0.100	28		EXTREME					
18	182 Fishbio 2	0.011	30		MODERATE					
19	183 Fishbio 3	0.011	10		MODERATE					
20	191 Fish Stat 1	0.000	7							
21	192 Fish Stat 2	0.000	10							
22	201 Sea Sample 1	0.005	10							
23	202 Sea Sample 2	0.000	10							
24	211 Biostats 1	0.000	3							

Where Projects do not Contribute leave Cells Blank

REB&MAI- | FISH DAT

| EXTREME 1 (1.000) | GREAT 2 (.411) | SIGNIFI 3 (.188) | MODERATE 4 (.106) | TAD 5 (.052) |

	Alternatives	TOTAL	COSTS	REB&MAI-FISH DAT . .0542	BIO DATA . .1002	STOCK AS . .3397	ECONO AS . .0310	FORECAST-ENV MODL . .0147	POLLUTE . .0060	FISH TEC . .0340
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21	192 Fish Stat 2	0.000	10							
22	201 Sea Sample 1	0.005	10							
23	202 Sea Sample 2	0.000	10							
24	211 Biostats 1	0.000	3							

Copy the Projects' Total Scores and Costs to an Excel Spreadsheet

	A	B	C
1	**Northeast Fisheries Resource Allocation**		
2	(only top ten projects were included)		
3	Project	Effectiveness	Cost/Project
4		(the Total from Expert Choice)	
5	PopDyl-1	0.384	25
6	Calibrate	0.173	15
7	Sampling Data	0.149	35
8	Branch Needs	0.140	40
9	Eval Effort	0.139	35
10	Rec Data	0.139	20
11	Survey 1	0.107	10
12	Fishbio 1	0.100	28
13	Multisp Mode	0.085	10
14	Fish Chem 2	0.052	9
15			
16			

R&D2

To Better Display the Effectiveness Score, the Totals from Expert Choice, Divide by the largest, .384, and Multiply by 100

	A	B	D
1	**Northeast Fisheries Resource Allocation**		
2	(only top ten projects were included)		
3	Project	Effectiveness	Effectiveness Normalized
4		(the Total from Expert Choice)	(divide by .384)*100
5	PopDyl-1	0.384	100.000
6	Calibrate	0.173	45.052
7	Sampling Data	0.149	38.802
8	Branch Needs	0.140	36.458
9	Eval Effort	0.139	36.198
10	Rec Data	0.139	36.198
11	Survey 1	0.107	27.865
12	Fishbio 1	0.100	26.042
13	Multisp Mode	0.085	22.135
14	Fish Chem 2	0.052	13.542
15			

R&D2

To fund the projects that give the most effectiveness for the funds that can be spent, use Excel's Solver routine. Set up the Excel Spreadsheet as shown on the next slide, and enter $150,000 as the amount available. Then use the Excel command "Tools, Solver" to find the optimum solution.

Set up a Decision Variable column. 0 means do not fund, 1 means fund, the project in that row. Initially it contains all 0's, and Solver puts in 1's for the projects to be supported.

R&D1.xls

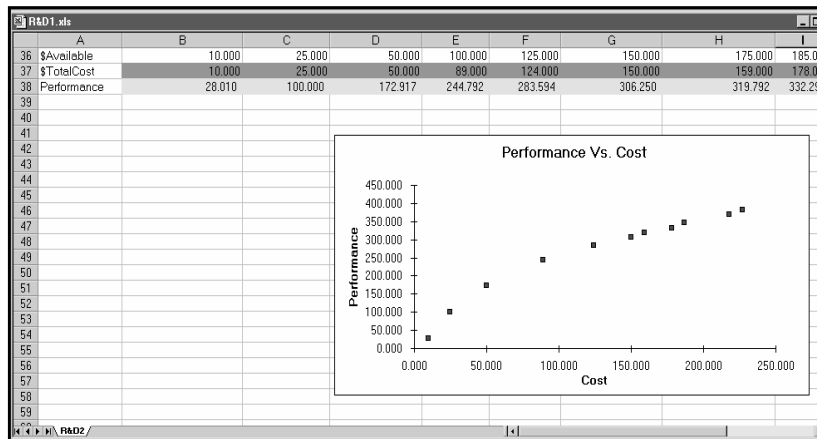|	A	B	C	D	E	F	G	H
1	Northeast Fisheries Resource Allocation							
2	(only Top Ten Projects)							
3								
4	Project	Effectiveness	Cost/Project	Effectiveness	Decision	Cost	Performance	
5		(Total from Ratings)	(in '000's)	(Normalized)*100	Variable	(in 000's)	(effectiveness)	
6	PopDyI-1	0.384	25	100.000	0	0.000	0.000	
7	Calibrate	0.173	15	45.052	0	0.000	0.000	
8	Sampling Data	0.149	35	38.802	0	0.000	0.000	
9	Branch Needs	0.140	40	36.458	0	0.000	0.000	
10	Eval Effort	0.139	35	36.198	0	0.000	0.000	
11	Rec Data	0.139	20	36.198	0	0.000	0.000	
12	Survey 1	0.107	10	27.865	0	0.000	0.000	
13	Fishbio 1	0.100	28	26.042	0	0.000	0.000	
14	Multisp Mode	0.085	10	22.135	0	0.000	0.000	
15	Fish Chem 2	0.052	9	13.542	0	0.000	0.000	
16					Total $'s	0.000	0.000	(Effectiveness)
17								
18					Avail. $'s	160.000		
19								

R&D2

Set up the Excel Solver routine parameters to maximize the Performance Effectiveness target cell, and solve. Solver puts the appropriate 1's and 0's in the Decision Variable Column.

Solver Parameters dialog:
- Set Target Cell: $G$16
- Equal To: ● Max ○ Min ○ Value of: 0
- By Changing Cells: $E$6:$E$15
- Subject to the Constraints:
  - $E$6:$E$15 <= 1
  - $E$6:$E$15 = integer
  - $E$6:$E$15 >= 0
  - $F$16 <= $F$18
- Buttons: Solve, Close, Guess, Options, Add, Change, Delete, Reset All, Help
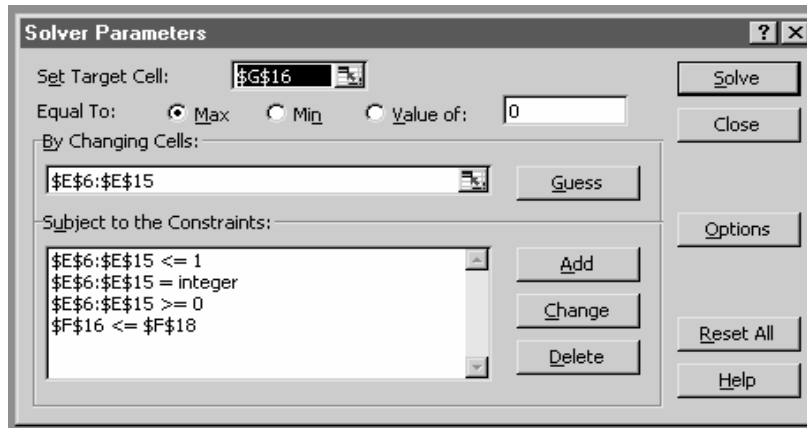
Solution: $159K dollars of the $160K available can be allocated as shown below with an effectiveness of 319.79

R&D1.xls

	A	B	C	D	E	F	G	H
1	Northeast Fisheries Resource Allocation							
2	(only Top Ten Projects)							
3								
4	Project	Effectiveness	Cost/Project	Effectiveness	Decision	Cost	Performance	
5		(Total from Ratings)	(in '000's)	(Normalized)*100	Variable	(in 000's)	(effectiveness)	
6	PopDyf-1	0.384	25	100.000	1	25.000	100.000	
7	Calibrate	0.173	15	45.052	1	15.000	45.052	
8	Sampling Data	0.149	35	38.802	1	35.000	38.802	
9	Branch Needs	0.140	40	36.458	0	0.000	0.000	
10	Eval Effort	0.139	35	36.198	1	35.000	36.198	
11	Rec Data	0.139	20	36.198	1	20.000	36.198	
12	Survey 1	0.107	10	27.865	1	10.000	27.865	
13	Fishbio 1	0.100	28	26.042	0	0.000	0.000	
14	Multisp Mode	0.085	10	22.135	1	10.000	22.135	
15	Fish Chem 2	0.052	9	13.542	1	9.000	13.542	
16					Total $'s	159.000	319.792	(Effectiveness)
17								
18					Avail. $'s	160.000		
19								

R&D2

The graph below shows that Effectiveness increases rapidly with additional expenditures up to about $150 K, and less rapidly after that.

R&D1.xls								
	A	B	C	D	E	F	G	H	I
36	$Available	10.000	25.000	50.000	100.000	125.000	150.000	175.000	185.000
37	$TotalCost	10.000	25.000	50.000	89.000	124.000	150.000	159.000	178.000
38	Performance	28.010	100.000	172.917	244.792	283.594	306.250	319.792	332.292
39									
40									
41									

Performance Vs. Cost

(chart: Performance vs. Cost scatter plot)

An Observation

- **Governments are often interested in getting the maximum effective-ness, regardless of cost**

- **Businesses are often interested in increasing their return per dollar spent, or maximizing their "bang per buck".**