Planning
&
Conflict
Resolution

By Thomas Saaty

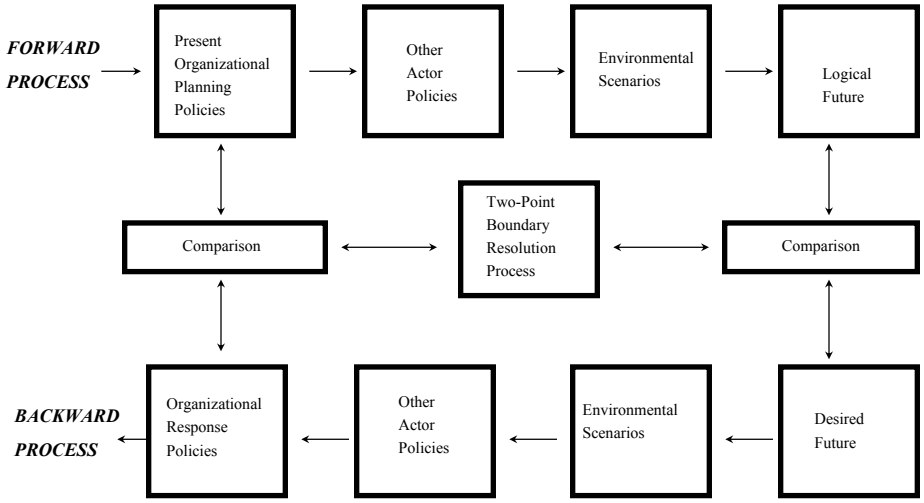
HOW TO STRUCTURE HIERARCHIES IN FORWARD AND BACKWARD PLANNING

There are two generic types of hierarchies:

1- The forward process hierarchy is used to project the likely or logical future;

2- The backward process hierarchy is used to find promising control policies to attain desired future.

A Schematic Representation of the Basic Planning Orientation



Decisions and the Backward Process

All problems of choice and decision are expressions of desire. They are backward processes in which we set priorities on what is important or should be and use it to identify the best choice to satisfy it.

Outcome Projection & Elections

The Forward Process

All problems of prediction are forward process problems about what people prefer and what is likely to happen as a result of that preference.

FUTURE

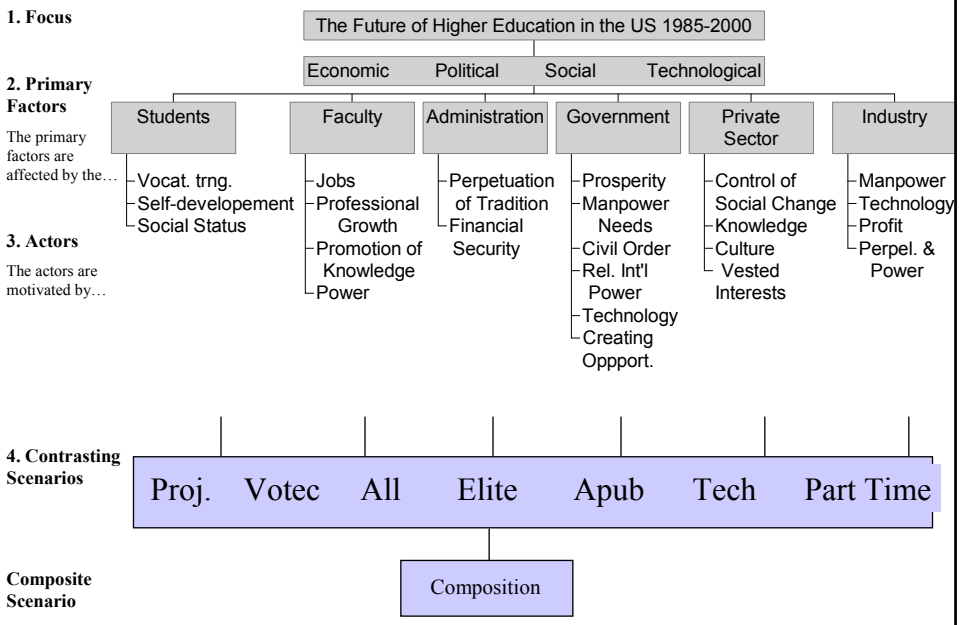
Planning is an iterative process combining the forward and backward processes to produce convergence of the likely to happen towards what is desired to happen.

GENERIC HIERARCHY FOR FORWARD PLANNING

- Time Horizons
- Uncontrollable Environmental Constraints
- Risk Scenarios
- Controllable Systemic Constraints
- Overall Objectives of the System
- Stakeholders
- Stakeholder Objectives (Separate for each one)
- Stakeholder Policies (Separate for each one)
- Exploratory Scenarios (Outcomes)
- Composite or Logical Scenario (Outcome)

Contingency Planning policies must be devised to deal with unexpected occurrences and scenarios included to allow for such a possibility.

A Hierarchy of Influences on Higher Education



Seven Scenarios are offered.

1. (PROJ) Projection of the present status quo (slight perturbation of present)
2. (VOTEC) Vocational-Technically Oriented (Skill orientation)
3. (ALL) Education for All (subsidized education)
4. (ELITE) Elitism (for those with money or exceptional talent)
5. (APUB) All Public (government owned)
6. (TECH) Technology Based (little use of classroom-use of media, computers)
7. (P.T.) Part-Time Teaching; no research orientation

SEVEN SCENARIOS AND THE CALIBRATION OF THEIR CHARACTERISTICS

Scale: -5 +5 ←→

Scenario Weights **CHARACTERISICS**	.096 1 PROJ	.259 2 VOTEC	.191 3 ALL	.174 4 ELITE	.122 5 APUB	.068 6 TECH	.081 7 P.T.	COMP
STUDENTS								
1. Number	-2	+2	+4	- 3	- 1	+2	- 2	0.42
2. Type (I.Q.)	-1	-2	- 3	+3	- 1	- 2	- 1	1.0 0
3 Function	+1	-1	0	+1	0	- 2	+2	0.03
4. Jobs	+1	+4	- 3	+4	+1	- 2	+1	1.32
FACULTY								
1. Number	-2	+2	+4	- 3	- 1	- 5	- 4	-.22
2. Type (Ph.D.)	+1	0	-2	+3	+1	+2	- 3	.25
3 Function (role on campus)	- 2	- 3	-2	+1	- 2	- 5	- 5	-2.12
4 Job Security	-2	+ 1	+2	- 3	- 1	- 4	- 4	-.79
5. Acad. Freedom	0	-2	0	+2	- 1	- 4	- 5	-.97
INSTITUTION								
1. Number	-1	+2	+2	- 3	- 1	- 4	- 1	-.19
2. Type (acad./non-acad.)	-1	- 4	- 3	+3	- 1	- 3	- 3	-1.75
3. Governance**	+2	+4	+1	- 2	+2	5	5	2.06
4. Effieciency **	+2	+3	- 2	+4	- 1	- 1	0	1.09
5. Accessibility	0	+2	+5	- 3	+2	+ 4	+1	1.55
6. Culture-Entertain.	0	- 2	+3	+3	+1	- 3	- 1	.41
7. Avail $ and other Resources	-1	+2	+2	- 2	0	- 1	- 3	.64
EDUCATION								
1. Curriculum (life long learning)	1	- 2	+2	+3	+1	+0	- 1	.50
2. Length of Study	0	- 3	+2	0	+1	+2	0	-.14
3. Value of a Degree	-1	0	- 2	+4	- 1	- 2	- 2	-.20
4. Cost per Student	+3	+3	+3	+4	+2	- 1	- 1	2.43
5. Research by Faculty	+1	- 1	- 1	+3	+1	- 3	- 4	.24

Which factor has the greater impact on higher education?

HIGHER EDUC.	Econ	Pol	Soc	Tech	Priority Vector
Econ.	1	4	3	5	.549
Pol.	1/4	1	1/3	1	.106
Soc.	1/3	3	1	2	.236
Tech.	1/5	1	1/2	1	.109

Who has more impact on the way education affects the economy of the United States?

Econ.	S	F	A	G	P	I	E.V.
Stu.	1						.04
Fac.	1/3	1					.02
Adm.	2	5	1				.06
Gov.	8	8	7	1			.47
Pri.	5	6	3	1/5	1		.21
Ind.	8	8	5	1/4	5	1	.28

Who has more impact on the way education affects the political situation of the United States?

Pol.	S	F	A	G	P	I	E.V.
Stu.	1						.044
Fac.	1	1					.044
Adm.	1/3	1/3	1				.027
Gov.	7	7	7	1			.500
Pri.	5	5	5	1/7	1		.116
Ind.	7	7	7	1/5	6	1	.270

Who has more impact on the way education affects the social issues in the United States?

Soc.	S	F	A	G	P	I	E.V.
Stu.	1						.102
Fac.	1/3	1					.067
Adm.	1/3	1/4	1				.037
Gov.	5	5	5	1			.411
Pri.	1	3	5	1/4	1		.121
Ind.	5	4	5	1/3	3	1	.262

Who has more impact on the way education affects the technology of the United States?

Tech.	S	F	A	G	P	I	E.V.
Stu.	1						.022
Fac.	7	1					.105
Adm.	3	1/7	1				.034
Gov.	8	4	7	1			.231
Pri.	8	3	7	1/2	1		.165
Ind.	9	5	8	3	5	1	.443

Which objective has more impact on the students vis-à-vis education?

STUDENT	V.T.	S.D.	S.S.	E.V.
Voc. Trng	1	4	7	.687
Self-Devel		1	5	.243
Soc. Status			1	.069

Which objective has more impact on the faculty vis-à-vis education?

FACULTY	J	P.G.	P.K.	P	E.V.
Jobs	1	5	4	6	.596
Prof. Growth		1	1	3	.154
Promo			1	5	.190
Knowl.				1	.060
Power					

Which objective has more impact on the administration vis-à-vis education?

ADMIN.	P	F.S.	E.V.
Perpetuation	1	1	.250
Financial Security	3		.750

Which objective has more impact on the government vis-à-vis it's objectives?

GOV	P	C.O.	M	RIP	T	OPP	E.V.
Prosperity	1	1/5	3	3	5	6	.203
Civ. Order		1	5	7	8	8	.516
Manpower			1	1/2	3	5	.092
Rel. Int'l Power				1	3	5	.110
Technology					1	4	.051
Create Oppor.						1	.027

Which object has more impact on the private sector vis-à-vis it's objectives?

PRI	CSC	K	C	V.I.	E.V.
Con. Soc.	1	3	3	1/5	.220
Ch.		1	3	1/3	.139
Knowledge			1	1/6	.065
Culture				1	.576
Vest. Int.					

Which objective has more impact on industry vis-à-vis it's objectives?

IND	CSC	K	C	V.I.	E.V.
Manpower	1				.040
Technology	4	1			.084
Profit	9	7	1		.331
Perpetuation & Power	7	7	3	1	.546

	Econ.	Pol.	Soc	Tech				
S	.04	.04	.10	.02	.55	E	.05	**S**
F	.02	.04	.07	.10			.05	**F**
A	.06	.03	.04	.03	.11	P	.05	**A**
G	.47	.49	.41	.23	.24	S =	.46	**G**
P	.12	.12	.12	.16			.14	**P**
I	.28	.27	.26	.44	.21	T	.34	**I**

$$ForGovernment: .46\begin{bmatrix}.20\\.52\\.09\\.11\\.05\\.03\end{bmatrix}=\begin{bmatrix}.09\\.24\\.04\\.05\\.01\\.01\end{bmatrix}\begin{matrix}\text{Pr}osperity\\Civ.Order\\Manpower\\R.I.P.\\Techno\log y\\CreateOppor.\end{matrix}$$

$$ForIndustry: .34\begin{bmatrix}.04\\.08\\.33\\.55\end{bmatrix}=\begin{bmatrix}.01\\.03\\.11\\.19\end{bmatrix}\begin{matrix}Manpower\\Techno\log y\\\text{Pr}ofit\\Perpet\&\ Power\end{matrix}$$

We choose the factors from both actors whose priority is about ten percent or more.

$$\begin{bmatrix} .15 \\ .38 \\ .17 \\ .30 \end{bmatrix} = \begin{matrix} \text{Pr}osperity \\ CivilOrder \\ \text{Pr}ofit \\ Perpet\&Power \end{matrix}$$

Which scenario has more impact on the prosperity of the United States?

PROSP	SQ	VT	EA	E	AP	TB	PT	EV
STAT QUO	1	1/5	1/3	5	1	5	5	.129
VOC. TECH		1	3	7	1	5	5	.329
ED. ALL			1	7	5	5	5	.275
ELITE				1	1/5	3	1	.041
ALL PUB					1	3	5	.149
TECH						1	1/3	.032
BASED							1	.045
PART-TIME								

Which scenario has more impact on the civil order of the United States?

CIVIL ORD.	PROJ	VT	EA	E	AP	TB	PT	EV
STAT QUO	1	1/3	1/5	5	1	3	3	.125
VOC. TECH		1	1/3	5	1	3	3	.180
ED. ALL			1	5	3	5	5	.369
ELITE				1	1/5	1/3	1/2	.033
ALL PUB					1	5	5	.177
TECH						1	1/3	.050
BASED							1	.065
PART-TIME								

Which scenario has more impact on profit ability?

PROFIT	PROJ	VT	EA	E	AP	TB	PT	EV
STAT QUO	1							.067
VOC. TECH	5	1						.309
ED. ALL	1/4	1/7	1					.028
ELITE	5	1	8	1				.331
ALL PUB	1/3	1/3	3	1/6	1			.048
TECH-BASED	3	1/5	3	1/5	4	1		.129
PART-TIME	3	1/5	3	1/5	3	1/3	1	.089

Which scenario has more impact on perpetuating industrial methods and power?

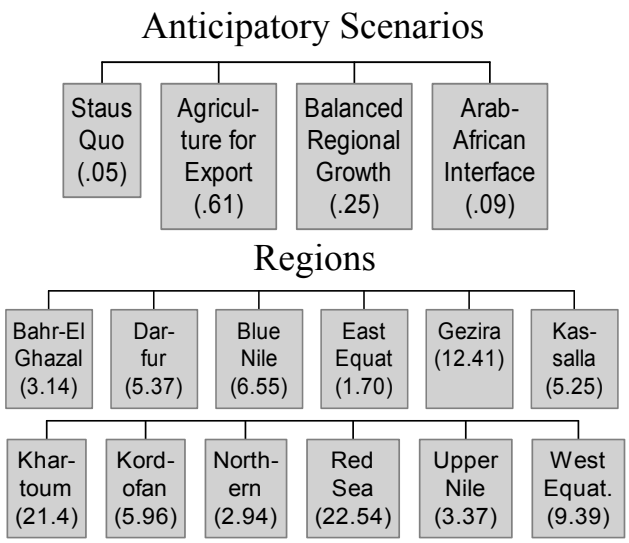
PERP & PWR	PROJ	VT	EA	E	AP	TB	PT	EV
STAT QUO	1							.062
VOC. TECH	7	1						.306
ED. ALL	1/7	1/5	1					.026
ELITE	5	1	8	1				.330
ALL PUB	1	1/5	5	1/6	1			.085
TECH	3	1/3	3	1/5	1/3	1		.075
BASED	4	1/5	4	1/5	2	2	1	.115
PART-TIME								

		PROS	*C.ORD.*	*PROF*	*P&P*			
	1	.129	.125	.067	.062			.096
	2	.329	.180	.309	.306	.14		.259
	3	.275	.369	.028	.026	.38	=	.191
scenario	4	.041	.033	.331	.330	.17		.174
	5	.149	.177	.048	.085	.30		.122
	6	.032	.050	.129	.075			.068
	7	.045	.065	.089	.115			.081

THE BACKWARD PROCESS HIERARCHY

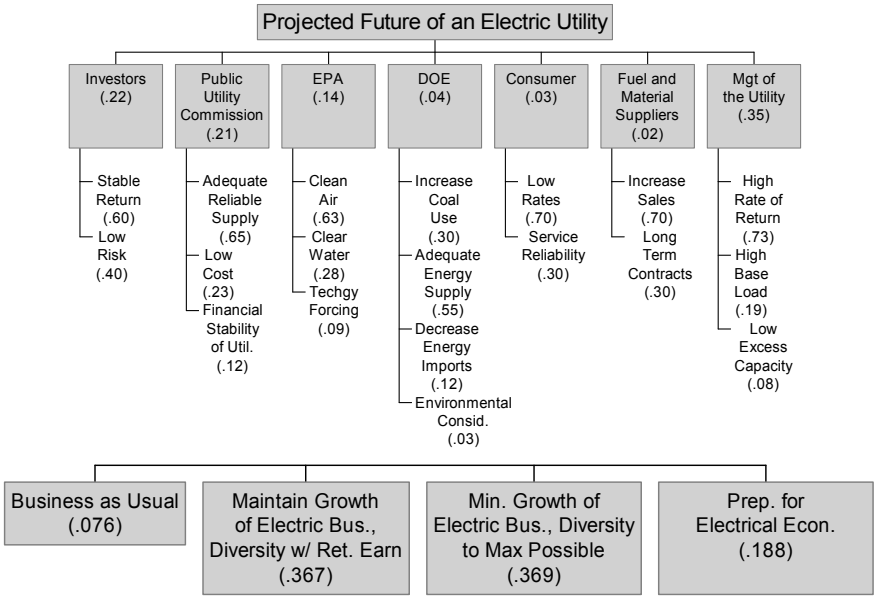
- Anticipatory Scenarios
- Problems and Opportunities
- Actors and Coalitions
- Actor Objectives
- Actor Policies
- Particular Control Policies to Influence the Outcome

Planning Backward from the Future to the Present: Sudan Transport

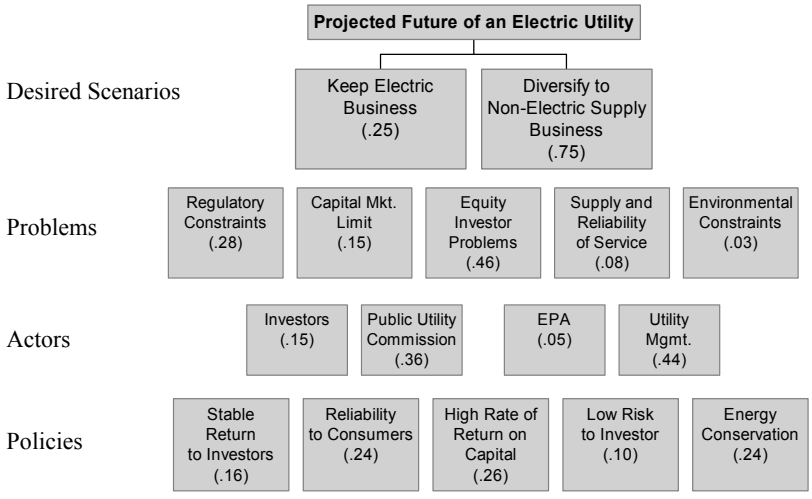


PROJECT	PRIORITY	COST	PRIORITY/COST RATIO
RAIL			
Port Sudan-Haiya	4.724	9.10	0.52
Haiya-Atbara	3.455	9.50	0.36
Atbara-Khartoum	8.443	11.00	0.77
El-Rahad-Babanusa	1.005	12.70	0.08
ROAD			
Wad Medani-Gedaref	2.840	23.90	0.12
Gedaref-Kassala	0.872	14.20	0.06
Kassala-Haiya-Port Sudan	2.229	50.00	0.04
Wad-Medani-Sennar	0.526	14.90	0.04
Sennar-Kosti	0.345	7.20	0.05
Sennar-Es Suki	0.546	7.00	0.08
Ed Dubeibat-Kadugli	1.253	12.30	0.08
Kadugli-Talodi	0.266	6.60	0.04
Nyala-Kass-Zalingei	0.951	11.30	0.08
Juba Nimuli	0.329	5.30	0.06
Juba-Amadi-Rumbek-Wau	0.494	20.30	0.02

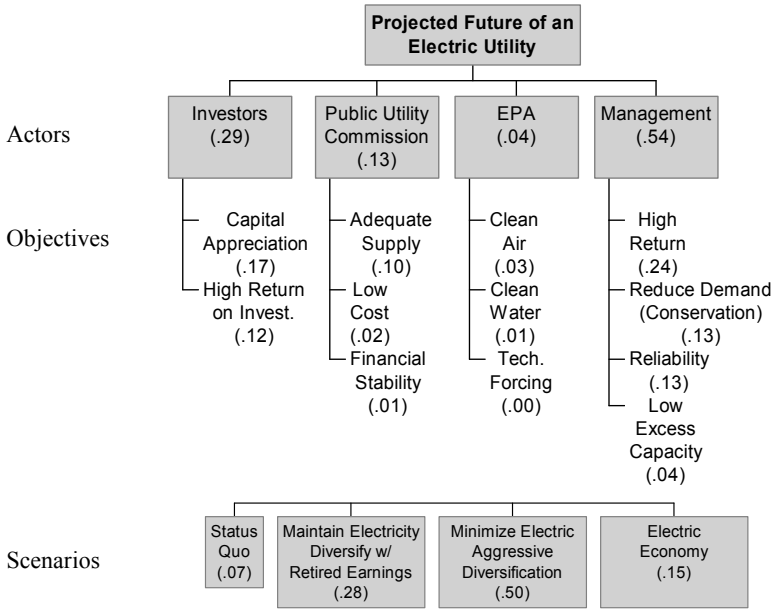
Forward Process Hierarchy



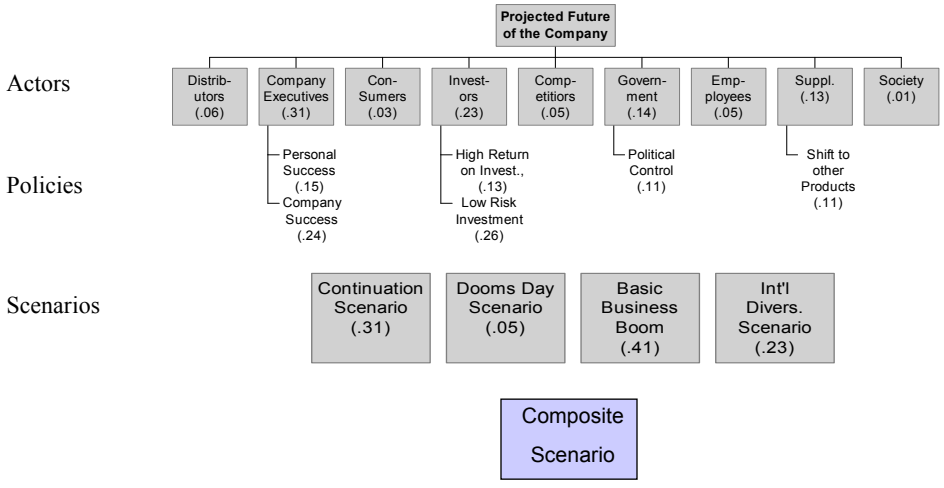
Backward Process Hierarchy



Second Forward Process

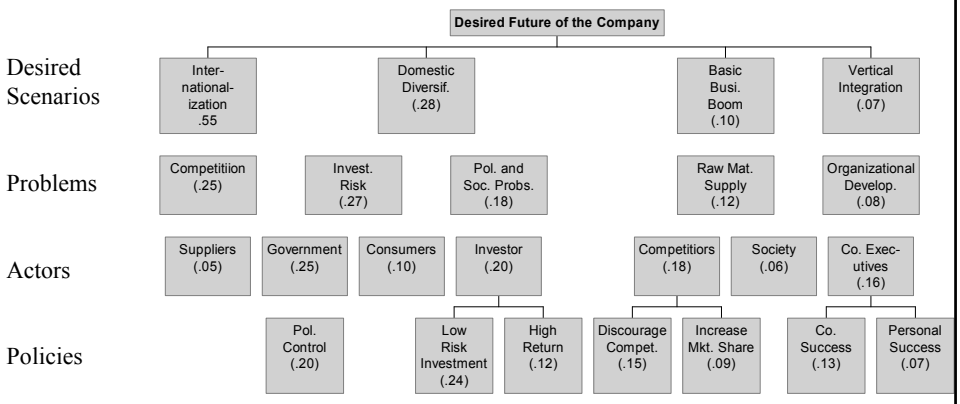


The Forward Planning Process



(Numbers represent the weight of importance of an element at a particular level of the analysis)

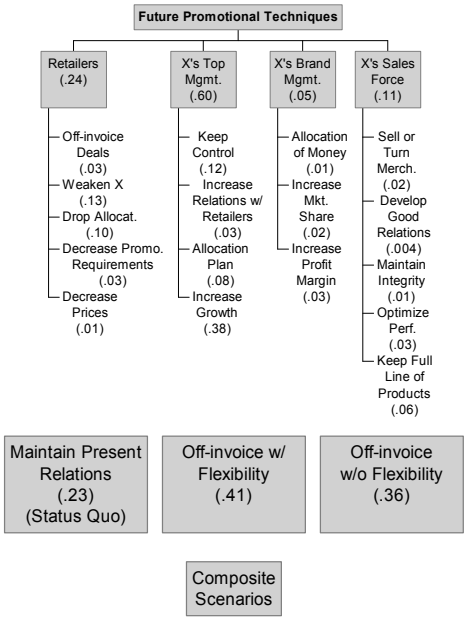
Backward Planning Process



(Numbers represent the weight of importance of an element at a particular level of the analysis)

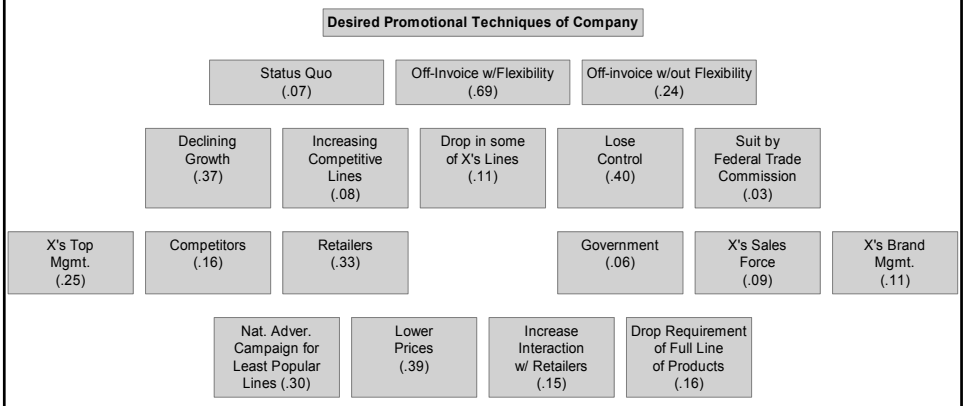
Exhibit

Forward Process Hierarchy

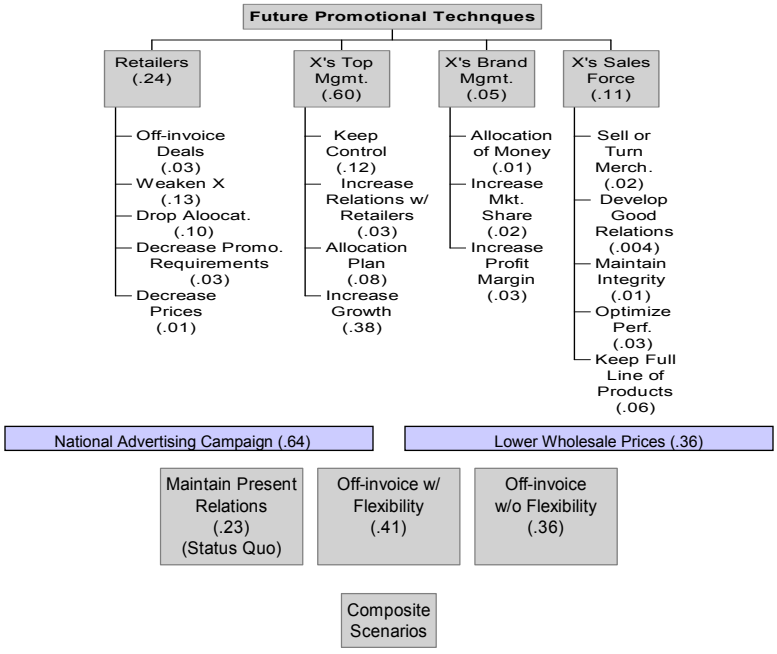


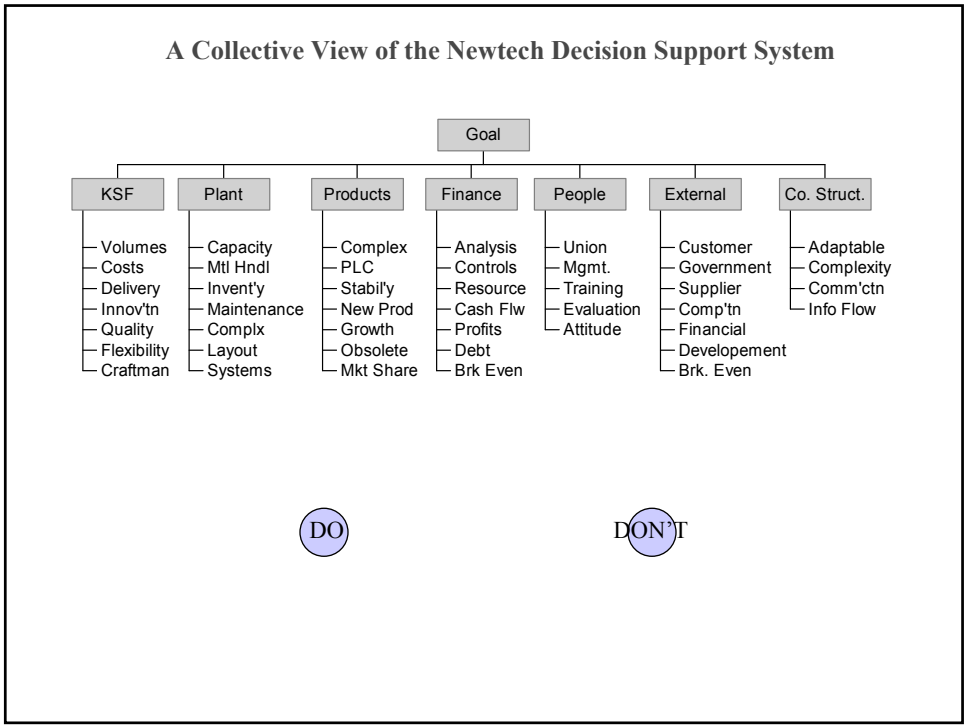
Exhibit

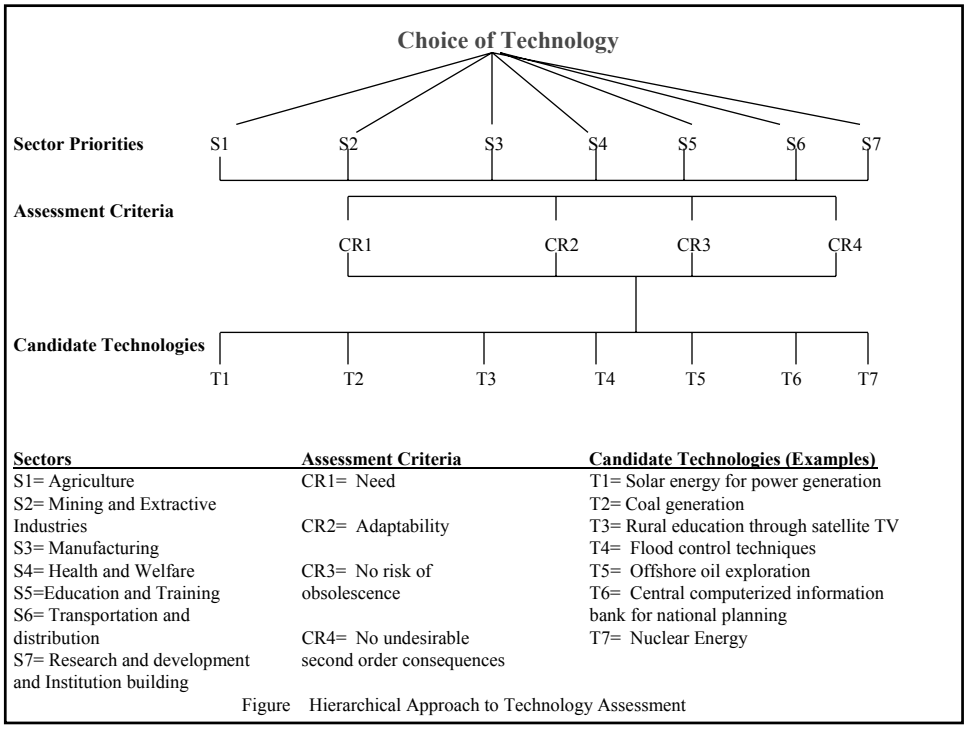
Backward Process Hierarchy



Second Forward Hierarchy Process

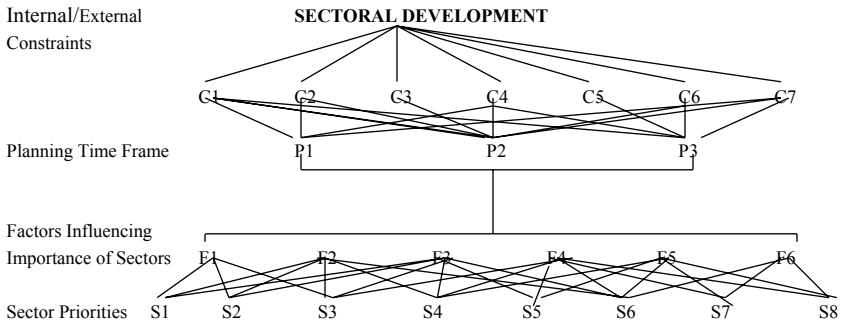






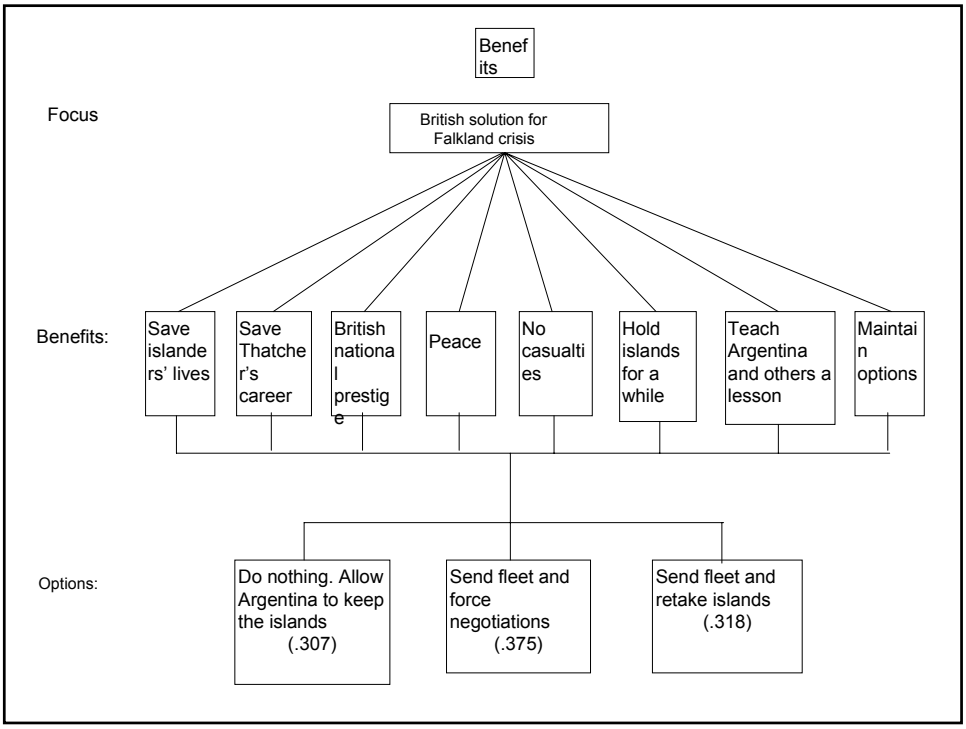
Sectors	Assessment Criteria	Candidate Technologies (Examples)
S1= Agriculture	CR1= Need	T1= Solar energy for power generation
S2= Mining and Extractive Industries	CR2= Adaptability	T2= Coal generation T3= Rural education through satellite TV
S3= Manufacturing		T4= Flood control techniques
S4= Health and Welfare	CR3= No risk of	T5= Offshore oil exploration
S5=Education and Training	obsolescence	T6= Central computerized information
S6= Transportation and distribution	CR4= No undesirable	bank for national planning T7= Nuclear Energy
S7= Research and development and Institution building	second order consequences	

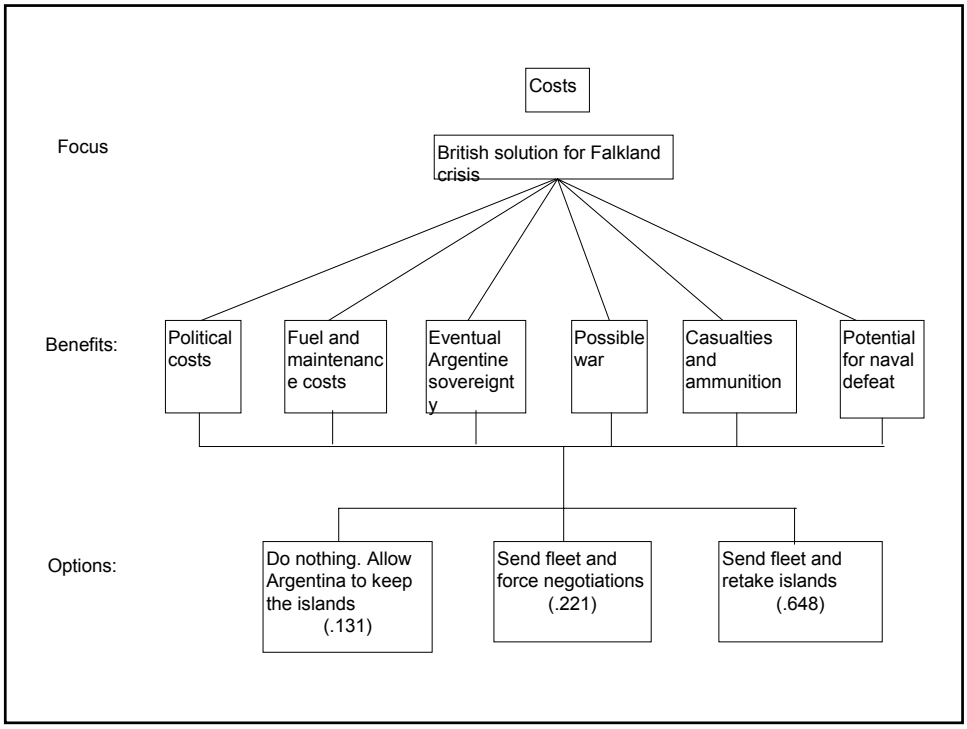
Figure Hierarchical Approach to Technology Assessment



Internal/External Constraints	**Planning Time Frames**	**Factors Influencing Importance of Sectors**	**Sectors**
C1= World Political Situation	**P1**=Short (1-5 yrs.)	**F1**=Population engaged in Sector	**S1**=Agriculture
C2=Foreign Exchange Situation	**P2**=Medium (6-10 yrs.)	**F2**=Contribution of sector to GNP	**S2**=Mining and Extractive Industries
C3=Food Situation	**P3**= Long (11-20 yrs.)	**F3**=Contribution of sector to inflation/deflationary effects	**S3**=Manufacturing
C4=Political Leadership at home		**F4**=Contribution to Employment	**S4**=Health and Welfare
C5='Felt Urgency' for development		**F5**=Contribution to Exports, balance of payments	**S5**=Education and Training
C6=Extent of Independence desired		**F6**=Untapped Growth Potential	**S6**=Transportation and Distribution
C7=Capacity to meet targets			**S7**=Communication
			S8=Research and development and Institution building

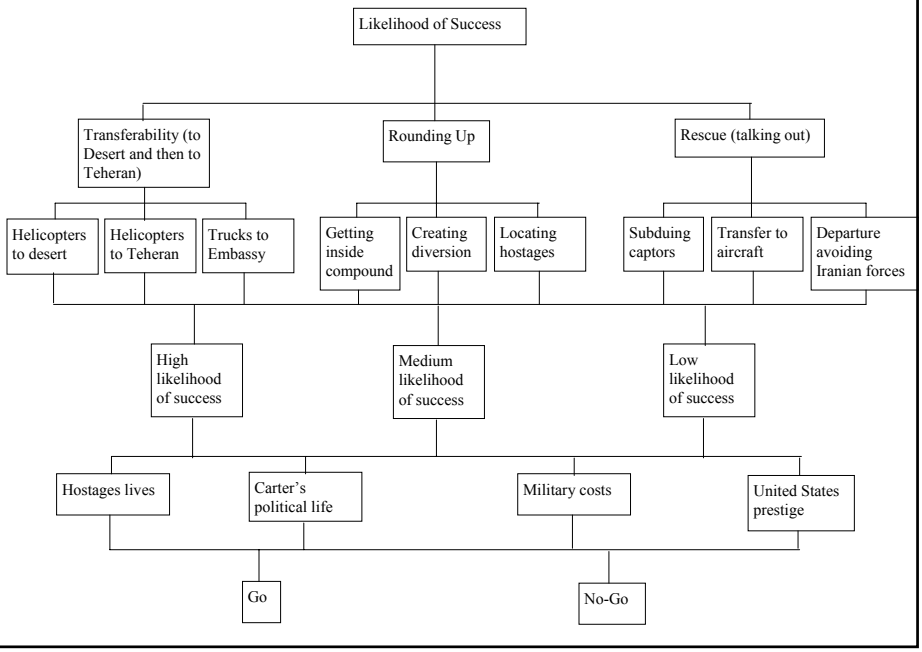
Figure Determining Sector Priorities Based on Constraints (Backward Approach)





	BENEFITS	COSTS	B/C
Argentina keeps islands	0.307	0.131	**2.34**
Sent fleet and force negotiations	0.375	0.221	**1.70**
Sent fleet and retake islands	0.318	0.648	**0.49**

US IRAN HOSTAGE PROBLEM



	1	2	3	4	Priorities
1. Hostages' lives	1	1/3	5	1/3	0.15
2. Carters political life	3	1	7	4	0.54
3. Military costs	1/5	1/7	1	1/6	0.05
4. U.S. prestige	3	1/4	6	1	0.26

The analysis showed that :

GO : 0.41 NO GO : 0.59