
CASE 2 USE OF OPERATIONS RESEARCH TECHNIQUES: A CASE STUDY OF ECS CORPORATION

The Essential Commodities Supply Corporation (herein after referred to as The Corporation) is a public sector undertaking in the State charged with the duty of carrying out public distribution of essential commodities to the people of the State at such rates as would discourage private traders to deal in such commodities at exorbitant prices during festival times and other times of high demand. The Corporation accomplishes this by procuring various items of essential commodities like rice, sugar, maida, sooji, different types of grams etc., from different parts of the country at appropriate times and transporting them to various districts of the State and selling them to the public through its own outlets as well as a series of fair price shops. In some items like Palmolin, Tea, etc., the Corporation is able to generate surplus. In other commodities like rice, sugar etc., the corporation follows a policy of selling 10% below the prevailing market rates. This may result in losses. However because of the cross subsidisation among different items the corporation breaks even and in some years earns overall surplus.

The annual turnover of the corporation is about Rs 200 crores. The corporation is managed as a company. It has a Director Board and an MD, a GM and regional and district level managers to manage the affairs of the company.

The corporation came into being more than a decade ago. Most of the personnel are officers serving on deputation from Govt. Departments. A few managers and other staff have been recruited from the open market. The MD, GM etc., are mostly drawn from the administrative services and they serve for short periods only.

One of the major items of essential commodity which the corporation deals with is sugar. Sugar is an item coming under Central Government Control. Based on the requisitions from the state through the Corporation the Central Government allocates periodically specified quantities from sugar mills situated in different parts of the country to the corporation. The Corporation has to make its own arrangements for lifting the sugar, and transport it from the mills to the various taluk level depots. The number of sugar factories from which sugar quota are allocated is in the range of 10 to 15. The number of destinations to which transport is to be arranged as at present is more or less equal to the number of Taluk Depots in the State, i.e. about 61.

The Corporation invites tenders for transport of sugar on a per tonne basis from the various mills to the taluk depots. However the tenderers are requested to quote rates for transport to the district headquarters (14 in numbers) which should hold good for transport to taluk level depots also. Thus every tenderer gives a quotation in the form of a matrix of 14 columns (no. of districts) and 10 to 15 rows only (no. of mills). Of course, tenders may quote for certain transports only. Usually 15 to 20 offers are received. (See annexure 1 for sample quotations)

The first step following the opening of tenders is to evaluate the tenders and tabulate the lowest rates quoted for all possible transportations from mills to destinations. Where there are 10 mills and 14 destinations for which, say 10 tenderers have quoted, this process involves locating from 10 offers for each of the 10 x 14 140 possible transportations. This work was being done manually taking about a full day or more than a day. Five Years back a management consultant Mr. C offered to get this work done in a few minutes time using a computer. He also offered to give the programme in a floppy so that the corporation can use the programme in any IBM compatible computer anywhere and also use the programme repeatedly every month or other periodic intervals whenever the work has to be repeated. He claimed that, including data entry the total time required to get an output showing lowest quoted rates for all possible transports would be only less than 30 minutes. The consultant demanded a nominal fee. The manager in charge of the section had difficulty in believing that the work could be got done in a few minutes. If this could be done in 30 minutes he will be rid of a cumbersome comparison process for hours together every month. The consultant was only too willing to demonstrate. After seeing the demonstration the Manager got convinced. He took up the matter with the general Manager. The General Manager knew something about computers and wondered how a computer programme could be written to tackle the problem.

Questions

- 1) Using the data in Annexure 1 find the least offers for all possible transportations. Present the results in 10 x 14 matrix.

Case prepared by Prof. S. Chidambara Iyer, Management Consultant, Trivandrum. Case Material has been prepared to serve as a basis for class discussion. Cases are not designed to present illustrations of either correct or incorrect handling of managerial problems.

Stage 2

Once a matrix of lowest rates is obtained, the next stage of the procedure is to select tenders for award of transport contracts. This meant the scanning of the matrix repeatedly to select a combination of transportations which resulted in as low a cost as possible. This was being done manually by the Manager sitting up with his assistants and doing repeated 'trials. Of course, there was no way of determining whether the allocation which they arrived at was the least cost allocation,

The Consultant Mr. C challenged the Manager that he will be able to suggest an allocation of transports which will be at least 10% cheaper than the allocation which the Manager had worked out manually. The consultant also claimed that from the data already fed into the computer, regarding the tender rates, the quantities allocated to each mill and the demand of different destinations, (see annexure 2 for typical allocations to mills and district-wise demands) it would be a matter of few minutes to get an almost least cost solution. He also offered to provide the programme in a floppy disc so that the corporation can take it to any computer which is IBM compatible and using the output from stage 1, and data relating to allocation to mills and district-wise demands get a print out of the least cost assignments in about 15 minutes of time. The consultant also was prepared to demonstrate his claim. Having been already convinced once of the consultant's claim regarding determination of the lowest quoted rates for all possible transportations, the Manager did not feel like challenging the consultant but wondered how it would be possible to accomplish the task in a few minutes, as it normally took several hours for him and his assistants to come up with a solution and that too with no assurance that the solution represents a least cost situation.

Questions

- 1) What method do you think the consultant adopted to get a quick solution?
- 2) Solve the problem using the Vogel's approximation method and N-W corner rule.

Stage 3

The Corporation bought the programme from the consultant for determination of lowest tender rates as well as least cost allocation of transports at nominal rates. This was in the year 1984. Since then the corporation has been using the programme all these years without any problems worth mentioning. The floppy is taken to a nearby computer centre and after feeding data, outputs are generated Nominal fees is also paid.

Of recent however, some problems have cropped up. Sometimes the solutions obtained require allocation of very large quantities to one contractor. The contractor who normally quote are known to the Corporation and their maximum capabilities are also generally known. It would be imprudent to allocate very large quantities to transport contractor beyond their capabilities. The Corporation therefore wants to introduce a constraint that not more than a specified quantity shall be allotted to any contractor. In the programme supplied by the consultant and which is under use now, there is no scope for introducing any constraints. The corporation would like to modify the programme to introduce the constraint.

The Corporation would also like to invite offers for delivery to various taluk depots as against inviting offers for a common rate for each district, which should hold good for different taluks in the district also. The present practice, it is feared induces the contractors to quote high average rates. The programme available with the corporation does not provide for feeding separate data for delivery to taluks.

Recently a group of O.R. trainers visited the Corporation to find out how far and with what results O.R. is being applied in the corporation. The corporation posed the above two problems to the group for a solution.

Questions

- 1) Suggest ways of solving the above two problems.

ANNEXURE 1(i)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	219	244	199	255	229	259	224	194	158	239	239	184	254	243
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	259	278	238	289	264	294	259	234	199	274	274	224	289	289
5.	S5	1200.0	264	289	243	294	269	299	264	239	204	279	279	229	294	294
6.	S6	1300.0	254	274	233	284	239	289	254	229	194	269	269	219	284	284
7.	S7	1000.0	204	224	179	254	234	244	204	179	144	219	219	169	234	245
8.	S8	1800.0	269	289	248	299	274	304	269	244	209	284	284	234	299	294
9.	S9	269.0	254	274	233	284	259	289	254	229	194	269	269	218	284	284
10.	S10	1600.0														
	Total	11958.6														

Place:

Date:

ANNEXURE 1(ii)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	247	252	214	279	247	297	250	216	158	261	252	198	286	273
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	270	256	225	306	257	324	270	236	187	279	274	216	295	299
5.	S5	1200.0	277	270	232	315	268	333	285	243	198	286	282	223	306	306
6.	S6	1300.0	272	265	232	315	257	335	277	240	194	285	279	225	304	306
7.	S7	1000.0	198	234	167	288	205	279	198	187	126	216	214	160	245	286
8.	S8	1800.0	252	281	232	279	263	335	260	252	187	250	245	223	261	304
9.	S9	269.0														
10.	S10	1600.0	178	225	158	272	196	270	187	180	119	207	205	153	236	277
	Total	11958.6														

Place:

Date:

ANNEXURE 1(iii)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	214	241	187	230	216	255	219	196	145	237	237	176	248	235
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	244	291	225	264	250	302	250	235	185	270	264	214	280	291
5.	S5	1200.0	246	273	228	264	252	304	252	237	287	273	266	216	282	293
6.	S6	1300.0	264	297	239	266	257	304	266	241	192	277	271	221	277	295
7.	S7	1000.0	174	250	154	223	290	250	178	190	115	194	190	144	214	291
8.	S8	1800.0	261	295	239	264	257	307	266	241	205	250	244	230	264	295
9.	S9	269.0	261	297	239	219	257	302	266	241	192	255	219	221	228	304
10.	S10	1600.0														
	Total	11958.6														

Place:

Date:

ANNEXURE 1(iv)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.00	265	259	192	340	249	267	265	269	179	309	309	187	309	236
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	341	264	331	380	264	305	341	306	281	360	360	281	360	255
5.	S5	1200.0	346	269	336	385	269	309	346	311	287	365	365	286	365	259
6.	S6	1300.0	309	245	301	385	252	288	309	288	255	335	345	279	345	249
7.	S7	1000.0	252	245	230	385	252	288	270	288	190	290	290	220	301	269
8.	S8	1800.0														
9.	S9	269.0														
10.	S10	1600.0														
	Total	11958.6														

Place:

Date:

ANNEXURE 1(v)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	219	247	194	248	210	268	219	190	152	234	234	179	249	260
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	299	329	269	310	299	349	299	279	240	309	309	260	324	334
5.	S5	1200.0	289	319	259	300	289	339	289	269	230	299	299	250	314	324
6.	S6	1300.0	244	275	214	264	242	320	244	212	184	260	260	204	270	280
7.	S7	1000.0	172	219	145	212	187	239	172	159	118	207	204	139	222	230
8.	S8	1800.0	259	290	220	279	252	329	259	234	199	270	270	220	270	300
9.	S9	269.0														
10.	S10	1600.0	156	194	135	207	177	220	156	142	94	185	183	128	212	210
	Total	11958.6														

Place:

Date:

ANNEXURE 1(vi)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	252	288	226	300	268	308	250	240	190	299	291	217	299	500
2.	S2	164.0	144	195	111	209	137	189	155	102	69	163	159	98	230	230
3.	S3	425.6	90	200	122	167	187	217	92	177	139	82	122	159	180	240
4.	S4	2000.0	279	330	252	360	271	333	299	279	215	298	294	255	327	410
5.	S5	1200.0	288	298	259	365	289	353	298	264	217	308	308	267	315	415
6.	S6	1300.0	249	287	239	299	269	319	259	219	199	259	259	219	269	500
7.	S7	1000.0	249	290	195	410	280	350	215	194	159	222	222	189	241	400
8.	S8	1800.0	244	279	239	299	268	319	254	227	189	236	227	229	241	500
9.	S9	269.0	244	279	239	299	269	319	254	227	189	236	227	229	241	500
10.	S10	1600.0	214	257	209	248	209	268	231	189	149	229	238	189	249	289
	Total	11958.6														

Place:

Date:

ANNEXURE 1(vii)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	247	277	211	257	247	311	247	237	187	255	244	210	262	410
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	244	267	214	282	257	305	239	236	184	279	275	203	269	410
5.	S5	1200.0	244	273	214	287	257	310	241	239	184	281	279	207	269	410
6.	S6	1300.0	260	285	225	290	267	326	261	242	212	286	284	221	282	410
7.	S7	1000.0	189	235	158	227	199	251	184	188	126	192	185	155	222	277
8.	S8	1800.0	259	287	281	270	264	320	259	254	201	259	257	231	269	410
9.	S9	269.0	239	410	221	209	410	410	239	410	181	199	190	190	229	410
10.	S10	1600.0	185	229	154	232	199	246	185	183	116	184	181	149	219	267
Total		11958.6														

Place:

Date:

ANNEXURE 1(viii)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.00	214	241	187	230	216	255	219	196	145	237	237	176	248	235
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	244	291	225	264	250	302	250	235	185	270	264	214	280	291
5.	S5	1200.0	246	293	228	264	252	304	252	237	187	273	266	216	282	293
6.	S6	1300.0	264	297	239	266	257	304	266	241	192	277	271	221	277	295
7.	S7	1000.0	174	250	154	223	190	250	178	190	115	194	190	144	214	291
8.	S8	1800.0	251	295	239	264	257	307	266	241	205	250	244	230	264	295
9.	S9	269.0	261	287	239	219	257	302	266	241	192	225	219	221	228	304
10.	S10	1600.0														
Total		11958.6														

Place:

Date:

ANNEXURE 1(ix)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	247	277	211	257	247	311	247	237	187	255	244	210	262	410
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	244	267	214	282	257	305	239	236	184	279	275	203	269	410
5.	S5	1200.0	244	273	214	287	257	310	241	239	184	281	279	207	269	410
6.	S6	1300.0	260	285	225	290	267	326	261	242	212	286	284	221	282	410
7.	S7	1000.0	189	235	158	237	199	251	184	188	126	192	185	155	222	277
8.	S8	1800.0	259	287	231	270	264	320	259	254	201	259	257	231	269	410
9.	S9	269.0	239	410	221	209	410	410	239	410	181	199	190	190	229	410
10.	S10	1600.0	185	229	154	232	199	246	185	183	116	184	181	149	219	267
Total		11958.6														

Place:

Date:

ANNEXURE 1(x)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	229	265	193	280	215	265	228	195	160	240	240	185	255	270
2.	S2	164.0	128	139	102	185	103	168	121	90	55	153	155	83	165	139
3.	S3	425.6	80	190	83	112	150	190	90	130	115	63	105	115	90	135
4.	S4	2000.0	257	265	220	300	238	305	240	215	175	275	280	203	280	288
5.	S5	1200.0	280	285	234	295	251	307	250	227	174	258	260	225	285	300
6.	S6	1300.0	278	382	232	291	250	305	248	225	172	255	255	223	280	290
7.	S7	1000.0	250	240	190	280	200	260	220	185	135	235	235	200	240	260
8.	S8	1800.0	275	280	225	285	247	308	260	210	176	240	245	210	280	280
9.	S9	269.0	255	285	225	225	265	315	245	240	180	240	225	205	225	305
10.	S10	1600.0	166	215	165	225	184	235	185	155	95	215	215	145	230	235
Total		11958.6														

Place:

Date:

ANNEXURE 1(xi)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	223	250	196	250	214	268	214	196	151	241	241	198	241	250
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	261	268	241	286	250	286	268	232	196	268	268	223	286	286
5.	S5	1200.0	268	277	250	295	259	295	277	241	196	277	277	223	286	295
6.	S6	1300.0	250	268	232	286	250	295	250	223	187	268	268	214	277	277
7.	S7	1000.0	214	241	187	250	205	259	205	187	142	223	232	169	232	232
8.	S8	1800.0	259	277	241	286	259	304	259	241	196	241	232	223	250	286
9.	S9	269.0	268	286	250	295	268	313	268	250	205	250	241	232	259	295
10.	S10	1600.0														
Total		11958.6														

Place:

Date:

ANNEXURE 1(xii)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	216	256	198	260	230	275	235	194	160	255	260	190	280	300
2.	S2	164.0	144	174	119	208	109	250	153	89	49	200	200	89	232	230
3.	S3	425.6	90	260	120	140	210	280	90	160	160	67	120	150	180	240
4.	S4	2000.0														
5.	S5	1200.0	244	290	224	304	235	299	245	224	185	264	264	194	310	300
6.	S6	1300.0														
7.	S7	1000.0	186	244	174	220	187	248	198	185	139	220	240	154	240	240
8.	S8	1800.0														
9.	S9	269.0														
10.	S10	1600.0														
Total		11958.6														

Place:

Date:

ANNEXURE 1(xiii)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	249	250	216	277	249	295	252	214	160	259	254	196	288	270
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	268	258	223	304	259	322	272	234	189	277	270	214	297	297
5.	S5	1200.0	279	268	234	313	270	335	283	245	196	288	280	225	304	208
6.	S6	1300.0	270	263	234	313	259	333	279	338	196	283	281	223	306	304
7.	S7	1000.0	196	236	269	286	207	289	196	186	124	218	212	162	243	288
8.	S8	1800.0	254	279	237	277	265	333	259	250	189	252	243	225	259	306
9.	S9	269.0														
10.	S10	1600.0	180	323	160	270	198	268	189	178	117	209	203	155	234	279
	Total	11958.6														

Place:

Date:

ANNEXURE 1(xiv)

SCHEDULE OF RATES/TONNE QUOTED FOR TRANSPORT OF SUGAR

Sl. No.	Sugar Mills	Allotment (Tonnes)	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13	D14
1.	S1	2200.0	265	259	190	345	249	267	265	269	179	309	309	182	300	236
2.	S2	164.0														
3.	S3	425.6														
4.	S4	2000.0	341	264	331	380	264	306	341	306	281	360	360	281	360	255
5.	S5	1200.0	346	219	336	390	269	309	346	311	297	365	365	286	365	259
6.	S6	1300.0	309	245	301	390	252	280	309	288	255	335	345	279	345	249
7.	S7	1000.0	252	245	230	390	252	288	270	288	190	290	290	220	301	269
8.	S8	1800.0														
9.	S9	269.0														
10.	S10	1600.0														
	Total	11958.6														

Place:

Date:

ANNEXURE 2

SUMMARY OF DISTRICT-WISE DEMANDS AND SUGAR MILL ALLOTMENTS

Sl. No.	Sugar Mills	Allotment (Tonnes)	Districts	Quantity (Tonnes)
1.	S1	2200	D1	850.0
2.	S2	164.0	D2	850.0
3.	S3	425.6	D3	1200.0
4.	S4	2000.0	D4	500.0
5.	S5	1200.0	D5	1000.0
6.	S6	1300.0	D6	400.0
7.	S7	1000.0	D7	800.0
8.	S8	1800.0	D8	1100.0
9.	S9	269.0	D9	900.0
10.	S10	1600.0	D10	550.0
			D11	950.0
			D12	1150.0
			D13	1450.0
			D14	258.6
	Total	11958.6	Total	11958.6