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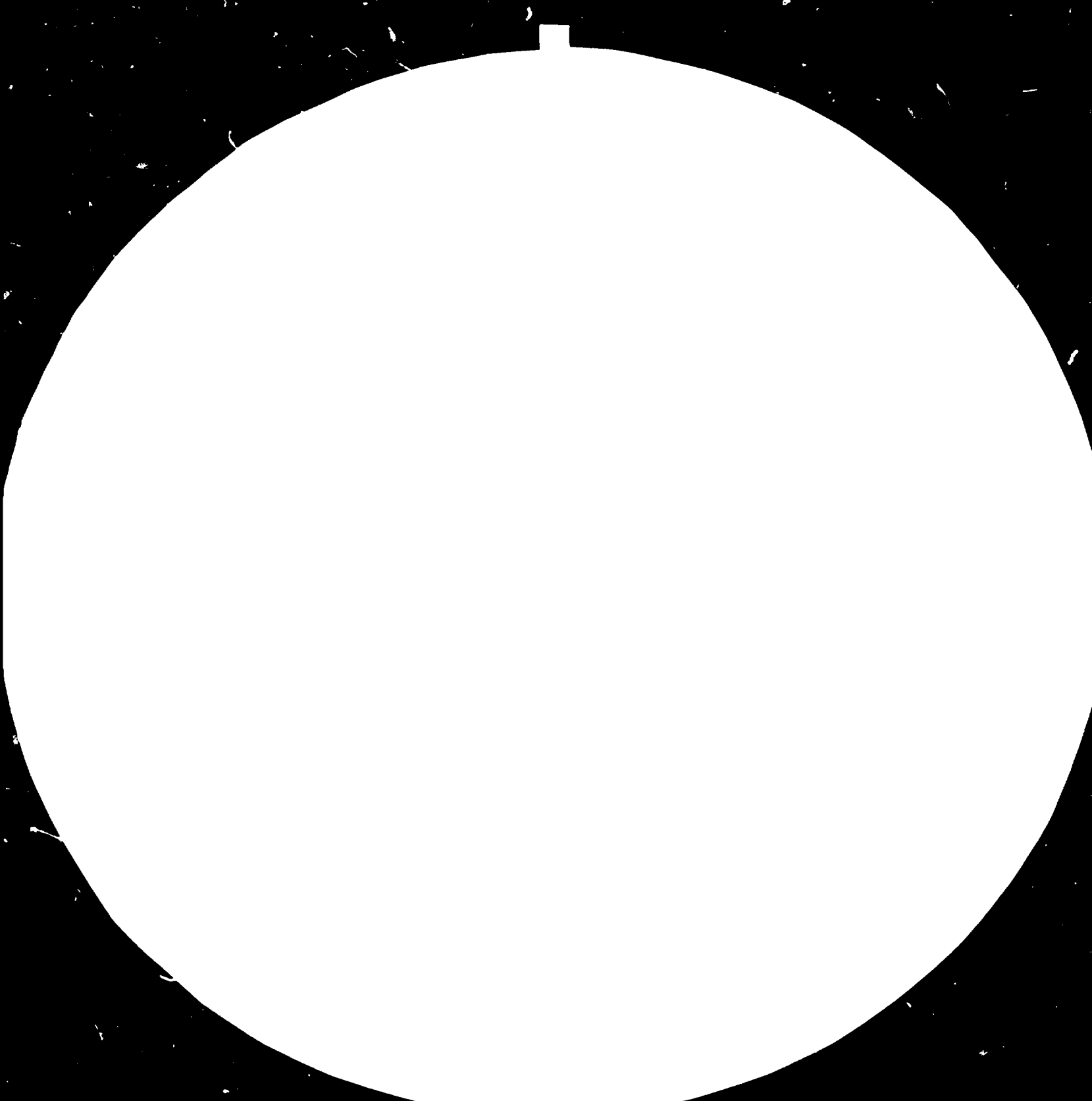
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**DEVELOPMENT OF
CAPITAL GOODS INDUSTRIES**

DP/TUR/76/034

TURKEY

13963

**TECHNICAL REPORT NO. XIX - TECHNICAL REPORT ON EARTH MOVING
MACHINERY WITH SPECIAL REFERENCE
TO MKEK'S PROJECT FOR MANUFACTURE
OF THESE MACHINES**

HAZİRAN 1983

DEVELOPMENT OF
CAPITAL GOODS INDUSTRIES
DP/TUR/76/034
TURKEY

Technical Report No. XIX - Technical Report on Earth Moving
Machinery With Special Reference
to MKEK's Project for Manufacture
of These Machines.

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DEVELOPMENT OF
CAPITAL GOODS INDUSTRIES
DP/TUR/76/034
TURKEY

Technical Report No. XIX - Technical Report on Earth Moving Machinery
with Special Reference to MKEK's Project
for Manufacture of These Machines.

Prepared for the Government of Turkey
by the United Nations Industrial Development Organisation
acting as executing agency for the United Nations Development Programme

Based on the work of
Capital Goods Development Project in Turkey

United Nations Industrial Development Organisation
Vienna

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LIST OF ABBREVIATIONS

SPO State Planning Organization
CGDP Capital Goods Development Project
SEE State Economic Enterprises
MKEK Makina Kimya Endüstrisi Kurumu ()
TCK Türkiye Cumhuriyeti Karayolları (Turkish Republic Highways)
YSE Yol Su Elektrik (Road, Hydraulic and Electric Works)
DSİ Devlet Su İşleri (State Hydraulic Works)
TEK Türkiye Elektrik Kurumu (Turkish Electricity Company)
TPAO Türkiye Petrolleri Anonim Ortaklığı (Turkish Petroleum Company)
KBI Karadeniz Bakır İşletmeleri (Black Sea Copper Works)
TCDD Türkiye Cumhuriyeti Demiryolları (Turkish State Railways)
TKİ Türkiye Kömür İşletmeleri (Turkish Coal Works)
TUSTAS Türkiye Sanayi Tesisler Anonim Şirketi (Turkish Industrial Plants Company)

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1.5. This study was conducted by Mr. Hasan Yilmaz, SPO expert, under the direction of Mr. M.M. Luther, Chief Technical Adviser, Capital Goods Development Project.

1.6. The project management is grateful to MKEK General Manager Mr. Akin Cakmakci, now Undersecretary, Ministry of Industry and Technology, Mr. Gunay Gungen, deputy General Manager of MKEK, Mrs. Suzan Moral, Head of project group, who made themselves available for discussions at different stages of the study. They are also indebted to Mr. Osman Ersan, Deputy-Head, Credits and Investment Department of the Ministry of Industry and Technology who did the initial spadework for data collection. The project management is also grateful to managers of all state enterprises who were visited for data collection and were very cooperative.

1.7. Mr. Vahit Erdem, National Project Coordinator of the Capital Goods Project and Head, Sectoral Planning Division, SPO, Mrs. Nimet Ipek and Mr. Fatih Ozatay, experts, SPO, were continuously associated with the study.


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- 2.4. The fact that these enterprises will do work, partly departmentally, partly by renting their machines to private companies and partly by outright contract to private sector companies who will use their own machinery has been taken into consideration. It has also been noted that private sector construction firms are likely to take up an increasing volume of work using their own machinery.
- 2.5. Details of the total work planned by these enterprises in 1983-88 were tabulated on the basis of cubic meters of soil which will be excavated, loaded and transported. The total requirements were calculated on the basis of working period in hours per year, the hourly capacity of each machine (and hence total work per machine per year). By comparing total requirements figure with present machine park, additional demand for each enterprise was found. For this purpose it was assumed that the PRESENT park with PRIVATE SECTOR contractors will be off set against either private sector construction work or such other work that has not been foreseen at present and that the additional demand computed will in effect be the total national demand irrespective of whether it arises from private sector contractors or SEE's themselves.
- 2.6. In order to calculate replacement demand, present national machine park was split up according to age groups to calculate machinery expected to be replaced every year.
- 2.7. Domestic capacity for manufacture of earth moving machinery, total demand and the net demand for MREK product-mix are on table 1.

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TABLE I
COMPARISON OF DEMANDS PROJECTED IN
DIFFERENT STUDIES
AND
DEMAND/CAPACITY BALANCE

EARTH MOVING MACHINERY	DEMAND PROJECTIONS						CAPACITY PROJECTIONS				
	Previous Studies			C.C.D.P			Domestic capacity other than MKEK	Produc- tion of 1981	demand for MKEK m/c Alt.1	demand for MKEK m/c Alt.2	MKEK Prod. Prog- ramme
	Sp. Comitee Report	Tustas Alt.1	Tustas Alt.2	Tustas Alt.3	Alt.1	Alt.2					
DOZER	605	1506	1862	903	518	498	200	20	318	298	240
EXCAVATOR (R.T)	132	85	105	4	41	38	30	20	11	8	40
EXCAVATOR (Crw.)		256	317	360	179	176	20	9	159	156	60
LOADER (R.T)	210	397	490	189	55	37	100	10	-45	-63	160
LOADER (Crw.)	385	363	449	229	118	83	150	65	-32	-67	160
MOBILE VINCH	-	233	288	80	26	15	10	3	16	5	35
HEAVY TRUCK	595	-	271	-	157	157	-	-	157	157	160

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- 2.11. A comparison of the demand projections in previous studies carried out and in this study is also given in table I.
- 2.12. MKEK may be asked to immediately commission or carry out a revised techno-economic study of polatli project based on these recommendations.
- 2.13. SEE's may be requested to draw up perspective plans for use of their existing park and amount of work to be done by contractors-plans which may be updated every year based on availability of other resources.
- 2.14. Another demand capacity study on the lines of this report may be conducted in 3-4 years time, to decide on the time frame for implementation of the master plan and also if in view of the data available any other revisions are called for.
- 2.15. Findings of this study have been discussed with Akin Cakmakci, Undersecretary of Ministry of Technology and Industry, Mr. Gunay Gungen, Deputy General Manager of MKEK, and SPO experts who have all agreed with the conclusions and recommendations.

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sub-sector under the heading "Other Industry Machinery". In the third approach, demand projections were calculated by adding 2% for spare parts to machinery requirement calculated by simulation from data gathered from selected firms. In June 1981, this feasibility study was revised but there was no change in assumption or methodology. Their findings are shown in Ann. II. (A comparison has been made of findings of these two reports with results of this study by the Capital Goods Project See Table I.)

3.1.3. The latest study on this subject is a report of a special committee of experts of several public enterprises, private companies, universities, Ministry of Industry and State Planning Organization, set up for the purpose of formulation of the 5th Five Year Plan. In this, it was found that there was park increase of 75.16% in the last 10 years during which the average national growth rate was 4.5%. Assuming that this 4.5% growth rate will continue for the next 10 years, it was concluded that there will be an 80% increase in the total park. It is also assumed that 35% of total park will be replaced in the next 10 years, so there will be demand of 115% of the present park which was rounded off to 8% per year and all forecasts made on this basis. Another approach used earth moving machinery requirements of some public enterprises as the basis. Their findings are shown in Ann. III. (The results of special committee report have also been compared with the conclusions reached in this study by the Capital Goods Project See Table I).

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3.2. DEMAND FORECASTING TECHNIQUE ADOPTED BY CAPITAL GOODS PROJECT

3.2.1. The most reliable results can be obtained by means of an analytical approach which will cover almost all the earth moving machinery users including State enterprises, private companies and municipalities. Out of these, most of the earth moving work is done by public enterprises themselves or contracted by them to private companies. In order to evaluate the demand for earth moving machinery for years 1983-1988, 13 public enterprises were chosen and a questionnaire (Annexure I) sent to them. These are:

Sectors of work handled by each is shown in brackets

- 1- Karayollari (Highways)
- 2- Yol, su, elektirik (Road, water, electricity)
- 3- Devlet Su Isleri (Irrigation and Dams)
- 4- ETIBANK (Mining and Metallurgy)
- 5- Turkiye Elektrik Kurumu (Electricity power generation)
- 6- T. Petrolleri Anonim Ortakligi (Petroleum)
- 7- Karadeniz Bakir Isletmeleri (Copper mining)
- 8- Toprak-Su (Soil and Water)
- 9- Orman Genel Mudurlugu (Forestry)
- 10- Liman Insaatlari Genel Mudurlugu (Port construction)
- 11- TCDD inaatlari Genel Mudurlugu (Railway construction)
- 12- T. Cimento sanayi (Cement)
- 13- T. Komur Isletmeleri (Coal Mining)

3.2.2. Data about the total quantity of excavation, loading and transportation planned by them in the next 6 years was

collected to calculate the total machine park required by these enterprises. In order to calculate the additional demand, working period in hours per year being followed by them was multiplied by the hourly capacity of each machine to find total work per machine per year.

3.2.3. For this purpose, all calculations were made in terms of the machines in the following product-mix considered in the feasibility report of MKEK project.

TABLE III

Machine Nomenclature	Machine Code	Licensor	Engine	Weight	Capacity
Dozer	723410013023921	KAELBLE GMEINDER PR15	MERCEDES OM 346	17.600 ton	55 m ³ /hr
Excavator Crawler	723422022013921	FUCHS 713 R	DEUTZ F4L912	16.000 ton	65 m ³ /hr
Excavator rubber-tyred	723422022013921	FUCHS 713 M	DEUTZ F4L912	16.700 ton	65 m ³ /hr
Loader Crawler	723420031023921	KAELBLE GMEINDER LR12	MERCEDES OM 360	13.00 ton	125 m ³ /hr
Loader rubber-tyred	723420031013921	KAELBLE GMEINDER SL12E	MERCEDES OM 401	11.500 ton	180 m ³ /hr
Mobile vinch	744222133123921	FUCHS 500 K	DEUTZ F4L912	16.000 ton	15 m ³ /hr
Heavy truck	744112041003931	BEIAZ 540-4x2	360 Hp 22.300 cc.	21.000 ton	15 m ³ /hr

3.2.4. Yearly work plan was obtained from each enterprises and work planned was divided by out-put per machine per year to arrive at the number of machines required. An allowance of 10% for repair and maintenance, and an efficiency factor

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of 80 % were assumed. That is, machine park figures would be multiplied by a factor of 0.72 to find the number of effective machines. Their present park figures were used to calculate the number of machines required on additional account. After evaluating the answers to these questionnaires, each of these 13 enterprises were visited and a series of meetings held with them to understand the special problems and needs of each enterprise.

3.2.5. As a result of these meetings it was decided that the total park required as calculated above may represent the total requirements of machinery for the work irrespective of whether it is done departmentally or by renting machines to contractors. In other words, it was assumed for the purpose of these calculations that the present park of contractors will not be used for SEE's work. The rationale of this assumption was that at present on an average only 16% of the total park of the machines under consideration is with the private sector and in the foreseeable future this park may be assumed to be used for private sector construction and other jobs not accounted for in this study.

3.2.6. Data on their present machine park according to age groups was collected to find the replacement demand.

3.3. CALCULATION OF ADDITIONAL DEMAND

3.3.1. Additional demand of these 13 enterprises as calculated are shown in Tables IV to XV. These show the anticipated work and total machine requirement. Assumptions made for each enterprise, and results are given below:

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3.3.1.1. TURKIYE CUMHURİYETİ KARAYOLLARI GENEL MUDURLUGU (TCK)

(General Directorate of Turkish Republic Highways)

According to National Transport Master Plan approved by the Government of Turkey, 690.540.840m³ soil will be excavated in years 1983-1992. Approximately 30% of excavated soil is loaded and transported in short distances (\approx 600m) for filling. Heavy trucks are needed only for rock filling and all other transportation is done by smaller trucks. It is assumed that each year 7.765.000m³ material for superstructure will be carried (5-10km) by smaller trucks up to 7 tons. (Incidentally in 1983, 25% of work will be done by contractors and this will increase to 40% by 1993).

3.3.1.2. YOL SU ELEKTRİK İŞLERİ GENEL MUDURLUGU (YSE)

(General Directorate of Road, Hydraulic and Electric Works)

Assumptions on excavation, loading and transportation are as follows:

90% of excavation will be done by dozers
10% " " " " " rubber tyred excavators
65% " " " " " loaded and transported
75% " loading will be done by crawler loader
25% of loading will be done by rubber tyred loader.

Heavy trucks are considered productive in short distances (max. 2km). YSE do not need heavy trucks and propose to do necessary transportation by means of their dumpers (2681) and wooden bodied trucks (394). (Incidentally yearly average of 7.900.000m³ of excavation is at present done by private contractors).

TCK (TOTAL)

TABLE IV

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.
					m ³	M/C/yr		m ³	M/C/yr		m ³	M/C/yr		m ³	M/C/yr		m ³	M/C/yr		m ³	M/C/yr	
Excavation	Dozer	55m ³ /hr	1500 hr.	82500	51789	628	-337	51789	628	--	51789	628	--	51789	628	--	51789	628	--	51789	628	--
						291			628			628			628			628			628	
Excavation	Excavator (Crawler)	55m ³ /hr	1500 hr.	97500	17262	178	-164	17262	178	--	17262	178	--	17262	178	--	17262	178	--	17262	178	--
						14			178			178			178			178			178	
Excavation	Excavator (R.T.)	65m ³ /hr	1500	97500																		
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	1500	187500	35018	207	-131	35018	207	--	35018	207	--	35018	207	--	35018	207	--	35018	207	--
						76			207			207			207			207			207	
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	1500	270000	12938	49	-189	12938	49	-189	12938	49	-189	12938	49	-189	12938	49	-189	12938	49	-189
						238			238			238			238			238			238	
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton	150 days	262500 t/km	107724	411	+376	107724	411	--	107724	411	--	107724	411	--	107724	411	--	107724	411	--
						35			411			411			411			411			411	

Table V

V.S.F. (TOTAL)

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.
					m ³	M/Cpar.		m ³	M/Cpar.		m ³	M/Cpar.		m ³	M/Cpar.		m ³	M/Cpar.		m ³	M/Cpar.	
Excavation	Dozer	55m ³ /hr	1760	96800	45110	467	138	4611	477	129	4711	488	117	4711	488	117	4711	488	117	4711	488	117
						605		605		605		605		605		605		605		605		605
Excavation	Excavator	60m ³ /hr	1760	114000																		
Excavation	Excavator	45m ³ /hr	1760	114000	2790	25	11	2790	25		2790	25		2790	25		2790	25		2790	25	
						5		5		5		5		5		5		5		5		5
Loading Excavated Soil	Loader (Front)	125m ³ /hr	1760	220000	23851	119	212	23851	119	212	23851	119	212	23851	119	212	23851	119	212	23851	119	212
						331		331		331		331		331		331		331		331		331
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	1760	116800	6784	23	110	6784	23	110	6784	23	110	6784	23	110	6784	23	110	6784	23	110
						133		133		133		133		133		133		133		133		133
Loading Excavated Soil	Mobile Winch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton																				

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3.3.1.3. DEVLET SU ISLARI GENEL MÜDÜRLÜĞÜ (DSİ)

(General Directorate of State Hydraulic Works)

DSİ is only doing some repair, maintenance and project work by its own machine park. Like others, they have a renting system and they rent their earth moving machinery not only to contractors but also to farmers and municipalities. Work done by DSİ can be divided into two:

- a- Irrigation
- b- Dam construction

For irrigation, the objective is to water 70.000 hectares per year. Total excavation, loading and transportation has been calculated on the basis of an example of irrigation activities and facilities required for 10.000 hectares. For dams, all 54 dams under construction were taken into account assuming that they will be finished in the next 5 years.

Following assumptions were made about machine utilization in DSİ:

- 75% of total excavation by dozers and excavators of which
 - 51% with dozers
 - 36% with crawler excavators
 - 13% with rubber tyred excavators.
- 73% of total loading by crawler loaders and the rest by rubber tyred loaders.
- Heavy trucks needed for only those dam constructions where filling material is rock.

Total work that will be done by DSİ and machinery requirements are given in Table VI.

D.S.I. (TOTAL)

Table VI

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000 m ³	No. of M/C Req. M/C park	New Dem.	Work Plan 1000 m ³	No. of M/C Req. M/C park	New Dem.	Work Plan 1000 m ³	No. of M/C Req. M/C park	New Dem.	Work Plan 1000 m ³	No. of M/C Req. M/C park	New Dem.	Work Plan 1000 m ³	No. of M/C Req. M/C park	New Dem.	Work Plan 1000 m ³	No. of M/C Req. M/C park	New Dem.
Excavation	Dozer	55m ³ /hr	2000	110000	69228	621	+28	172431	659	+38	77051	701	+42	81732	744	+43	87716	708	+54	93864	854	+56
						340			621			659			701			744				
Excavation	Excavator (Crawler)	65m ³ /hr	2000	130000	8208	374	+17	51204	397	+23	54459	422	+25	58139	450	+28	62152	481	+31	66550	515	+34
						200			374			397			422			450				
Excavation	Excavator (R.T.)	65m ³ /hr	2000	130000	17035	132	-35	18069	140	-27	19207	149	-18	20158	156	-11	21527	167	+-	23001	178	+11
						167			140			149			156			167				
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	2000	250000	35588	143	+58	36537	147	+4	37581	151	+4	39398	159	+8	40549	164	+5	42193	170	+6
						85			143			147			151			159				
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	2000	36000	13149	37	-22	13509	38	-21	13884	39	-20	14307	40	-19	14772	42	-17	15287	38	-21
						59			38			39			40			42				
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton	250 days	262500 t/km	38880	149	+-	38880	149	+-	38880	149	+-	38880	149	+-	38880	149	+-	38880	149	+-
						-			149			149			149			149				

ETIBANK (total)

Table VII

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.
						M/C park		M/C park		M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park
Excavation	Dozer	55m ³ /hr	2000 hr	11000 m ³	3000	28	-14	4.160	38	-4	4960	45	+3	4360	40	-5	4660	43	-2	4560	42	-3
						42			42			42			45			45				
Excavation	Excavator (Crawler)	65m ³ /hr	2000 hr.	130000 m ³	4700	37	+7	6240	48	+11	7440	58	+10	6540	51	-7	6960	54	-4	6840	53	-5
						27			37			48			58			58				
Excavation	Excavator (R.T.)	65m ³ /hr	2000 hr.	130000 m ³																		
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	2000 hr.	250000m ³	2200	9	-22	2600	11	-20	3100	13	-18	2725	11	-20	2900	12	-19	2850	12	-19
						31			31			31			31			31				
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	2000 hr.	360.000 m ³	5300	15	-32	7280	21	-26	8680	25	-22	7630	22	-25	8120	23	-24	7980	23	-24
						47			47			47			47			47				
Loading Excavated Soil	Mobile Vinch	15 ton	2000hr.	40.000m ³	200	5	-33	520	13	-25	620	16	-22	545	14	-24	580	15	-23	570	15	-23
						38			38			38			38			38				
Transport of Excavated Soil	Heavy Truck	35 ton	300 days	157.500 ton-km	21830 ton-km.	139	+52	29484	189	+49	35154	223	+35	30901	197	-26	32886	209	-14	30164	192	-31
						87			139			188			223			223				

T.E.P. (TOTAL)

Table VIII

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.
					m ³	M/C park		m ³	M/C park		m ³	M/C park		m ³	M/C park		m ³	M/C park		m ³	M/C park	
Excavation	Dozer	55m ³ /hr	2480 hr.	136400	5000	37	-24	8000	60	-1	10000	74	+13	10000	74	+-	10000	74	+-	8000	60	-14
						61			61			61			74			74			74	
Excavation	Excavator (Crawler)	65m ³ /hr	2480 hr.	161200 m ³	3000	20	+20	4000	25	+5	6000	38	+13	6000	38	+-	6000	38	+-	4000	25	-13
						-			20			25			38			38			38	
Excavation	Excavator (R.T.)	65m ³ /hr	2480 hr.	161200 m ³	2000	13	+11	3000	20	+7	4000	25	+-	4000	25	+-	4000	25	+-	3000	20	-5
						2			13			25			25			25			25	
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	2480 hr.	310000	3000	10	+5	4500	15	+5	6000	20	+10	6000	20	+-	6000	20	+-	4500	15	-5
						5			10			20			20			20			20	
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	2480 hr.	446400	4000	10	-3	6000	15	+2	8000	19	+4	8000	19	+-	8000	19	+-	6000	15	-4
						13			13			19			19			19			19	
Loading Excavated Soil	Mobile Vinch	15 ton	2480 hr.	49600	3000	62	+7	4500	92	+30	6000	122	+30	6000	122	+-	6000	122	+-	4500	92	-30
						55			62			92			122			122			122	
Transport of Excavated Soil	Heavy Truck	35 ton																				

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where petroleum may be found is always in places difficult to reach. Earth moving machinery is also used by TPAO for clearing existing roads. The present machine park of TPAO is adequate for these purposes and has been taken into account for only replacement demand.

3.3.1.7. KARADENİZ BAKIR İŞLETMELERİ GENEL MÜDÜRLÜĞÜ (KBI)
(General Directorate of Black Sea Copper Plant)

Dozers are not being used for excavation but only for preparation work which is 10% of total excavation. KBI uses excavators for loading but it is assumed that contractors will use crawler loaders for this purpose. It is impossible to use rubber tyred machines for this purpose because of high rate of silting in soil. Total work that is expected to be done up to 1988 and their machine requirement are given in Table IX. (Past records indicate that 1.100.000m³/yr. excavation, loading and transportation may be contracted).

3.3.1.8. TOPRAK SU GENEL MÜDÜRLÜĞÜ
(General Directorate of Soil and Water)

Toprak Su has thousands of projects all over the country and there are no ready records to show the proportion of work done by contractors. After discussions with Toprak-Su management, it appears that a figure of 60% of is reasonable.

3.3.1.9. ORMAN GENEL MÜDÜRLÜĞÜ
(General Directorate of Forestry)

Orman Genel Müdürlüğü carry out all the work departmentally.

KARADENİZ BAYIR (TOTAL)

Table IX

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.
						M/C park		M/C park			M/C park			M/C park			M/C park			M/C park		
Excavation	Dozer	55m ³ /hr.	2000 hr.	110000 m ³	252	3	-3	263	3	-3	308	3	-3	336	4	-2	336	4	-2	336	4	-2
						6			6			6			6			6			6	
Excavation	Excavator (Crawler)	65m ³ /hr.	2000 hr.	130000 m ³	2523	20	+12	2630	21	+1	3080	24	+3	3363	26	+2	3363	26	--	3363	26	+-
						8			20			21			24			24			26	
Excavation	Excavator (R.T.)	65m ³ /hr.	2000 hr.	130000 m ³																		
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr.	2000	250000	880	4	-4	940	4	+-	1000	4	+-	1000	4	+-	1000	4	+-	1000	4	+-
						-			4			4			4			4			4	
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr.	2000	360000	378	2	-8	390	2	-8	440	2	-8	474	2	-8	474	2	-8	474	2	-8
						10			10			10			10			10			10	
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton	300 days	220500 t/km (1000)	18097 t/km (1000)	83	+52	19305	88	+5	23085	105	+17	25225	115	+10	25225	115	+-	25225	115	+-
						31			83			88			105			115			115	

TOPRAK-SI (TOTAL)

Table X

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.
					m ³	M/Cpark		m ³	M/Cpark		m ³	M/Cpark		m ³	M/Cpark		m ³	M/Cpark		m ³	M/Cpark	
Excavation	Dozer	55m ³ /hr	1280	70400	29325	412	-253	30000	422	-10	32260	454	+32	33622	473	+19	35337	498	+25	37488	528	+30
						159			412			422			454			473			498	
Excavation	Excavator (Crawler)	65m ³ /hr	1280	83200	7055	85	+58	7462	90	+5	7537	91	+1	7612	92	+1	7662	93	+1	7737	94	+1
						27			85			90			91			92			93	
Excavation	Excavator (R.T.)	65m ³ /hr	1280	81200	625	8	+6	635	9	+1	645	9	+-	655	9	+-	665	9	+-	675	9	+-
						2			8			9			9			9			9	
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	1280	160000	14188	90	+52	15013	95	+5	15673	100	+5	16613	105	+5	16713	106	+1	17613	111	+5
						38			90			95			100			105			106	
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	1280	230400	3000	14	-32	3300	15	-31	3500	16	-30	3700	17	-29	4000	18	-28	4050	18	-28
						46			46			46			46			46			46	
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton																				

ORMAN GENEL MÜDÜRLÜĞÜ (TOTAL)

Table XI

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.	Work Plan 1000	No. of M/C Req.	New Dem.
					m ³	M/C park		m ³	M/C park		m ³	M/C park		m ³	M/C park		m ³	M/C park		m ³	M/C park	
Excavation	Dozer	55m ³ /hr	1100 hr.	60500 m ³	30539	505 400	105	30539	505 505	+-	30539	505 505	+-	30539	505 505	+-	30539	505 505	+-	30539	505 505	+-
Excavation	Excavator (Crawler)	65m ³ /hr	1100 hr.	71500 m ³																		
Excavation	Excavator (R.T.)	65m ³ /hr	1100 hr.	71500 m ³																		
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	1100 hr.	137500 m ³	1980	15 78	-63	1980	15 78	-63	1980	15 78	-63	1980	15 78	-63	1980	15 78	-63	1980	15 78	-63
Loading Excavated Soil	Loader (R.T.)	18m ³ /hr	1100 hr.	198000 m ³																		
Loading Excavated Soil	Mobile Vlach	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton	110 days																			

LIMAN INSAAT GENEL MÜDÜRLÜĞÜ (TOTAL)

TABLE XII

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.
						M/C park		M/C park		M/C park		M/C park		M/C park		M/C park		M/C park		M/C park		M/C park
Excavation	Dozer	55m ³ /hr	2000	110000	325	3 14	-11	413	6 14	-10	450	5 14	-9	488	5 14	-9	525	5 14	-9	563	6 14	-8
Excavation	Excavator (Crawler)	65m ³ /hr	2000	130000	325	3 24	-21	413	4 24	-20	450	4 24	-20	488	4 24	-20	525	5 24	-19	563	5 24	-19
Excavation	Excavator (R.T.)	65m ³ /hr	2000	130000																		
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	2000	250000	1274	6 1	+5	1341	6 1	+5	1408	6 1	+5	1475	6 1	+5	1552	7 1	+6	1629	7 1	+6
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	2000	300000	5096	15 4	+11	5364	15 15	+1	5632	16 15	+1	5900	17 16	+1	6208	18 17	+1	6516	19 18	+1
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton																				

T.C.D.D. İNŞAAT GENEL MÜDÜRLÜĞÜ (TOTAL)

TABLE XIII

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.
						M/C park		m ³ /Cpark			m ³	M/Cpark		m ³	M/Cpark		m ³	M/Cpark		m ³	M/Cpark	
Excavation	Doser	55m ³ /hr	1960 hr.	107800 m ³	3316	26	-23	4420	35	+9	4900	39	-4	6500	51	+12	5600	44	-7	5160	41	-10
						3			26			35			39			51			51	
Excavation	Excavator (Crawler)	65m ³ /hr	1960 hr.	127400 m ³	622	5	+4	829	7	+2	919	8	+1	1219	10	+2	1050	8	-2	968	8	-2
						1			5			7			8			10			10	
Excavation	Excavator (R.T.)	65m ³ /hr	1960 hr.	127400 m ³	207	2	+2	276	3	+1	306	3	+-	406	4	+1	350	3	-1	323	3	-1
						-			2			3			3			4			4	
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	1960 hr.	245090 m ³	3316	17	-17	4420	19	-2	4900	20	+1	6500	27	+7	5600	23	-4	5160	22	-5
						-			17			19			20			27			27	
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	1960 hr.	352900 m ³	829	3	+3	1105	4	+1	1225	4	+-	1625	5	+1	1400	4	-1	1290	4	-1
						-			3			4			4			5			5	
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton	245 days	385875 t/km	18652 (1000)	49	+49	2486	64	-15	2756	72	+8	36562	95	+23	31500	82	-13	29025	76	-19
						-			49			64			72			95			95	

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3.3.1.12. TURKIYE CIMENTO SANAYII T.A.S Gn. Md.

(General Directorate of Cement Industry Stock C.O.)

All the work is done departmentally and their demand for earth moving machinery is given in Table XIV.

3.3.1.13. TURKIYE KOMUR ISLETMELERI (TKI)

(Turkish Coal Works)

Past values of excavation were examined and it was decided that yearly average excavation is $105.748.900m^3$, out of which $37.993.300m^3$ was by TKI and $67.755.600m^3$ by contractors. 23% of total excavation is done by dozers and the rest is done by draglines which are not considered in this study. All the excavated soil by dozers is loaded and transported. Draglines are also used in loading, so only 20% of excavation done by draglines is loaded by loaders. All the loading is done by rubber-tyred loaders.

Crawler loaders and mobile vonches do not directly affect coal production but they are used as supporting machines. While on the basis of department's total work, no extra machines may be justified in practice, the fact that there are 13 establishments, 47 regions and hundreds of coal mines where these machinery is needed, makes it necessary to plan for machinery region-wise and in some case mine-wise. Results are given in Table XV.

3.4. ASSUMPTIONS FOR ADDITIONAL DEMANDS

3.4.1. There are two approaches. In the first one, net demands of enterprises are summed up and surpluses of machines are ignored - the assumption

CIMENTO (TOTAL)

TABLE XIV

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.
					M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park	M/C park
Excavation	Dozer	55m ³ /hr	2000	110000	2305	21	+16	2535	23	+2	2700	25	-2	3150	29	+4	3500	32	+3	3850	35	+3
						5			21			23			29			32			32	
Excavation	Excavator (Crawler)	65m ³ /hr	2000	130000	3220	25	-4	3542	28	-1	3695	29	+-	3950	30	+1	4100	32	+2	4550	35	+3
						29			29			29			30			32				
Excavation	Excavator (R.T.)	65m ³ /hr	2000	130000	1855	15	+15	2040	16	+1	2300	18	+2	2900	27	+5	3200	25	+2	3700	29	+4
						-			15			16			18			23			25	
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	2000	250000	2225	9	-4	2447	10	-3	2615	11	-2	2900	12	-1	3250	13	+-	3525	15	+2
						13			13			13			13			13				
Loading Excavated Soil	Loader (R.T.)	180m ³ /hr	2000	360000	3005	9	+2	3305	10	+1	3215	9	-1	3500	10	+-	3850	11	+1	4250	12	+1
						7			9			10			10			10			11	
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton																				

T.K.I. (TOTAL)

TABLE XV

WORK DESCRIPTION	M/C REQ.	CAPACITY	WORKING PERIOD PER YEAR	TOTAL WORK PER M/C PER YEAR	1983			1984			1985			1986			1987			1988		
					Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.	Work Plan 1000 m ³	No. of M/C Req.	New Dem.
						M/C park			M/C park			M/C park			M/C park			M/C park			M/C park	
Excavation	Dozer	55m ³ /hr	1680	92400 m ³	24321	264	164	24321	264	↔	24321	264	↔	24321	264	↔	24321	264	↔	24321	264	↔
						100			264			264			264			264			264	
Excavation	Excavator (Crawler)	65m ³ /hr	1680																			
Excavation	Excavator (R.T)	65m ³ /hr	1680	109200 m ³																		
Loading Excavated Soil	Loader (Crawler)	125m ³ /hr	1680	210000																		
Loading Excavated Soil	Loader (R.T)	180m ³ /hr	1680	302000	45469	151	+79	45469	151	↔	45469	151	↔	45469	151	↔	45469	151	↔	45469	151	↔
						72			151			151			151			151			151	
Loading Excavated Soil	Mobile Vinch	15 ton																				
Transport of Excavated Soil	Heavy Truck	35 ton	210 days																			

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being that SEE's even if they have machines surplus to their requirements as revealed by this study will find justifications to retain them. The second approach assumes that enterprises which have excess machinery may be able to lend them to others who need them.

- 3.4.2. SEE's will provide all the machinery required for the work which may be done departmentally or otherwise. In fact, considerable work is done by contractors but in the absence of data regarding the machine park with them and utilisation for public sector, private sector, export contracts etc., it has been assumed that the machine park at present actually available with contractors will be offset against work done by the private sector for the private sector and other items of work which have not been taken into account in this study for lack of data. (Provision however has been made for future corrections by recommending that initial capacity in MKEK should be pegged at levels relating to conservative estimates of demands in the immediate future, but that a master plan for the new plant will provide for higher capacities).
- 3.4.3. The ratio of machine park between these 13 enterprises and all SEE's, as well as the national totals will remain the same upto 1993.

3.5. ADDITIONAL DEMAND

- 3.5.1. The results of evaluation of additional demand of these 13 enterprises are given in Tables XVI, XVII, XVIII, XIX, XX, XXI, XXII.
- 3.5.2. A summary of national additional demand figures are given in Tables XXIII, XXIV.

3.6. REPLACEMENT DEMAND

- 3.6.1. In order to calculate replacement demand, these selected enterprises machine park figures were collected according to age groups. These figures are given in Tables XXV → XXXI.

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Summation of total machine park according to age groups is given in Table XXXII.

- 3.6.2. By studying previous feasibility studies and report of the special committee constituted by SPO for the formulation of the 5th. Five year Development Plan, it was found that the 13 enterprises constitute 93% of the total public sector machine park. Distribution of machine park among private sector and municipalities is given in Ann. IV.
- 3.6.3. An average life of 10 years was assumed for all the machines under consideration.
- 3.6.4. Table XXXIII. shows the distribution of national machine park according to age groups. It is assumed that distribution of machinery of private sector and municipalities according to age groups will be same as public sector machine park. On this basis, national replacement demand is given in Table XXXIV.

3.7. TOTAL DEMAND

- 3.7.1. Total national demand for seven kinds of earth moving machinery was calculated by means of adding replacement demand to new demand in 1983-1988. Two alternative values of the total demand have been computed in the context of two alternatives for additional demand (Para 3.4.1.).
- 3.7.2. Replacement demand was distributed over 6 years and additional demand (Alt. I) and additional demand (Alt. II) was added to this in order to find total demand Alt.I and Alt.II. These are given in Tables XXXV and XXXVI respectively.
- 3.7.3. Since the demands for additional work as well as replacements are uneven being very high in earlier years, the total figures have been averaged out to arrive at a realistic annual demand. These are as under:-

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ALTERNATIVE I

Dozer -----	518
Exc. R.T. -----	41
Exc. Crw. -----	179
Loader R.T. -----	55
Loader Crw. -----	118
M. Vinch -----	26
H. Truck -----	157

ALTERNATIVE II

Dozer -----	498
Exc. R.T. -----	38
Exc. Crw. -----	176
Loader R.T. -----	37
Loader Crw. -----	83
M. Vinch -----	15
H. Truck -----	157

EARTH MOVING MACHINERY DEMAND OF SOME
SELECTED STATE ENTERPRISES ACCORDING TO THEIR WORK PLAN

DOZERS

TABLE XVI

YEAR ITEMS	1983	1984	1985	1986	1987	1988
T.C.K.	+337	+ -	+ -	+ -	+ -	+ -
Y.S.E. *	- 133	- 123	- 117	- 117	- 117	- 117
D.S.i.	+ 281	+ 38	+ 42	+ 43	+ 54	+56
ETİBANK	- 14	- 4	+ 3	- 5	- 2	- 3
TEK	- 24	- 1	+ 13	+ -	+ -	- 4
TPAO	-	-	-	-	-	-
Krd. BAKIR	- 3	- 3	- 3	- 2	- 2	- 2
TOPRAK-SU	+ 253	+ 10	+ 32	+ 19	+ 25	+ 30
ORMAN Gn.Md.	+ 105	+ -	+ -	+ -	+ -	+ -
LİMAN İnş.	- 11	- 10	- 9	- 9	- 9	- 8
TCDD	+ 23	+ 9	+ 4	+ 12	- 7	- 10
ÇİMENTO	+ 16	+ 2	+ 2	+ 4	+ 3	+ 3
TKİ	+ 164	+ -	+ -	+ -	+ -	+ -
TOTAL (1)	1179	59	96	78	82	89
TOTAL (2)	1062	59	96	78	82	89

* Excess machinery will be given to other enterprises which have demand

TABLE XVII

EARTH MOVING MACHINERY DEMAND OF SOME
SELECTED STATE ENTERPRISES ACCORDING TO THEIR WORK PLAN

EXCAVATOR (crawler)

YEAR ITEMS	1983	1984	1985	1986	1987	1988
T.C.K.	+ 164	+ -	+ -	+ -	+ -	+ -
Y.S.E.	- 3	- 3	- 3	- 3	- 3	- 3
D.S.İ.	+ 174	+ 23	+ 25	+ 28	+ 31	+ 34
ETİBANK	+ 7	+ 11	+ 10	- 7	- 4	- 5
TEK	+ 20	+ 5	+ 13	+ -	+ -	- 13
TPAO	-	-	-	-	-	-
Krd. BAKIR	+ 12	+ 1	+ 3	+ 2	+ -	+ -
TOPRAK-SU	+ 58	+ 5	+ 1	+ 1	+ 1	+ 1
ORMAN Gn.Md.	-	-	-	-	-	-
LİMAN İnş. *	- 21	- 20	- 20	- 20	- 19	- 19
TCDD	+ 4	+ 2	+ 1	+ 2	- 2	-2
ÇİMENTO	- 4	- 1	+ -	+ 1	+ 2	+ 3
TRİ	- 3	- 3	- 3	- 3	- 3	- 3
TOTAL (1)	439	47	53	34	33	38
TOTAL (2)	420	47	53	34	33	38

EARTH MOVING MACHINERY DEMAND OF SOME
SELECTED STATE ENTERPRISES ACCORDING TO THEIR WORK PLAN

TABLE XVIII-

EXCAVATOR (Rubber tyred)

YEAR ITEMS	1983	1984	1985	1986	1987	1988
T.C.K. *	- 18	- 18	- 18	- 18	- 18	- 18
Y.S.E.	+ 19	+ -	+ -	+ -	+ -	+ -
D.S.İ.	- 35	- 27	- 18	- 11	+ -	+ 11
ETİBANK	-	-	-	-	-	-
TEK	+ 11	+ 7	+ 5	+ -	+ -	- 5
TPAO	- 2	- 2	- 2	- 2	- 2	- 2
Krd. BAKIR	-	-	-	-	-	-
TOPRAK-SU	+ 6	+ -	+ -	+ -	+ -	+ -
ORMAN Gn.Md.	-	-	-	-	-	-
LİMAN İnş.	-	-	-	-	-	-
TCDD	+ 2	+ 1	+ 2	+ 5	+ 2	+ 3
ÇİMENTO	+ 15	+ 1	+ 2	+ 5	+ 2	+ 3
TKİ	- 3	- 3	- 3	- 3	-3	- 3
TOTAL (1)	+ 53	+ 9	+ 7	+ 6	+ 2	+ 14
TOTAL (2)	35	9	7	6	2	14

EARTH MOVING MACHINERY DEMAND OF SOME
SELECTED STATE ENTERPRISES ACCORDING TO THEIR WORK PLAN

TABLE XIX

LOADER (crawler)

YEAR ITEMS	1983	1984	1985	1986	1987	1988
T.C.K.	+ 131	+ -	+ -	+ -	+ -	+ -
Y.S.E. *	- 212	- 212	- 212	- 212	- 212	- 212
D.S.İ.	+ 58	+ 4	+ 4	+ 8	+ 5	+ 6
ETİBANK	- 22	- 20	- 18	- 20	- 19	- 19
TEK	+ 5	+ 5	+ 20	+ -	+ -	- 5
İPAO	- 3	- 3	- 3	- 3	- 3	- 3
Krd. BAKIR	+ 4	+ -	+ -	+ -	+ -	+ -
TOPRAK-SU	+ 52	+ 5	+ 5	+ 5	- 1	+ 5
ORMAN Gn.Md.	- 63	- 63	- 63	- 63	- 63	- 63
LİMAN İnş.	+ 5	+ 5	+ 5	+ 5	+ 6	+ 6
TCDD	+ 17	+ 2	+ 1	+ 7	- 4	- 5
ÇİMENTO	- 4	- 3	- 2	- 1	+ -	+ 2
TKİ	- 12	- 12	- 12	- 12	- 12	- 12
TOTAL (1)	272	+ 21	+ 35	+ 25	+ 11	+ 19
TOTAL (2)	60	21	35	25	11	19

EARTH MOVING MACHINERY DEMAND OF SOME
SELECTED STATE ENTERPRISES ACCORDING TO THEIR WORK PLAN

TABLE XX

LOADER (Rubber tyred)

YEAR ITEMS	1983	1984	1985	1986	1987	1988
T.C.K.	- 189	- 189	- 189	- 189	- 189	- 189
Y.S.E. *	- 110	- 110	- 110	- 110	- 110	- 110
D.S.i.	- 22	- 21	- 20	- 19	- 17	- 21
ETİBANK	- 32	- 26	- 22	- 25	- 24	- 24
TEK	- 2	+ 2	+ 4	+ -	+ -	- 4
TPAO	- 4	- 4	- 4	- 4	- 4	- 4
Krd. BAKIR	- 8	- 8	- 8	- 8	- 8	- 8
TOPRAK-SU	- 32	- 31	- 30	- 29	- 28	- 28
ORMAN Gn.Md.	-	-	-	-	-	-
LİMAN İnş.	+ 11	+ -	+ 1	+ 1	+ 1	+ 1
TCDD	+ 2	+ 1	+ -	+ 1	- 1	- 1
ÇİMENTO	+ 2	+ 1	- 1	+ -	+ 1	+ 1
TKİ	+ 79	+ -	+ -	+ -	+ -	+ -
TOTAL (1)	95	4	5	2	2	2
TOTAL (2)	- 15	4	5	2	2	2

EARTH MOVING MACHINERY DEMAND OF SOME
SELECTED STATE ENTERPRISES ACCORDING TO THEIR WORK PLAN

TABLE XXI

MOBILE VINCH

YEAR ITEMS	1983	1984	1985	1986	1987	1988
T.C.K.	-	-	-	-	-	-
Y.S.E. *	- 19	- 19	- 19	- 19	- 19	- 19
D.S.İ.	-	-	-	-	-	-
ETİBANK *	- 33	- 25	- 22	- 24	- 23	- 23
TEK	+ 7	+ 30	+ 30	+ -	+ -	- 30
TPAO	-	-	-	-	-	-
Krd. BAKIR	-	-	-	-	-	-
TOPRAK-ŞU	-2	-2	-2	-2	-2	-2
ORMAN Gn.Md.	-	-	-	-	-	-
LİMAN İnş.	-2	-2	-2	- 2	- 2	-2
TCDD	-	-	-	-	-	-
ÇİMENTO	-3	-3	-3	-3	-3	-3
TKİ	-23	-23	-23	-23	-23	-23
TOTAL (1)	7	30	30	-	-	-
TOTAL (2)	-57	-34	-34	-64	-64	-64

EARTH MOVING MACHINERY DEMAND OF SOME
SELECTED STATE ENTERPRISES ACCORDING TO THEIR WORK PLAN

TABLE XXII

HEAVY TRUCK

YEAR ITEMS	1983	1984	1985	1986	1987	1988
T.C.K.	+ 376	+ -	+ -	+ -	+ -	+ -
Y.S.E. **	-	-	-	-	-	-
D.S.İ.	+ 149	+ -	+ -	+ -	+ -	+ -
ETİBANK	+ 52	+ 49	+ 35	- 26	- 14	- 31
TEK **	-	-	-	-	-	-
TPAO **	-	-	-	-	-	-
Krd. BAKIR	+ 52	+ 5	+ 17	+ 10	+ -	+ -
TOPRAK-SU **	-	-	-	-	-	-
ORMAN Gn.Md. **	-	-	-	-	-	-
LİMAN İnş. **	-	-	-	-	-	-
TCDD	+ 49	+ 15	+ 8	+ 23	- 13	- 19
ÇİMENTO **	-	-	-	-	-	-
TKİ						
TOTAL (1)	678	69	60	33	-	-
TOTAL (2)	678	69	60	33	-	-

** Heavy Trucks are not needed

TOTAL NEW DEMAND (1)

TABLE XXIII

ITEMS \ YEARS	1983	1984	1985	1986	1987	1988
Doser	1179	59	96	78	82	89
Excavator R.T.	53	9	7	6	2	14
Excavator Crv.	439	47	53	34	33	38
Loader R.T.	95	4	5	2	2	2
Loader Crv.	272	21	35	25	11	19
M.Vinch	7	30	30	-	-	-
H.Truck	678	69	60	33	-	-

TOTAL NEW DEMAND (2)

TABLE XXIV

YEARS ITEMS	1983	1984	1985	1986	1987	1988
Dozer	1062	59	96	78	82	89
Excavator R.T.	35	9	7	6	2	14
Excavator Crv.	420	47	53	34	33	38
Loader R.T.	-	-	-	-	-	-
Loader Crv.	60	21	35	25	11	19
M. Vinch	-	-	-	-	-	-
H. Truck	678	69	60	33	-	-

MACHINE PARK OF SOME SELECTED ENTERPRISES ACCORDING TO
AGE GROUPS

TABLE XXV

DOZLRS

ITEMS	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
T.C.K	-	200	60	145	-	-
Y.S.E.	204	234	116	286	-	-
D.S.I.	-	186	185	38	62	2
ETİBANK	8	18	13	20	-	-
TEK	36	6	20	23	-	-
TPAO	5	3	-	5	1	-
Krd. BAKIR	-	2	6	1	-	-
TORRAK-SU	26	117	26	29	23	-
ORMAN Gn.Md.	361	130	35	29	-	-
LİMAN İne.	-	-	10	9	-	1
TCDD	5	4	3	-	8	4
ÇİMENTO	3	2	1	1	-	-
TKİ	41	48	29	9	5	7
TOTAL	689	950	504	595	99	14

MACHINE PARK OF SOME SELECTED ENTERPRISES ACCORDING TO
AGE GROUPS

TABLE XXVI

EXCAVATOR (crawler)

ITEMS	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
T.C.K.	2	1	-	2	6	8
Y.S.E.	-	3	-	-	-	-
D.S.I.	50	91	58	28	20	30
ETIBANK	-	15	5	17	-	-
TEK	-	-	-	-	-	-
TPAO	-	-	1	-	-	-
Krd. BAKIR	-	1	7	3	-	-
TOBRAK-SU	-	29	4	5	-	-
ORMAN Gn.Md.	-	-	-	-	-	-
LİMAN İnş.	-	-	2	11	7	5
TCDD	10	-	-	4	20	7
ÇİMENTO	-	6	5	9	-	20
TKİ	9	18	12	4	8	8
TOTAL	71	164	94	83	61	78

MACHINE PARK OF SOME SELECTED ENTERPRISES ACCORDING TO
AGE GROUPS

TABLE XXVII

EXCAVATOR (Rubber tyred)

ITEMS	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
T.C.K	1	1	-	1	2	13
Y.S.E.	2	1	5	-	-	-
D.S.I.	50	91	30	56	4	1
ETIBANK	-	-	-	-	-	-
TEK	2	-	-	-	-	-
TPAO	1	-	1	-	-	-
Krd. BAKIR	-	-	-	-	-	-
TORRAK-ÇU	-	-	1	25	-	-
ORMAN Gn.Md.	-	-	-	-	-	-
LIMAN İnş.	-	-	-	-	-	-
TCDD	-	-	-	-	-	-
ÇİMENTO	-	-	-	-	-	-
TKİ	-	3	-	-	-	-
TOTAL	56	96	37	59	6	14

MACHINE PARK OF SOME SELECTED ENTERPRISES ACCORDING TO
AGE GROUPS

TABLE XXVIII

LOADER (crawler)

ITEMS	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
T.C.K	-	51	30	25	-	-
Y.S.E.	200	116	43	101	-	-
D.S.I.	-	110	3	3	-	-
ETIBANK	-	22	19	2	-	-
TEK	2	1	4	-	-	-
TPAO	1	-	-	2	-	5
Krd. BAKIR	-	-	-	-	-	-
TORRAK-U	15	31	3	4	-	-
ORMAN Gn.Md.	97	3	5	5	-	-
LİMAN İno.	-	-	-	1	-	-
TCDD	2	8	-	-	-	-
ÇİMENTO	4	7	3	4	-	-
TKİ	5	4	-	-	3	-
TOTAL	326	353	110	147	3	5

MACHINE PARK OF SOME SELECTED ENTERPRISES
ACCORDING TO AGE GROUPS

LOADER RUBBER TYRED

TABLE XXIX

ITEMS \ AGE GROUP	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
T.C.K	-	288	-	37	-	6
Y.S.E.	-	175	10	-	-	-
D.S.I.	-	47	5	5	25	-
ETIBANK	13	20	24	8	-	-
TER	5	6	7	-	-	-
TPAO	1	1	3	-	-	-
Krd. BAKIR	2	1	10	-	-	-
TORRAK-SU	5	39	14	5	1	-
ORMAN Gn.Md.	-	-	-	-	-	-
LIMAN İng.	-	-	1	1	2	-
TCDD	-	8	-	-	-	-
ÇİMENTO	5	4	-	-	-	-
TKİ	65	16	8	10	-	-
TOTAL	96	605	82	66	28	6

MACHINE PARK OF SOME SELECTED ENTERPRISES
ACCORDING TO AGE GROUPS

MOBILE VINCH

TABLE XXX

ITEMS \ AGE GROUP	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
T.C.K	-	-	-	-	-	7
Y.S.E.	-	10	-	-	-	-
D.S.I.	-	-	-	-	-	-
ETİBANK	1	7	36	9	-	-
TEK	12	51	1	12	-	-
TPAO	-	-	-	-	-	-
Krd. BAKIR	-	-	-	-	-	-
TOBRAK-U	-	-	-	2	-	-
ORMAN Gn.Md.	-	-	-	-	-	-
LİMAN İnş.	-	-	2	-	-	-
TCDD	-	-	-	-	-	-
ÇİMENTO	3	-	-	-	-	-
TKİ	5	6	2	1	5	4
TOTAL	21	83	41	24	5	12

MACHINE PARK OF SOME SELECTED ENTERPRISES ACCORDING TO
AGE GROUPS

TABLE XXXI

HEAVY TRUCK

ITEMS	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
T.C.K	43	-	-	-	-	-
Y.S.E.	-	-	-	-	-	-
D.S.I.	-	-	-	-	-	-
ETİBANK	33	46	13	26	-	-
TEK	-	-	-	3	-	-
TPAO	-	-	-	-	-	-
Krd. BAKIR	-	6	29	8	-	-
TORRAK-U	-	-	-	-	-	-
ORMAN Gn.Md.	-	-	-	-	-	-
LİMAN İnş.	-	-	-	-	-	-
TCDD	-	-	-	-	-	-
ÇİMENTO	-	-	-	-	-	-
TKİ	-	-	-	-	-	-
TOTAL	83	52	42	37	-	-

DISTRIBUTION OF EARTH MOVING MACHINERY
 ACCORDING TO AGE GROUPS IN SOME SELECTED
 STATE ENTERPRISES

TABLE XXXII

ITEM \ AGE GROUP	AGE GROUP					
	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
Dozers	689	950	504	595	99	14
Excavator R.T.	56	96	37	59	6	14
Excavator Crw.	71	164	94	83	61	78
Loader R.T.	96	605	82	66	28	6
Loader Crw.	326	353	110	147	3	5
M.Vinch	21	83	41	24	5	12
H.Truck	81	52	42	37	-	-
TOTAL	1342	2303	916	1011	202	129

TABLE XXXIII

DISTRIBUTION OF NATIONAL PARK
ACCORDING TO AGE GROUPS

AGE GROUP ITEM	0 - 5	5 - 10	10 - 15	15 - 20	20 - 25	25 -
Dozers	865	1193	633	747	124	17
Excavator R.T.	76	131	50	80	8	19
Excavator Crw.	97	224	128	113	83	107
Loader R.T.	117	736	100	80	34	7
Loader Crw.	398	431	134	180	4	6
M. Vinch	24	93	46	27	6	13
H. Truck	106	67	54	47	-	-

-Total park to be replaced

Dozer ----- 1521
 Exc. R.T. ----- 157
 Exc. Crw. ----- 431
 Loader R.T. ----- 221
 Loader Crw. ----- 324
 M. Vinch ----- 92
 H. Truck ----- 101

NATIONAL REPLACEMENT DEMAND

YEARS ITEMS	1983	1984	1985	1986	1987	1988
Dozer	254	254	254	254	254	254
Excavator R.T.	26	26	26	26	26	26
Excavator Crw.	72	72	72	72	72	72
Loader R.T.	37	37	37	37	37	37
Loader Crw.	54	54	54	54	54	54
M.Vinch	15	15	15	15	15	15
H.Truck	17	17	17	17	17	17

TABLE XXXV

TOTAL DEMAND (1)
(NEW DEMAND (1) + REPLACEMENT DEMAND)

ITEMS \ YEARS	1983	1984	1985	1986	1987	1988
Dozer	1433	313	350	332	326	343
Excavator R.T.	79	35	33	31	28	40
Excavator Crw.	511	519	125	106	105	110
Loader R.T.	132	41	42	39	39	39
Loader Crw.	326	75	89	79	65	73
M. Vinch	22	45	45	15	15	15
H. Truck	695	86	77	50	17	17

Yearly average demand is

Dozer ----- 518
 Exc. R.T. ----- 41
 Exc. Crw. ----- 179
 Loader R.T. ----- 55
 Loader Crw. ----- 118
 M. Vinch ----- 26
 H. Truck ----- 157

TABLE XXXVI

TOTAL DEMAND (2)
(NEW DEMAND (2) + REPLACEMENT DEMAND)

YEARS ITEMS	1983	1984	1985	1986	1987	1988
Dozer	1316	313	350	332	336	343
Excavator R.T.	61	35	33	32	28	40
Excavator Crw.	492	119	125	106	105	110
Loader R.T.	37	37	37	37	37	37
Loader Crw.	114	75	89	79	65	73
M. Vinch	15	15	15	15	15	15
H. Truck	695	86	77	50	17	17

Yearly Average Demand is

Dozer ----- 498
 Exc. R.T. ----- 38
 Exc. Crw. ----- 176
 Loader R.T. ----- 37
 Loader Crw. ----- 83
 M. Vinch ----- 15
 H. Truck ----- 157

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CHAPTER IV

CONCLUSIONS

4.1. DOMESTIC PRODUCTION

There are three important manufacturers of earth moving machinery in Turkey namely, CIMSATAS, CUKUROVA ITHALAT VE IHRACAT AND MKEK. There are also some other private manufacturers like Erg Makina, Nace, Ozmak, Mutafcilar but their capacities and production figures have not been taken into account because they do not seriously affect the total demand. Domestic capacity other than MKEK, total production in 1982 and demand for MKEK machinery is given in Table XXXVII. MKEK is now manufacturing earth moving machinery in a small factory in Ankara but it is assumed that these machines will be manufactured in Polatli Factory after commissioning.

4.2. MKEK, POLATLI PLANT CAPACITY AND TOTAL DEMAND (Table XXXVII)

Here capacity is given in terms of two stages, namely, initial capacity and master plan. The reason for this is that, it will be useful to set up an interchangeable capacity which can be rearranged easily according to changes in market conditions in future years. Explanations on recommended capacities are as follows:

A) DOZERS

Yearly average demand for dozers is 518 units p.a. in Alt.I and 498 in Alt.II and CIMSATAS is expected to have a capacity of 200 units p.a. Demand for MKEK dozers is 318-298 p.a. It is recommended that an initial capacity of 200 units p.a may be planned with a provision for later

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expansion to 300 units. The capacity being planned at present is 240 units p.a.

B) RUBBER TYRED EXCAVATORS

The demand is 41 units per annum with Alt. I and 38 with Alt. II. There is a capacity of 30 units p.a. with Cukurova. It is recommended that MKEK should drop this item from its production programme. At present 40 units p.a. are planned.

C) CRAWLER EXCAVATORS

Demand is 179 units p.a. with Alt. I and 176 with Alt. II and there is a capacity of only 20 units p.a. with a number of small firms in the private sector. An initial capacity of 60 p.a. with provision for expansion to 100 units p.a. is recommended for MKEK Polatli Plant as against 60 planned at present.

D) LOADERS

The total annual demand is 118 p.a. for crawler type and 55 for rubber tyred loaders with Alt. I 83 and 37 for Alt. II. Private sector capacity already installed or planned with CIMSATAS is 150 and 100. It is recommended that MKEK should drop both these items from production programme. Capacity planned at present is 160 p.a. of each.

E) MOBILE VINCH

A demand of 26 units p.a. under Alt. I and 15 under Alt. II is estimated and there is capacity for 10 units in private sector, split up between small firms. It is recommended that MKEK should provide for a production of 5 units p.a. initially and provide for a production of 15 p.a. in the master plan, as against 35 p.a. planned at present.

F) HEAVY TRUCKS

Demand for Heavy Trucks with carrying capacity of 35 tons is 157 units p.a. It is recommended that a capacity of 160 units p.a. may be set up as envisaged by MKEK.

TABLE XXXVII

CAPACITY/DEMAND BALANCE
for
EARTH MOVING MACHINERY

ITEM	Ave. Dem. per year Alt. I	Ave. Dem. per year Alt. II	Domestic capacity other than MKEK	Production of 1981	Demand for MKEK m/c Alt. I	Demand for MKEK m/c Alt. II	MKEK Prod. Prog.
Dozer	518	498	200	20	318	298	240
Excavator R.T.	41	38	30	20	11	8	40
Excavator Crw.	179	176	20	9	159	156	60
Loader R.T.	55	37	100	10	-45	-63	160
Loader Crw.	118	83	150	65	-32	-67	160
M. Vinch	26	15	10	3	16	5	35
H. Trucks	157	157	-	-	157	157	160

- 4.2.1. While there is no doubt regarding the necessity of additional capacity to be created, in view of uncertainty of some data and the need to ensure full utilisation of installed capacity and taking into account the fact that there is a learning curve and it will take a few years for the new plant to develop its skills and reach sizable production figures, it is recommended that capacity in the new plant at Polatlı should be created in two phases.
- 4.2.2. A summary of capacities now being recommended by the Capital Goods Project is given in Table XXXVIII.

4.3. IMPORTANT ASSUMPTIONS

- 4.3.1. On the distribution of total machine park between private sector, public enterprises and municipalities only two studies are available. One was in 1972 by Chamber of civil engineers and other in 1979 by Tustas in the feasibility report for MKEK. The ratio of distribution given by Tustas has been accepted as representative of present distribution even though there may have been minor changes on account of differences on the relative growth of these three groups of users. The total park calculated on this basis has been used only for calculating the anticipated replacement demand.
- 4.3.2. The additional machines have been calculated on the basis of work plans of public enterprises and total work per machine per year. This is a straight-forward calculation for all additional demand which may arise from the three groups of users, actual distribution between them depending on how much is contracted or done departmentally or by renting equipment. It is assumed that private sector will use its present machine park for private sector work and other unforeseen work in the public sector.

TABLE XXXVIII

RECOMMENDATIONS ON MKEK EARTH MOVING
MACHINERY PRODUCTION PLAN

ITEM	INITIAL CAPACITY	MASTER PLAN	MKEK Production Prog.
Dozers	200	300	240
Exc. R.T.	-	-	40
Exc. Crw.	60	100	60
Loader R.T.			160
Loader Crw.			160
M.Vinch	5	15	35
H.Truck	160	160	160

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4.4. FUTURE PLAN OF ACTION

- 4.4.1. MKEK may be asked to immediately commission or carry out a revised techno-economic study of the Polatli Project based on these recommendations.
- 4.4.2. SEİE may be requested to draw up perspective plans for use of their existing park and amount of work to be done by contractors plans which may be updated every year based on availability of other resources.
- 4.4.3. Another demand capacity study on the lines of this report may be conducted in 3-4 years time to decide on the time frame for implementation of the master plan and also if in view of the data then available any other revisions are called for.

FORM I

KURULUSUN ADI:

PROJENIN ADI:

	1983	1984	1985	1986	1987	1988
1- TOPLAM YAPILMASI PLANLANAN KAZI (1000xm ³) a) Dozerle b) Paletli ekskavatorle c) Lastik tekerlekli ekskavatorle						
2- TOPLAM YAPILMASI PLANLANAN YUKLEME a) Paletli loderle b) Lastik tekerlekli loderle c) Mobil vincle						
3- TASIMA a) Calisma sahasinda ortalama uzaklik b) Gunluk sefer sayisi c) Yilda is gunu sayisi						

FORM II

KURULUSUN ADI

ÖZET

	1983	1984
1- TOPLAM YAPILMASI PLANLANAN KAZI (1000m³)		
a) Dozerle		
b) Paletli ekskavatorle		
c) Lastik tekerletli ekskavatorle		
2- TOPLAM YAPILMASI PLANLANAN YUKLEME		
a) Paletli loderle		
b) Lastik tekerlekli loderle		
c) Mobil winçle		
3- TASIMA		
a) Gölisme sahasında ortalama uzaklık		
b) Günlük sefer sayısı		
c) Yılda iş günü sayısı		

1985	1986	1987	1988

FORM III

MEVCUT MAKINA PARKI

(Adet)

Makina Yas Grubu	Dozer	Paletli Ekskavator	Lastik Teker. Ekskavator	Paletli Loder	Lastik Teker Loder	Mobil Vinc	Agir Is Mamyonu
0-5							
5-10							
10-15							
15-20							
20-25							
25-							

RESULTS OF SPECIAL COMMITTEE REPORT

ITEMS \ YEARS	1983	1984	1985	1986	1987	1988
Dozer		516	557	601	648	706
Excavator R.T.		102	115	124	155	165
Excavator Crw.						
Loader R.T.		174	186	211	231	248
Loader Crw.		336	365	389	401	433
M.Vinch						
H.Truck		510	551	600	632	681

Average Demand per annum is:

Dozer -----605

Excavator ----- 132

Loader R.T. -----210

Loader Crw. ----- 385

Heavy Truck ----- 595

DISTRIBUTION OF EARTH-MOVING MACHINERY PARK
AMONG USERS

ITEM	USLE PUBLIC	%	PRIVATE	%	MUNICI- PALITIES	%
Dozers	2723	81.4	461	13.8	160	4.8
Excavator Crw.	401	70.3	144	25.2	25	4.5
Excavator R.T.	133	70.7	48	25.5	7	3.8
Loader Crw.	685	84.8	70	8.6	52	6.6
Loader R.T.	753	85.4	70	7.9	58	6.7
Mobile Vinch	439	84.7	60	11.6	19	3.7
Heavy Truck *		79.5		15.5		5

* Data not available. Average percentages are taken.

Reference: MKEK Polatli plant feasibility (1979) by TUSTAS.

