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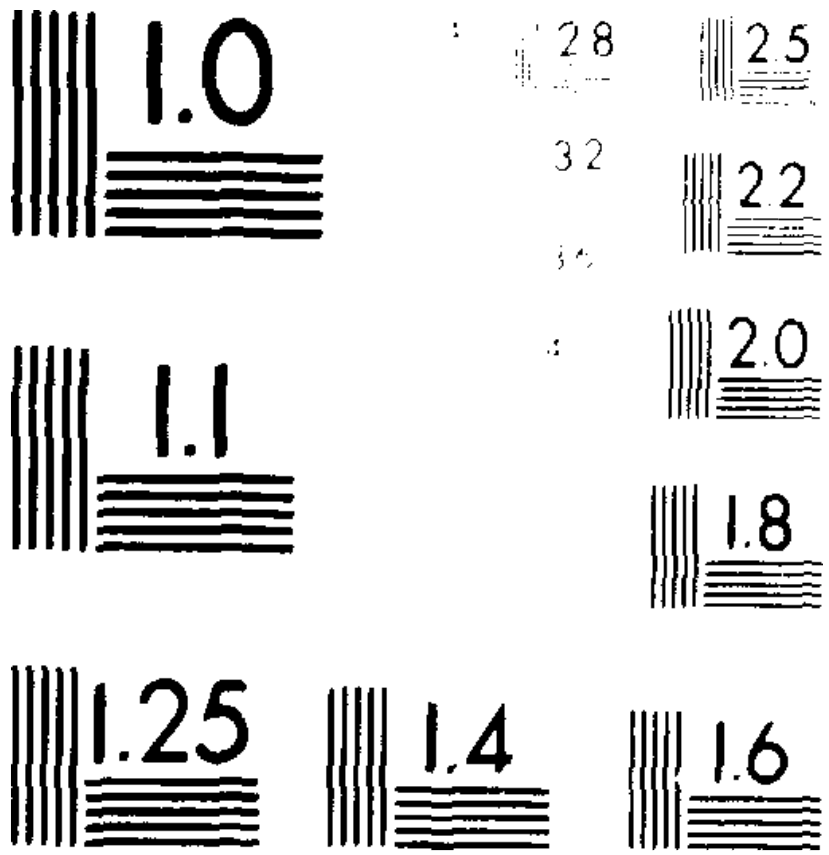

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1982

DEVELOPMENT OF CAPITAL GOODS INDUSTRIES

DP/TUR/78/034

Turkey.

Technical Report No.VII: Transmissions

M.M. Luther

2046

Birleşmiş Milletler Kalkınma Programı

UNITED NATIONS NATIONS UNIES

DEVELOPMENT PROGRAMME IN TURKEY

CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

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DEVELOPMENT OF CAPITAL GOODS INDUSTRIES

DP/TUR/76/034

Technical Report No. 7

TRANSMISSIONS

by

M.M.Luther

Chief Technical Adviser

Capital Goods Development Project in Turkey

The views expressed in this paper do not necessarily reflect the views of UNIDO.

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UNITED NATIONS NATIONS UNIES

DEVELOPMENT PROGRAMME IN TURKEY

CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

TABLE OF CONTENTS

U.N. BUILDING, 197 ATATÜRK BULVARI P.O. BOX 407, ANKARA CABLES : UNDEVPRO TEL : 26 54 65 TELEX : 42664

Birleşmiş Milletler Kalkınma Programı

UNITED NATIONS NATIONS UNIES

DEVELOPMENT PROGRAMME IN TURKEY

CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

TABLES

U.N. BUILDING, 197 ATATÜRK BULVARI P.O. BOX 407, ANKARA CABLES : UNDEVPRO TEL. : 26 54 85 TELEX : 42024

CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY

LIST OF APPENDICES

CAPITAL GOODS DEVELOPMENT PROJECT IN TURKEY 1

CHAPTER 1

INTRODUCTION

1.1. In the Capital Goods Development Project being conducted by SPO and UNIDO for planning the future of capital goods industry in Turkey, as a matter of high priority those state sector projects which are already in the pipeline are being analysed. This report examines the project of TUMOSAN for production of gearboxes and rear axles for commercial vehicles (SPO's Project No. 78C230040) to be located at Konya and in this context deals with demand and supply of transmissions as one of the principal inputs of the automotive industry .

1.2. Dr. Ali Unal of TUMOSAN was deputed by General Manager of TUMOSAN to collect data and assist in making projections of demand and supply. SPO deputed Mr. Omer Ozdemlr to assist and provide the necessary data from SPO. Dr. Ali Unal has been further assisted by Mr. Arif Gucun and Mr. H. Firat Tugrul. Mr. M.M.Luther, Chief Technical Adviser, UNIDO, had a series of meetings wlth these experts. Consclusions and recommendations

have been discussed with management of TÜMOSAN who have agreed with them. Mrs. Güler İzmirlioğlu and Mr. Ziya Sıddıki, National Project Coordinators and Mr. Vahit Erdem provided the necessary help in coordination with TÜMOSAN.

1.3. CTA, UNIDO would like to place in record his appreciation of cooperation of officials of SPO, the Ministry of Industry and the management of TÜMOSAN for their open minded discussions as well as for the very valuable contributions made by all experts mentioned above.

1.4. Scope of the study.

This study covers inter alia:

(i) Anticipated demand in the present environment in the period of 1983-1990.

(ii) Capacity available and anticipated for gearboxes and rear axles for commercial vehicles, tractor and passenger-car transmission gears and engine timing gears.

(iii) Proposals for filling up anticipated gaps.

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M.M.Luther
Chief Technical Adviser
Capital Goods Development Project

CHAPTER II

SUMMARY

2.1. Transmissions are used in every vehicle to transmit power from engine to the rotating wheels.The trarsmission parts of the commercial vehicles known as gearboxes and rear axles are being considered in the context o· projects for manufacture of diesel engines which have been identified as one of the priority sub-sectors by SPO for Capital Goods Development Project. Technical Report No. III and VI deal with diesel engines for commercial vehicles while Technical Report No. V covers farm tractors and tractor diesel engines. This report deals with gearboxes and rear-axles for commercial vehicles and gear components for tractor and passenger-car transmissions and for diesel engine timing gears.

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2.2. The demand analysis for diesel engines in the Reports III, V and VI have been based on the forecast for vehicles which were estimated from relations between fleet and G.N.P. For gearboxes and rear axles as well as the gears of tractor transmissions and diesel engine timing gears are derived from the vehicle and engine demand forecast in reports of the Capital Goods Project. Demand for gears of passenger-cars are based on the demand forecast published by Industrial Development Bank of Turkey(T.S.K.B) in August 1981.

2.3. Demand forecasts have been carried out for three groups of gearboxes and rear axles, namely, light, medium and heavy duty, used in related vehicle types and for gears in three groups of loose gears and shafts for tractor transmissions, diesel engine timing gears and passenger car transmissions.

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2.4. Domestic demand has been estimated and expected to reach, for light duty gearboxes and axles, a level between 42,000 and 72.000 p.a. for medium duty an average of 17.000 and 25.000 and for heavy duty gearboxes and rear-axles around[1] between 12,000 and 16,000, by 1990. Domestic demand foreseen for tractor gears is between62.000 and 36.000 sets for engine timing gears a level of 130.000-200.000 sets and for passenger car gears around 72.000 sets by the end of this decade.

2.5. There is a good potential of export of these products, as installed in vehicles and for these vehicle assembly industries in the Middle East and Islamic Countries. 10% of the capacity should be earmarked for exports and adequate measures should be employed for exploiting this potential.

2.6. For tractor gears, capacity exists in HEMA and M.K.E.K. plants but it will fall short of the demand by 1990. Car plant of OYAK has capacity for car transmission gears for its own production and demand from other car producers appears to be unmet.

(1) See Page 10

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There is no producer of engine timing gear hence the total unmet demand for tractor and car transmissions and engine timing gears reaches a level of 75.000 in terms of tractor gears indicating that demand is expected to be twice as much as the installed capacity by 1990.

2.7. For medium duty gearboxes and differential carriers of medium duty rear axles there is a capacity in HEMA and for medium duty axle housing there is installed capacity in EGE INDUSTRIES. Capacity for medium duty gearboxes and rear axles appears to be adequate upto 1990. There is no existing capacity for light duty gearboxes and rear axles or for heavy duty gearboxes and rear axles.

2.8. TÜMOSAN at present plans to produce light and heavy duty gearboxes and light duty rear axles of 57.000 and 42.000 units p.a. respectively.

2.9. It is recommended that TÜMOSAN have a master plan for not only these products but also heavy duty rear axles. The production plan and investment of foreign exchange for it are summarised below:

YEARS	PRODUCT				FOREIGN EXCHANGE INVESTMENT ($ Million)				
	Gearboxes		Rear Axles		Gearboxes		Rear Axles		
	Light Duty	Heavy Duty	Light Duty	Heavy Duty	Light Duty	Heavy Duty	Light Duty	Heavy Duty	Total
1982					4				4
1983	4000				5	4			9
1984	10000	3000			4	4			8
1985	20000	4000	4000		9	-	3		12
1986	36000	6000	10000			5	8		13
1987	42000	8000	20000				4	5	9
1988	42000	10000	32000	3000				7	7
1989	42000	12000	40000	5000				8	8
1990	42000	15000	42000	8000					

2.10. This report has been discussed with the management of TUMOSAN who are in agreement with the conslusions and recommendations.

CHAPTER III

ANALYSIS OF DOMESTIC DEMAND

3.1. Demand for transmissions used in all engine powered vehicles including trucks, buses, passenger-cars and farm tractors is derived from demand for vehicles and diesel engines which in turn are related to the demand of vehicles. Accordingly, both demand and production capacity of vehicles will be the limiting factors, for demand for transmissions.

3.2. Forecast of demand for transmissions is based on technical reports Nos. III, IV and VI of Chief Technical Adviser of the UNIDO/SPO project for the development of Capital Goods Industries in Turkey. These dealt with Heavy-duty Diesel Engines, Light-duty Diesel Engines and Tractor and Tractor Diesel Engines. Passenger cars however have not been covered by the project. For the purpose of this report anticipated production of passenger cars has been estimated to assess the pattern of demand for transmissions in this subject.

U.N. BUILDING, 197 ATATÜRK BULVARI P.O. BOX 407, ANKARA CABLES : UNDEVPRO TEL : 26 54 85 TELEX : 42664

3.3. PRESENT STATUS

The vehicle industry in Turkey, at present, functions in the form of assembly units, main components such as diesel engines, transmissions being imported and fitted on to locally-made chassis. There are however some small variations in this current practice depending on the vehicle type and the manufacturer.

From the transmissions standpoint vehicles may be grouped as shown on Figure 1.In addition to the transmissions used in vehicles a mechanism known as engine timing gear incorporated in diesel engines has been included in this chart because of its essentially similar component composition.

In the commercial vehicles comprising pick-ups, minibuses, midibuses, trucks, buses and truck tractors transmissions, made up of gearboxes and rear axles, are bought, fully assembled, from independent producers and assembled onto the vehicles. These suppliers are often different than the licensors of vehicles. This is due not only to the economies of scale in manufacture but also speci lised

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Figure: 1

GROUPING OF TRANSMISSIONS REQUIRED IN LOCAL MARKET

Existing Plants	Capacity for gearbox	Capacity for Rear Axle
Hema - Polatlı	20.000	20.000
TÜMOSAN (Planned)	57.000	42.000
Total	77.000	62.000

Existing Plants	Capacity for tractors	Capacity for cars
Hema - Polatlı	50.000	-
M.K.E.K.	10.000	-
OYAK-Renault	-	45.000
Total	60.000	45.000

knowledge of transmissions.

In the tractors, transmissions, form part of the chassis of the vehicle and tractor producers buy or import gear-type components in loose form and import of machine the housings(transmission casings) in their own plant. Economics of production are relevant since gear production facilities cover plain, bevel and planetary gears, pinions, spline shafts and synchronizer and dog-clutches and this specialized line of manufacture is economical only in relatively large volumes.

In the passenger-car industry transmission is either made up of two separate components as gearbox and rear axles or in case of front-drive cars gearbox and drive mechanism of axle is combined in one (transmission housing) and the rear axle is then a simple trailing dead-axle. Only one car producer (OYAK-Renault) manufactures the transmission completely and the other two car producers (TOFAŞ AND OTOSAN) follow the practice of tractor manufacturers with machining of housing in their plant, importing gear components and

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assembling them in gearboxes and rear axles.

In the diesel engine manufacture engine timing gears, are supplied by gear manufacturers or imported. Transmissions in the present vehicle industry are therefore procured in two forms. For commercial vehicles gearboxes and rear axles are bought and installed in vehicles as complete units whereas in the other sector of the vehicle industry they are procured as loose gears and shaft components which are then installed in vehicles.

3.4. Demand for transmissions will therefore be studied in two separate groups namely as loose gears and shafts for tractors, diesel engines and passenger cars and as gearboxes and rear axles for commercial vehicles.

3.5. DEMAND FOR GEARS AND SHAFTS

3.5.1. Demand for gears and shafts is related to the demand for tractors, passenger cars and for tractors and diesel engines. In Appendix I demand forecast for tractors and tractor diesel engines are shown under minimum demand and favourable conditions as indicated in Technical Report No. V of the

project for Development of Capital Goods in Turkey. These were worked considering parameters of agricultural income, tractor price level, bank credits and related agricultural growth. Similarly Appendix II shows demand forecast for diesel engines worked out for the Technical Report No. VIII on "Diesel Engine Industry in Turkey-An Overview" by the Capital Goods Development Project. For the passenger cars the only available demand forecast covers years upto 1985, worked out by Industrial Development Bank of Turkey (TSKB) and shown in Appendix III. It is therefore assumed that demand for cars will be determined and limited by the production capacities reaching 80% of the installed capacity in 1990. This is considered realistic for determining the unfilled demand for gears and shafts for passenger cars particularly since one of the big producers has his own production facility. The existing production capacities of car manufacturers and estimated demand for passenger cars are shown in Appendix 3.

Demand for loose gears and shafts as sets used in tractors, diesel engines and passenger cars are tabulated in Table I for minimum and favourable demand conditions. It is to be noted that in a tractor one set contains approximately 40-45

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TABLE: 1

Demand for gears and shafts-as sets used in Tractors, Diesel Engines and Passanger Cars

Years	Minimum Demand Conditions			Favourable Conditions		
	Tractor Transmission Gears	Diesel Engine Timing Gears	Passanger Car Trans Gears	Tractor Transmission Gears	Diesel Engine Timing Gears	Passanger Car Transmission Gears
1983	48904	89178	30000	50610	94186	30000
1984	50545	96521	39000	53847	107895	39000
1985	52131	106095	49000	57579	124245	49000
1986	53863	116703	55000	62238	148640	55000
1987	56560	127868	60000	67888	166648	60000
1988	57916	134284	64000	73766	184271	64000
1989	60182	134867	68000	80160	191704	68000
1990	62116	133024	72000	86882	200296	72000
Avg(1983-86)	52361	102259	43250	56080	118756	43250
Avg(1987-90)	59194	132829	66000	77174	185399	66000
Avg(1983-90)	55227	117495	54625	66627	152123	54625

parts of helical, spur, bevel, pinion and synchronizer gears with splined and geared shafts. In diesel engines a timing gear set contains 5-6 helical plain gears. In passenger car transmission one set includes 20-25 gears of various types, synchronizer parts and splined and geared shaft parts. For comparison of actual number of geared parts and shafts 8 engine timing gear set or 2 passenger cars, transmission gear-shaft sets have been considered as equivalent to one tractor transmission gear-shaft set.

3.6. DEMAND FOR GEARBOXES AND REAR-AXLES FOR VEHICLES

3.6.1. Demand for gearboxes and rear-axles are derived from demand for commercial vehicles. Demand forecasts for pick-ups, minibuses, trucks, midibuses and buses have been extracted from figures worked out for the Technical Report No. VIII of Capital Goods Development Project and shown in Appendices 4,5,6 respectively while demand for truck-tractors is based on the demand forecast study carried out by DESIYAB in 1977 for TÜMOSAN project Report No.1977/43 and is shown in Appendix VII.

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3.6.2. These demand forecasts have been carried out with respect to diesel engine power ratings(HP's) for vehicles concerned. However because of the differences in design and related manufacture of gearboxes and rear axles used in vehicles of various gross weights these products may accordingly be classified in three groups with associated vehicle types.

a) Light duty gearboxes and rear axles are used in vehicles of up-to 8 tons gross weight which covers minibuses, pick-ups, light trucks and midibuses . Gearboxes of this group have input-torque rating of 18-30 kgm and rear axles have carrying capacity of 1.5-6 tons.

b) Medium duty gearboxes and rear axles are incorporated in vehicles of upto 12 tons gross weight which covers trucks of 6-8 ton pay-load capacity. Gearboxes are of capacity of 35-45 kgm. input-torque while rear axles are rated as 6.5-8.5 tons axle carrying weight.

c) Heavy duty gearboxes and rear axles are for the applications for vehicles with 14-42 tons gross weight, which covers trucks, buses, truck-tractors. Gearboxes are rated as 50-125 kgm input-torque and rear axles have axle carrying capacity of 9-10 tons for single axles and 13-16 ton for tandem axles.

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The vehicle types with associated drive line components such as diesel engines, gearboxes and rear axles are summarized in Table 2.

Demand for vehicles given in Appendices 4,5,6,7 are re-arranged and given in Tables 3,4 and 5 as demand for three groups of vehicles defined according to gearbox and rear axle types discussed above.

3.6.3. Based on the forecasts of demand for commercial vehicles shown in Tables 3, 4 and 5 total domestic demand for light medium and heavy duty gearboxes and rear axles are summarized in Table 6 for minimum demand and favourable conditions.

TABLE: 2

Classification of transmissions as related to vehicle types and Diesel Engines

Transmission class	Light Duty	Medium Duty	Heavy Duty
Vehicle Type	Pick-up, Jeep, Light truck, minibuses-midibuses	8 ton truck	10 ton truck, Buses, Truck Tractors
Payload (tons)	1 - 5	6 - 8	10 - 36
Gross Vehicle Weight (tons)	2 - 8	9 - 12	14 - 42
Engine power (HP)	50 - 85	100 - 130	140 - 350
Gearbox rating Kpm. input Torque	18 - 30	35 - 45	50 - 125
Rear Axle rating carry.Cap.(tons)	1.5 - 6	6.5 - 8.5	9 - 16

U.N. BUILDING, 197 ATATÜRK BULVARI P.O. BOX 407, ANKARA CABLES: UNDEVPRO TEL: 26 54 85 TELEX: 42684

TABLE: 3

DOMESTIC DEMAND FORECAST FOR LIGHT DUTY VEHICLES

YEARS	Minimum Demand Conditions					Favourable Demand Conditions				
	Pick-up-Minibus		Truck	Midibus		Pick-up-Minibus		Truck	Midibus	
	60-65 HP	75-80 HP	85 HP	85 HP	TOTAL	60-75 HP	75-80 HP	85 HP	85 HP	TOTAL
1983	12967	9165	2144	393	24669	14131	9888	2317	425	26861
1984	14892	10764	2480	445	28581	17584	12675	2866	515	33640
1985	17481	12522	2887	496	33386	22075	15791	3527	610	42003
1986	21135	14540	3297	540	39512	29749	20679	4466	744	55638
1987	24390	16052	3852	519	44813	34568	23327	5184	743	63822
1988	25971	17298	4344	525	48128	37935	25875	5847	772	70429
1989	23744	16427	4343	485	44999	37748	26492	6057	757	71054
1990	21981	15620	4095	512	42208	38313	27384	6031	812	72540
(Avg(983-86)	16619	11749	2702	468	31539	20885	14785	3294	574	39538
(Avg(987-90)	24022	16349	4156	511	45039	37141	25770	5780	771	69462
(Avg(983-90)	20321	14049	3429	490	38289	29013	20278	4537	673	54501

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Table: 4

DOMESTIC DEMAND FOR MEDIUM - DUTY VEHICLES

(130 HP TRUCK)

YEARS	MINIMUM DEMAND CONDITIONS	FAVOURABLE CONDITIONS
1983	11.433	12.355
1984	13.211	15.282
1985	14.818	18.107
1986	16.266	22.034
1987	18.233	24.534
1988	19.647	26.507
1989	18.819	26.246
1990	16.294	24.929
Avg. (1983-86)	13.923	16.945
Avg. (1987-90)	18.606	25.555
Avg. (1983-90)	16.297	21.250

Table: 5

DOMESTIC DEMAND FORECAST FOR HEAVY DUTY VEHICLES

	MINIMUM DEMAND CONDITIONS					FAVOURABLE CONDITIONS				
	170 HP ENGINE			200-350 HP		170 HP ENGINE			200-350 HP	
YEARS	Truck	Bus (170-210)	Total	Truck	TOTAL	Truck	Bus (170-210)	Total	Truck	TOTAL
1983	715	1,571	2,286	1,886	4,172	773	1,701	2,474	1,886	4,360
1984	826	1,777	2,603	2,111	4,714	955	2,060	3,015	2,111	5,126
1985	1,540	1,985	3,525	2,235	5,760	1,881	2,440	4,321	2,235	6,556
1986	2,418	2,163	4,581	2,481	7,062	3,275	2,97[illegible]	6,249	2,481	8,730
1987	3,595	2,075	5,670	2,592	8,262	4,838	2,974	7,812	2,592	10,404
1988	4,912	2,099	7,011	2,852	9,593	6,627	3,090	9,717	2,852	12,569
1989	5,790	1,940	7,730	3,137	10,867	8,076	3,031	11,107	3,137	14,244
1990	6,278	2,047	8,325	3,451	11,776	9,248	3,246	12,494	3,451	15,945
Avg(1983-86)	1,375	1,874	3,249	2,178	5,427	1,721	2,294	4,015	2,178	6,193
Avg(1987-90)	5,144	2,040	7,184	3,008	10,192	7,197	3,085	10,282	3,008	13,280
Avg(1983-90)	3,260	1,957	5,217	2,593	7,810	4,459	2,689	7,148	2,593	9,738

TABLE : 6

DOMESTIC DEMAND FOR GEARBOXES AND REAR-AXLES

	MINIMUM CONDITIONS			FAVOURABLE CONDITIONS		
YEARS	Light Duty	Medium Duty	Heavy Duty	Light Duty	Medium Duty	Heavy Duty
1983	24,669	11,433	4,172	26,861	12,355	4,360
1984	28,581	13,221	4,714	33,640	15,282	5,126
1985	33,386	14,818	5,760	42,003	18,107	6,556
1986	39,512	16,266	7,062	55,638	22,034	8,730
1987	44,813	18,233	8,262	63,822	24,534	10,404
1988	48,128	19,647	9,593	70,429	26,507	12,569
1989	44,999	18,819	10,867	71,054	26,246	14,244
1990	42,208	16,924	11,776	72,540	24,929	15,945
Avg(1983-1986)	31,539	13,932	5,427	39,538	16,945	6,193
Avg(1987-1990)	45,037	18,406	10,192	69,462	23,555	13,280
Avg(1983-1990)	38,289	16,169	7,810	54,501	21,250	9,738

CHAPTER IV

EXPORT

4.1. There is a considerable potential for exports of vehicles equipped with Turkish diesel engines, gearboxes and rear axles in the Islamic group of countries particularly in the Middle East.

4.2. Gearboxes and rear axles may be additionally exported as components to the countries where automotive assembly industries have started as in the case of Iraq, Iran and Saudi Arabia.

4.3. In Technical Reports of the Project for Development of Capital Goods in Turkey dealing with tractors, tractor diesel engines, light, medium and heavy duty diesel engines new exports have been foreseen. This will in turn create a demand for export purposes for loose gears and shafts.

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4.4. It is therefore felt that in view of situation of Turkey from the point of its stage of technological development in relation to other countries in the Middle East as well as other Islamic countries, a minimum of 10% should be earmarked for exports in either form. In the case of TÜMOSAN there is no restrictions imposed by the licensor companies. Tables 7,8,9,10 show total demand forecasts including estimates of exports for gears and shafts as loose components, light, medium and heavy duty vehicles respectively.

4.5. A detailed study of markets should be carried out to make the best use of the opportunities particularly as drive component supplier for vehicle assemblers with the possibility of bilateral long term agreements for supply of these items to other countries.

4.6. Adequate steps for ensuring international standards of quality will be essential to make dent in these markets.

Table: 7

DEMAND FOR TRACTORS

Years	Minimum Conditions			Favourable Conditions		
	Domestic	Export	Total	Domestic	Export	Total
1983	48904	4890	53794	50610	5060	55670
1984	50545	5045	55590	53847	5390	59237
1985	52131	5213	57344	57579	5760	63339
1986	53863	5386	59249	62283	6230	68513
1987	56560	5656	62216	67888	6790	74678
1988	57916	5791	63707	73766	7380	81146
1989	60182	6018	66200	80160	8020	88180
1990	62116	6211	68327	86882	8690	95572
Avg(1983-86)	51361	5136	56462	56080	5610	61690
Avg(1987-90)	59194	5919	65113	77174	7720	84894
Avg(1983-90)	55277	5527	60804	66627	6660	73287

Table: 8

DEMAND FOR TOTAL DIESEL ENGINE

Years	Minimum Conditions			Favourable Conditions		
	Domestic	Export	Total	Domestic	Export	Total
1983	90717	9072	99789	95725	9572	105297
1984	98535	9853	108388	109369	10937	120306
1985	107807	10781	118588	125955	12595	138550
1986	118427	11843	130270	150410	15041	165451
1987	129811	12981	142792	168321	16832	185135
1988	137397	13740	151137	185114	18511	203625
1989	136585	13658	150243	193422	19342	212764
1990	134588	13459	148047	201860	20186	222046
Avg(1983-86)	103871	10387	114258	120365	12036	142401
Avg(1987-90)	134595	13459	148054	187179	18718	205897
Avg(1983-90)	119233	11923	131756	153772	15377	169149

U.N. BUILDING, 197 ATATÜRK BULVARI P.O. BOX 407, ANKARA CABLES : UNDEVPRO TEL : 26 54 65 TELEX : 42684

Table: 9

DEMAND FOR GEARBOXES AND REAR AXLES MINIMUM CONDITIONS

YEAR	LIGHT DUTY			MEDIUM DUTY			HEAVY DUTY		
	Domestic	Export	Total	Domestic	Export	Total	Domestic	Export	Total
1983	24669	2466	27115	11433	1143	12576	4172	417	4589
1984	28581	2858	31439	13421	1342	14763	4714	471	5185
1985	33386	3386	36772	14818	1481	16299	5760	576	6336
1986	39512	3951	43463	16216	1621	17837	7602	760	8362
1987	44813	4481	49294	18233	1823	20056	8262	826	9088
1988	48128	4812	52940	19647	1964	21161	9593	959	10552
1989	44999	4499	49498	18819	1881	20700	10867	1086	11953
1990	42208	4220	46428	16924	1692	18616	11776	1177	12953
Avg.(1983-86)	31539	3154	34693	13932	1393	15325	5427	542	5969
Avg.(1987-90)	45037	4503	49540	18406	1840	20246	10192	1019	11211
Avg.(1983-90)	38289	3829	42792	16169	1617	17786	7810	781	8591

U.N. BUILDING, 197 ATATÜRK BULVARI P.O. BOX 407, ANKARA CABLES : UNDEVPRO TEL : 26 54 60 TELEX : 42864

Table: 10

DEMAND FOR GEARBOXES AND REAR AXLES FAVOURABLE CONDITIONS

YEAR	LIGHT DUTY			MEDIUM DUTY			HEAVY DUTY		
	Domestic	Export	Totah	Domestic	Export	Totah	Domestic	Export	Totat
1983	26861	2686	29547	12355	1235	13590	4360	436	4796
1984	33640	3364	37004	15282	1528	16810	5126	512	5638
1985	42003	4200	46203	18107	1810	19917	6556	655	7211
1986	55638	5563	61201	22034	2203	24237	8730	893	9603
1987	63822	6382	70204	24534	2453	26987	10404	1040	11444
1988	70429	7042	77471	26507	2650	29157	12569	1256	13825
1989	71054	7105	78159	26246	2624	28870	14244	1424	15668
1990	72540	7254	79794	24929	2492	27421	15945	1594	17539
Avg.(1983-86)	39538	3953	43491	16945	1694	18639	6193	619	6812
Avg.(1987-90)	69462	6946	76408	25555	2555	28110	13280	1328	14608
Avg.(1983-90)	54501	5450	59951	21250	2125	23375	9738	973	10711

CHAPTER V

SUPPLY POSITION

5.1. PRODUCTION CAPACITY FOR GEARS AND SHAFTS

There are only 3 major gear manufacturers in Turkey.

5.1.1. OYAK-RENAULT located in Bursa produces also gears and shafts for their own passenger cars. The car produced, Renault 12, is a front driven small family car and gearbox and differential unit, main part of the axle are combined within one transmission housing. The machine shop and heat treatment unit have capacity to produce transmissions of the firms own design upto 45000 per year in two shifts.

5.1.2. HEMA DİŞLİ A.Ş. located in Polatlı has been established to meet the demands of the farm tractor manufacturers for tractor gears and shafts. Farm tractor manufacturers, being licensees of different companies of various countries have each their own material standards requiring special heat treatment

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processes. The plant is in the stage of commissioning and negotiations for orders are in progress. Its production capacity is set at 60,000 tractor transmission gears per year in two shifts. Production facilities could also be used for gears and shafts of medium duty gearboxes and differential heads but this will be resulting in corresponding lower capacity for tractor gears.

5.1.3. MKEK state owned public enterprise has gear production capacity as part of the machine tool factory in Kırıkkale. In addition to their own use for machine tools there exists a capacity for 10,000 tractor transmission gears and shafts per year in two shifts. It is understood from MKEK that while their heat treatment facilities are being improved to match the machining capacity they have no plans to expand this capacity.

5.1.4. There are a few other small scale gear producers set up in different parts of the country. Due to lack of complete gear manufacturing facility such as gear shaving machinery, heat treatment units and gear quality control equipment they cannot produce gears for automotive industry. They

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however are expected to cater for the demands of small and medium scale manufacturer in industry.

5.2. PRODUCTION CAPACITY FOR GEARBOXES AND REAR AXLES

5.2.1. HEMA DİŞLİ A.Ş. The plant mentioned in 5.1.2. has in addition to the stated gear cutting capacity, facility to machine differential carriers of Eaton 16200 rear axles. Also in the same companies Çerkezköy plant there exists facility for machining of gearbox-housing of Eaton SM475 type. With complementary use of facilities in two plants there is born a capacity for manufacture of gearboxes and differential heads of rear axles both for medium duty application at 20,000 units per year in 2 shifts. This will be however at the expense of the capacity for tractor transmission gears and shafts, reducing it to 50,000 sets per year in two shifts. The question of the design of gearbox manufactured in HEMA and elsewhere needs to be urgently considered for the sake of rationalisation in the industry which has a limited demand particularly if it has to export these products which in view of the high added value it must.

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5.2.2. EGE INDUSTRIES located in İzmir have facilities for production of medium duty rear axle housing and are at present licensed to produce only Rockwell 8 ton housing. The capacity is 20.000 per year in 2 shifts. The company currently supplies some truck manufacturers with axle housing.

5.3. COMPARISON OF DEMAND AND SUPPLY CAPACITY

Manufacturing facility and characteristics of different parts of gearboxes and rear axles are fundamentally different nature. From the point of view of integration therefore an analysis of demand including those for export and supply requires an in-depth study of existing production facilities not only for each group of products concerned but also for each main part of the product.

In Tables 11 and 12 comparison of demand and supply are shown till the year 1990 for minimum and favourable demand conditions for each major component of each product group. It is assumed that facilities at HEMA Polatlı Plant will be used both for tractor transmission gears and gear boxes and rear axles for commercial vehicles.

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Birleşmiş Milletler Kalkınma Programı

UNITED NATIONS NATIONS UNIES

DEVELOPMENT PROGRAMME IN TURKEY 33

TABLE : 11

Supply and Demand Comparison (minimum Condition)

			EXISTING INSTALLED CAPACITY	1983			1984			1985			1986			1987			1988			1989			1990		
				Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand
	LIGHT Duty	Housing		27115		27115	31439		31439	36772		36772	43463		43463	49294		49294	52940		52940	49498		49498	46428		46428
		Gears(set)		27115		27115	31439		31439	36772		36772	43463		43463	49294		49294	52940		52940	49498		49498	46428		46428
GEARBOX	MEDIUM DUTY	Housing	20000(1)	12576	6000(1)	6576	14763	10000(1)	4763	16299	15000(1)	1299	17837	16000(1)	1837	20056	18000(1)	2056	21161	20000(1)	1161	20700	20000(1)	700	18616	20000(1)	
		Gears(set)	20000(1)	12576	6000(1)	6576	14763	10000(1)	4763	16299	15000(1)	1299	17837	16000(1)	1837	20056	18000(1)	2056	21161	20000(1)	1161	20700	20000(1)	700	18616	20000(1)	
	HEAVY DUTY	Housing		4589		4589	5185		5185	6366		6366	8362		8362	9088		9088	10552		10552	11953		11193	12953		12953
		Gear(set)		4589		4589	5185		5185	6366		6366	8362		8362	9088		9088	10552		10552	11953		11193	12953		12953
	LIGHT DUTY	Housing		27115		27115	31439		31439	36772		36772	43463		43463	49294		49294	52940		52940	49498		49498	46428		46428
		Diff.Carrier		27115		27115	31439		31439	36772		36772	43463		43463	49294		49294	52940		52940	49498		49498	46428		46428
REAR		Gears(set)		27115		27115	31439		31439	36772		36772	43463		43463	49294		49294	52940		52940	49498		49498	46428		46428
AXLES	MEDIUM DUTY	Housing	20000(2)	12576	4000(2)	8576	14763	10000(2)	4763	16299	15000(2)	1299	17837	16000(2)	1837	20056	18000(2)	2056	21161	20000(2)	1161	20700	20000(2)	700	18616	20000(3)	
		Diff.Carrier	20000(1)	12576	4000(1)	8576	14763	10000(1)	4763	16299	15000(1)	1299	17837	16000(1)	1837	20056	18000(1)	2056	21161	20000(1)	1161	20700	20000(1)	700	18616	20000(1)	
		Gears(set)	20000(1)	12576	4000(1)	8576	14763	10000(1)	4763	16299	15000(1)	1299	17837	16000(1)	1837	20056	18000(1)	2056	21161	20000(1)	1161	20700	20000(1)	700	18616	20000(1)	
	HEAVY DUTY	Housing		4589		4589	5185		5185	6366		6366	8362		8362	9088		9088	10552		10552	11953		11193	12953		12953
		Diff Carrier		4589		4589	5185		5185	6366		6366	8362		8362	9088		9088	10552		10552	11953		11193	12953		12953
		Gears(set)		4589		4589	5185		5185	6366		6366	8362		8362	9088		9088	10552		10552	11953		11193	12953		12953
TRACTOR TRANSMISSION			50000(1)	53794	20000(1)	23794	55590	30000(1)	15590	57344	40000(1)	7344	59249	45000(1)	4249	62216	50000(1)	2216	63707	50000(1)	3707	66200	50000(1)	6200	68327	50000(1)	8327
GEARS (Set)			10000(3)		10000(3)			10000(3)			10000(3)			10000(3)			10000(3)			10000(3)			10000(3)			10000(3)	
DIESEL ENGINE TIMING (5)				(12474)		(12474)	(13548)		(13548)	(14823)		(14823)	(16283)		(16283	(17864)		(17864)	(18892)		(48892)	(18780)		(18780)	(18505)		(18505)
GEAR (Set)				99789		99789	108388		108388	118588		118588	130270		130270	142912		142912	151137		151137	150243		150243	148047		148047
CAR TRANSMISSION GEAR(Set)				30000	15000(4)	15000	39000	20000(4)	19000	49000	25000(4)	24000	55000	30000(4)	25000	60000	30000(4)	30000	64000	32000(4)	32000	68000	35000(4)	33000	72000	36000(4)	36000

(1) Hema Commisioned in 1981
(2) Ege Endüstri Commisioned in 1977
(3) MKEK Commisioned in 1968
(4) OYAK Commisioned in 1972

(5) Figures in bracket are number of timing gear sets while the members above are equivalent in terms of tractor gear sets.

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pply and Demand Comparison (Favourable Conditions)

			EXISTING INSTALLED CAPACITY	1983			1984			1985			1986			1987			1988			1989			1990		
				Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand	Demand	Supply	Unmet Demand
	Light	Housing		29547		29547	37004		37004	46203		46203	55638		55638	63822		63822	77471		77471	78159		78159	79794		79794
	Duty	Gears(Set)		29547		29547	37004		37004	46203		46203	55638		55638	63822		63822	77471		77471	78159		78159	79794		79794
ARBOX	Medium	Housing	20000(1)	13590	6000(1)	7590	16810	10000(1)	6810	19917	15000(1)	4917	24237	16000(1)	8237	26987	18000(1)	8987	29157	20000(1)	9157	28870	20000(1)	8870	27421	20000(1)	7421
	Duty	Gears(Set)	20000(1)	13590	6000(1)	7590	16810	10000(1)	6810	19917	15000(1)	4917	24237	16000(1)	8237	26987	18000(1)	8987	29157	20000(1)	9157	28870	20000(1)	8870	27421	20000(1)	7421
	Heavy	Housing		4796		4796	5638		5638	7211		7211	9603		9603	11444		11444	13825		13825	15668		15668	17539		17539
	Duty	Gears(Set)		4796		4796	5638		5638	7211		7211	9603		9603	11444		11444	13825		13825	15668		15668	17539		17539
	Light	Housing		29547		29547	37004		37004	46203		46203	55638		55638	63822		63822	77471		77471	78159		78159	79794		79794
	Duty	Diff.Carrier		29547		29547	37004		37004	46203		46203	55638		55638	63822		63822	77471		77471	78159		78159	79794		79794
R		Gears(Set)		29547		29547	37004		37004	46203		46203	55638		55638	63822		63822	77471		77471	78159		78159	79794		79794
	Medium	Housing	20000(2)	13590	4000(2)	9590	16810	10000(2)	6810	19917	15000(2)	4917	24237	16000(2)	8237	26987	18000(2)	8987	29157	20000(2)	9157	28870	20000(2)	8870	27421	20000(2)	7421
	Duty	Diff.carrier	20000(1)	13590	4000(1)	9590	16810	10000(1)	6810	19917	15000(1)	4917	24237	16000(1)	8237	26987	18000(1)	8987	29157	20000(1)	9157	28870	20000(1)	8870	27421	20000(1)	7421
		Gears(Set)	20000(1)	13590	4000(1)	9590	16810	10000(1)	6810	19917	15000(1)	4917	24237	16000(1)	8237	26987	18000(1)	8987	29157	20000(1)	9157	28870	20000(1)	8870	27421	20000(1)	7421
	Heavy	Housing		4796		4796	5638		5638	7211		7211	9603		9603	11444		11444	13825		13825	15668		15668	17539		17539
	Duty	Diff.Carrier		4796		4796	5638		5638	7211		7211	9603		9603	11444		11444	13825		13825	15668		15668	17539		17539
		Gears(Set)		4796		4796	5638		5638	7211		7211	9603		9603	11444		11444	13825		13825	15668		15668	17539		17539
CTOR TRANSMISSION			50000(1)	55670	20000(1)	25670	59237	30000(1)	29237	63339	40000(1)	13339	68513	45000(1)	13513	74678	50000(1)	14678	81146	50000(1)	21146	88180	50000(1)	28180	95572	50000(1)	35572
EARS (SET)			10000(3)		10000(3)			10000(3)			10000(3)			10000(3)			10000(3)			10000(3)			10000(3)			10000(3)	
SEL ENGINE TIMING (5)				(13162)		(13162)	(15038)		(15038)	(17318)		(17318)	(20681)		(20681)	(23141)		(23141)	(25453)		5453)	(26595)		(26595)	(27755)		(27755)
EARS (SET)				105297		105297	120306		120306	138550		138550	165451		165451	185133		158133	203625		203625	212764		212764	222046		222046
N TRANSMISSION GEARS (SET)				30000	15000(4)	15000	39000	20000(4)	19000	49000	25000(4)	24000	55000	30000(4)	25000	60000	30000(3)	30000	64000	32000(3)	32000	68000	35000(4)	33000	72000	36000(4)	36000

(1) Hema Commisioned in 1981

(2) Ege Endüstri Commisioned in 1977

(3) MKEK Commisioned in 1968

(4) OYAK Commisioned in 1970

(5) Figures in bracket are number of timing gear sets while the members above are equivalent in terms of tractor

5.3.1. Gearbox

For the gearboxes the analysis covers for main parts namely housing and gears which also includes splined and geared shafts and synchronizer parts. The other parts involved in gearboxes are usually produced and supplied by subcontractors. For the three groups of gearboxes there is production capacity only for one group, medium duty gearboxes, which exists in HEMA plants.HEMA Polatlı plant is at the present being commissioned and is expected to meet the full demand of medium duty gearboxes by 1985. Demand for the medium duty gearboxes is estimated to reach a level of 20,000 in last years of 1980s and can be expected to be met by HEMA alone. Should the economic developments be favourable demand for medium duty gearboxes is forecasted to increase to 27,000 by 1990 resulting in an unmet demand of 7,000 units.

For the light and heavy duty gearboxes demand is completely unmet and estimated to stabilize at a level of around 46.000 for light duty and around 13.000 for heavy duty gearboxes in 1990 in minimum demand conditions.

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Under favourable conditions demand is expected to reach 79.000 for light duty and 17.000 for heavy duty gearboxes by 1990.

5.3.2. REAR AXLES

Demand and supply analysis has been made for three main parts of the rear axles which are axle housing, differential carrier and gears that include crown, pinion and differential bevel gears. Only for medium duty axles there exist production facilities, at HEMA for differential carriers and gears and in EGE INDUSTRIES for axle housings. Demand and supply for medium duty as well as the light and heavy duty axles will follow the pattern for gearboxes. For medium duty axles it is expected that HEMA and EGE INDUSTRIES will produce in parallel to complement each others facility to meet the demand. Light and heavy duty axle demand is completely unmet.

5.3.3. TRACTOR TRANSMISSION GEARS

For the tractor gears there are two producers. Demand originating from different tractor will accordingly be for parts of varied types and designs. Although HEMA will have an installed capacity for 50,000 sets, it will

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take them 2-3 years to meet the demand in view of a variety of product specifications that they have to meet. Under minimum demand conditions existing capacities will be sufficient to meet demand by 1990 with some overtime working. Should the economic developments be favourable there will be an unmet demand from 1986 increasing to a level of 35,000 by 1990.

5.3.4. DIESEL ENGINE TIMING GEARS

Although one producer of tractor transmission gear MKEK also supplies timing gears for one diesel engine manufacturer, BMC, this is not shown on Tables 11 and 12 because of relatively small volume involved and being at the expense of tractor gear capacity. Demand for timing gears are therefore considered unmet reaching a level of 150,000 in 1990 in minimum demand conditions and a level of 220,000 by 1990 for favourable conditions In terms of equivalent tractor transmission gear sets the unmet timing gear demand will be 18,000 and 25,000 in 1990 for minimum and favourable demand conditions, respectively.

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5.3.5. Passenger Car Transmission Gears.

With one car producer (OYAK-RENAULT) having a capacity for transmission gears of own design there will be a unmet demand for transmissions resulting from demand for other car makes. It is assumed that OYAK-RENAULT will be having a share of half of the car demand and accordingly unmet demand for car transmissions will be reaching a level of 36,000 sets or equivalent to 14,000 tractor transmission sets in 1990.

5.3.6. To sum up the comparison of demand and supply for loose gear and shafts it is estimated that there will be a unmet demand in terms of tractor transmission gears for minimum conditions, reaching a level of 40.000 sets in 1990. For favourable economic conditions unmet demand will reach 76.000 tractor gear set in 1990 or in the other word only half of the demand will be met by existing producers with installed capacities.

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5.4. A Summary of unmet demand by 1990 given below

	Minimum demand	Favourable demand
Light duty gearboxes	46428	79794
Medium duty gearboxes	-	7421
Heavy duty gearboxes	12953	17539
Light duty rear axle	46428	79794
Medium duty rear axle	-	7421
Heavy duty rear axle	12953	79794
Tractor gears (set)	8327	35572
Timing gears set(In terms of tractor gear sets)	18505	27755
Passenger cars(In terms of tractor gear sets)	14000	14000

CHAPTER VI

TÜMOSAN PROJECT

6.1. PROJECT OUTLINE

6.1.1. COLLABORATION

6.1.1.1. TÜMOSAN plans to invest in gearbox and rear axle manufacture for commercial vehicles in Konya Integrated Works. A licence and engineering agreement with Zahnradfabrik Friedrichshafen A.G.(Z.F.) of W. Germany has been signed for the production of 5 types of gearboxes for all range of road vehicles. For production of 3 types of lig . duty axles a licence and engineering agreement has been signed with DANA Corporation.

6.1.1.2. It was asserted from TÜMOSAN that before concluding these agreements investigation had been made if it was possible to cover the entire ranges of gearboxes and rear axles of acceptable design with one licensor.

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6.1.2. PRODUCTS

6.1.2.1. From the manufacturing viewpoint gearboxes planned to be produced may be grouped as light, medium and heavy duty.

Products specifications and capacity of production for product groups planned for commercial vehicles are shown in Table 13.

6.1.2.2. Gearboxes and rear axles are of metric design. Gearboxes have 4,5,6 and 10 speeds. The light gearboxes are all synchronized while medium and heavy duty types are planned both in synchronized and constant-mesh version.

6.1.2.3. Light duty gearboxes are all split type housing made of aluminum alloy, while the housings of medium and heavy duty gearboxes are cast iron with aluminum covers. Housings of the same group of gearboxes lend themselves to be manufactured in one machine line requiring only change of tools and fixtures.

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Table: 13

PRODUCT SPECIFICATIONS AND PRODUCTION CAPACITIES

	GEARBOXES				REAR-AXLES		
	Type	Number of Speeds	Input Torque	Production Capacity	Type	Load-Carrying Capacity	Production Capacity
Light Duty	S5-18 S5-24	4 5	18 kg-m 24 kg-m	42.000	M60-3 M60-3E M70-HD	1500 Kg. 2500 Kg. 4500 Kg.	42.000
Medium Duty	S5-35	5	37 kg-m	-	-	-	-
Heavy Duty	S6-65 S5-111 GP	6 10	65 kg-m 125 kg-m	15.000	-	-	-
Total Capacity				57.000			42.000

6.1.2.4. Rear axles where only light duty types are proposed to be produced are of similar designs of "carrier type" with nodular cast iron differential carrier and steel tubes both of which constitute the housing. It is planned to machine their components in separate machine lines for carriers and tubes.

6.1.3. INVESTMENT PROGRAMME

6.1.3.1. GEARBOX PRODUCTION

TÜMOSAN is investing to produce 57.000 gearboxes per annum. The investment is planned to be made in two stages. First stage aims to reach a capacity of 30.000 gearboxes and second stage to increase the capacity from 30,000 to 57,000 units. Investment for machinery is planned to be made for main parts of the gearboxes, for assembly and test equipment and for auxillery and support facilities. The main parts include housing, covers, gears, splined and geared shafts, synchronizer and dog-clutch parts. The remaining small parts are planned to be procured from sub-suppliers. In Table 14 these stages and phases indicating sequence of groups of

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Table: 14

IN-PLANT PRODUCTION STAGES FOR GEAR BOXES

Phase	Investment for/ integration of	Cost of machinery million $			Percentage in-plant Production
		1. Stage	2. Stage	Total	
1	Assembly,housing,Cover	6	-	6	20
2	Gears, Shafts	8	8	16	34
3	Sychronizer parts	4	4	8	16
	Auxiliary facilities	3	2	5	
	TOTAL	21	14	35	70

1) 25 % supplied from local market

2) 5 % imports

Table: 15

IN-PLANT PRODUCTION STAGES FOR REAR AXLES

Phase	Investment for/ integration of	Cost of machinery, million $			Percentage in-plant production
		1. Stage	2. Stage	Total	
1	Assembly Carrier, Case ,tubes	4	-	4	30
2	Bevel gears,pinion, crown,axle shafts	6	4	10	45
	Auxiliary facilities	1		1	
	Total	11	4	15	75

1) 20 % supplied from local market

2) 5 % imports

Auxillary facilities include equipment for quality control, tool grinding inspection and setting devices central coolant system and maintenance departments.

parts manufacture are shown with respective value content and associated investment cost for machinery. Content of in-plant manufacture is estimated at 70%, parts to be bought from sub-suppliers amounts to 25% in value accounting for small finished components and standard parts. Remaining 5% is the value of the bearings which are to be imported. Investment for the machinery of the first phase which covers assembly and manufacture of housings and covers is to be made in one step for the final capacity since it involves special purpose machines. It is planned to install three separate machine lines one each for machining of aluminum housing of light duty gearboxes, cast iron housings and aluminum covers of heavy duty gearboxes. Investment for the machinery of second and third phases is planned to be realized in two stages. Second phase covers manufacture of gears and shafts while third phase is the manufacture of synchronizer and dog-clutch parts. These gear, shaft, synchronizer and dog-clutch parts are to be machined in lines of machinery specific for each part type. These lines can be repeated to increase capacity. Cost of the machinery for the first stage of 30,000 gearbox

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production capacity is $ 21 million reaching a local content ratio of 95% . Distribution of cost for phases of manufacture in first stage is $ 6 million for first phase, $ 8 million for second phase and $ 4 million for third phase. An additonal $ 14 million is planned to be invested in the second stage to increase the capacity by 27,000 to reach the final capacity of 57,000 gearboxes per annum. Break-up of second stage investment is $ 8 million for second phase and $ 4 million for third phase.

6.1.3.2. REAR AXLE PRODUCTION

TÜMOSAN is planning to produce 42,000 rear axles per year for light duty commercial vehicles . The investment is to be made in stages to create capacity for increasing demand in time. Investment for production machinery and equipment is to be phased considering manufacturing activities and parts to be produced in plant, which are machining of main parts of rear axles including of tubes, differential carrier and housing, crown; pinion and bevel (differential) gears, assembly and test equipment and auxillary and support facilities. In Table 15 these phases and stages are shown with corresponding percentage value of in-plant manufacture and related cost of investment. The total content of in-plant manufacture is 75%, the bought parts including finished small

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parts and standard part account for 20% and remaining 5% is for bearings which are to be imported. Investment for the phase containing assembly and test equipment and machinery for manufacture of differential carrier, differential housings and tubes is planned to be made in one step, for the final capacity as these are special purpose machinery. Investment for the gear production constituting second phase of manufacture can be made in stages. Lines of machines each for crown, pinion and differential bevel gears can be repeated to create more capacity.

Cost of machinery for first stage to achieve a capacity of 30,000 rear axles is estimated as $ 10 million where share of the phases are $ 4 million first phase and $ 6 million for second phase. To increase the capacity to 42,000 units per year second stage of investment is planned to be carried cut at a cost of $ 4 million.

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6.1.3.3. CONSTRUCTION

Both gearboxes and rear axles are planned to be produced in one building of 30,000 square meters. A separate building of 6,000 sqm. is foreseen for heat treatment shop.

6.1.3.4. TARGETS

Total cost of the project is $ 70 million of which $ 50 million is in foreign currency for machinery. In gearbox production the targeted integration level is planned to be reached in 1984 with investments to be completed 1986. Rear axle production is planned to start with assembly in 1984 with integration reaching targeted level in 1988 in the first stage. Investment is planned to be completed in 1987.

6.2. PRESENT STATUS OF PROJECT

6.2.1. The construction of the building of 30,000 sqm. for both gearbox and rear axle production is progressing. The infrastructure is being provided as part of the Konya Integrated Plant site. Main structure of the building is complete with erection of prefabricated columns and roof members and building is expected to be finished in 1982. ./..

A separate building of 6000 sqm is being built for heat treatment shop to cater for transmission and TÜMOSAN tractor parts.

6.2.2. The engineering documents of products and production for gearbox manufacture have been completed and the engineering fee has been fully paid. The amount invested today is TL. 744 million. Discussion with machine tool producers are being carried out and ordering stage for machines and equipment has been reached.

6.2.3. The technical documents for rear axle production is yet to be completed.

6.2.4. The adaptation of gearboxes to the vehicles has started Road tests of Military Jeep with a ZF S4-18 prototype gearbox are near completion. The adaptation of the same type to BMC pick-ups is underway with delivered prototype. Anadolu Holding has requested delivery of TÜMOSAN licensed Mitsubishi 4DR50 diesel engine and ZF S4-18 gearbox for planned pick-up manufacture. OTOSAN has agreed in principle to start adaptation of the same gearbox to their petrol engine powered minibuses and pick-ups. GENOTO has started

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the adaptation work for ZF S5-24 gearbox to their light trucks. Two vehicle manufacturers M.A.N. and OTOKAR (Licencee of Magirus Dentz) have already been using planned ZF gearboxes in their trucks, buses and minibuses and one pick-up manufacturer Chrysler,has been using DANA axles.

6.3. RECOMMENDATIONS FOR THE TÜMOSAN PROJECT

6.3.1. ANALYSIS OF UNMET DEMAND

6.3.1.1. Gearbox demand for the light duty gearboxes which is totally unmet is expected to be 46,000 and 79,000 in minimum and favourable demand conditions respectively by 1990 as seen from Tables 11 and 12 . Although it is expected that in favourable conditions there will be some unmet demand for medium duty gearboxes demand will be largely met by HEMA production. For heavy duty vehicles the demand which is again totally unmet due to lack of existing facilities for such products, is relatively small in numbers. When the value or cost of these heavy duty gearboxes are considered, which is 2-4 times as much

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of a light duty gearbox the unmet demand in money terms is considerable and would be comparable with unmet light duty gearbox demand in value added terms.

6.3.1.2. Rear axles : Unmet demand displays a similar picture with that of gearboxes. Unmet demand for light duty axles as expected to reach large volumes of 46,000 and 79,000 in minimum and favourable conditions by 1990. HEMA and EGE INDUSTRIES producing complementary parts of medium duty axles are expected to meet the demand in minimum conditions with some unmet demand in favourable conditions.Heavy duty axle demand which is totally unmet and in money terms is comparable with light duty axles.

6.3.1.3. Loose gears and Shafts: For the tractor transmission gears and engine timing gears demand is expected to be met till 1987 by HEMA and M.K.E.K and total unmet demand in terms of tractor gear sets will reach a level of 26,000 in minimum demand conditions and

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63,000 in favourable conditions in 1990. For the passenger car transmissions demand is assumed to be equally shared by the two major manufacturers and unmet demand is expected to be in the region of 36,000 in 1990.

6.3.2. PROPOSED PRODUCTION PLAN OF TÜMOSAN

6.3.2.1. Capacity of TÜMOSAN's planned gearbox and rear axle plants are appropriate to fill the unmet demand for gearboxes and rear axles.

Where the planned capacity for light duty products is in the same level of unmet demand in 1990 in minimum conditions and for heavy duty gearboxes capacity corresponds to mean of unmet demand for minimum and favourable demand conditions. The latter case is considered justified as the permissible axle weight (carrying capacity) on Turkish highways was increased from 8 to 10 tons resulting in expectation of slight shift of demand from medium duty truck to heavy trucks. Furthermore should minimum conditions for vehicle demand occur some of the excess capacity in gear and shaft manufacture may be utilized for production of light duty gearboxes.

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6.3.2.2. It is felt that in addition to light and heavy duty gearboxes and light rear axles TÜMOSAN in its master plan must include the unmet demand of heavy duty rear axles. The investment can however be phased in the context of likely available resources. Such a master production plan is shown on Table 16. The investment of foreign exchange on machines to suit this plan will uniformly spread out as below(in million dollars).

1982	4
1983	9
1984	8
1985	12
1986	13
1987	9
1988	7
1989	8

Table 17 gives the year-wise break-up of proposed investment of foreign exchange.

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Table : 16

PRODUCTION PROGRAMME FOR GEARBOXES

TYPES / YEARS	LIGHT DUTY			HEAVY DUTY		
	S4/18	S5-24	TOTAL	S6-65	S5-111GP	TOTAL
1983	4000	-	4000	-	-	-
1984	8000	2000	10000	3000	-	3000
1985	15000	5000	20000	3500	500	4000
1986	28000	8000	36000	5000	1000	6000
1987	32000	10000	42000	6000	2000	8000
1988	32000	10000	42000	8000	2000	10000
1989	32000	10000	42000	9500	2500	12000
1990	32000	10000	42000	11000	4000	15000

PRODUCTION PROGRAMME FOR REAR AXLES

TYPES / YEARS	Light Duty				Heavy Duty
	M60-3	M60-3E	M70 HD	TOTAL	
1985	4000	-	-	4000	
1986	6000	3000	1000	10000	
1987	12000	6000	2000	20000	
1988	16000	10000	6000	32000	3000
1989	20000	12000	8000	40000	5000
1990	20000	12000	10000	42000	8000

TABLE: 17

Master Plan for Investment by TOMOSAN or Transmission Project 55

based on Minimum Demand Conditions

(Expenses in Million $ on Machines)

		Gearboxes						Rear Axles				Total
		Light Duty			Heavy Duty			Light Duty		Heavy Duty		
		Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 1	Phase 2	
Loca-Lisation	In Plant	20	56	70	21	50	60	30	75	45	80	
	Sub.Sup.	20	25	25	30	34	34	20	20	15	15	
1982	S	1,5										
	G	2,5										
	T	4										4
1983	S				3							
	G		5		1							
	T		5		4							9
1984	S											
	G		2	2		3	1					
	T		2	2		3	1					8
1985	S							3				
	G		5	4								
	T		5	4				3				12
1986	S							2				
	G					3	2		6			
	T					3	2	2	6			13
1987	S											
	G								4	5		
	T								4	5		9
1988	S											
	G										7	
	T										7	7
1989	S									8		
	G											8
	T									8		
TOTAL		4	12	6	4	6	3	5	10	13	7	70
		22			13			15		20		

S: Special Purpose Machinery
G: General Purpose Machinery
T: Total for Machinery

6.3.2.3. Both Gearbox and rear axle production will start wit assembly in the first year. Manufacture of cast parts of gearbox (housing, cover) and gears and shafts is planned in the second year of manufacture, whereas in rear axle production machining of parts is planned to start in third year production. This is to allow time for completion of procurement of machines. On Table 18 a comparison of unmet demand and TÜMOSAN's production programme is shown. Master programme is then in line to meet the unmet demand towards the end of decade.

Birleşmiş Milletler Kalkınma Programı

UNITED NATIONS NATIONS UNIES

DEVELOPMENT PROGRAMME IN TURKEY 57

TABLE: 18 COMPARISON OF TÜMOSAN's MASTER PLAN AND UNMET DEMAND

TRANS-MISSION	Type		1983			1984			1985			1986			1987			1988			1989			1990		
			Unmet Demand			Unmet Demand			Unmet Demand			Unmet Demand			Unmet Demand			Unmet Demand			Unmet Demand			Unmet Demand		
			Minimum	Favourable	TÜMOSAN Production	Minimum	Favourable	TÜMOSAN Production	Minimum	Favourable	TÜMOSAN Production	Minimum	Favourable	Production	Minimum	Favourable	TÜMOSAN Production	Minimum	Favourable	TÜMOSAN Production	Minimum	Favourable	TÜMOSAN Production	Minimum	Favourable	TÜMOSAN Production
GEAR BOXES	Light Duty	Assembly	27115	29547	4000	31439	37004	10000	36772	46203	20000	43463	55638	36000	49294	63822	42000	52940	77471	42000	49498	78159	42000	46428	79796	42000
		Housing	27115	29547		31439	37004	10000	36772	46203	20000	43463	55638	36000	49294	63822	42000	52940	77471	42000	49498	78159	42000	46428	79796	42000
		Gears(set)	27115	29547		31439	37004	5000	36772	46203	20000	43463	55638	36000	49294	63822	42000	52940	77471	42000	49498	78159	42000	46428	79796	42000
	Medium Duty	Assembly	6576	7590		4763	6810		1299	4917		1837	8237		2056	8987		1161	9157		700	8870			7421	
		Housing	6576	7590		4763	6810		1299	4917		1837	8237		2056	8987		1161	9157		700	8870			7421	
		Gears(set)	6576	7590		4763	6810		1299	4917		1837	8237		2056	8987		1161	9157		700	8870			7421	
	Heavy Duty	Assembly	4589	4796		5185	5638	3000	6366	7211	4000	8362	9603	6000	9088	11444	8000	10552	13825	10000	11193	15668	12000	12953	17539	15000
		Housing	4589	4796		5185	5638		6366	7211	4000	8362	9603	6000	9088	11444	8000	10552	13825	10000	11193	15668	12000	12953	17539	15000
		Gears(set)	4589	4796		5185	5638		6366	7211	-	8362	9603	4000	9088	11444	8000	10582	13825	10000	11193	15668	12000	12953	17539	15000
REAR AXLES	Light Duty	Assembly	27115	29547		31439	37004		36772	46203	4000	43463	55638	10000	49294	63822	20000	52940	77471	30000	49498	78159	42000	46428	79796	42000
		Housing	27115	29547		31439	37004		36772	46203	-	43463	55638		49294	63822	20000	52940	77471	30000	49498	78159	42000	46428	79796	42000
		Dif.Carrier	27115	29547		31439	37004		36772	46203		43463	55638		49294	63822		52940	77471	30000	49498	78159	42000	46428	79796	42000
		Gears(set)	27115	29547		31439	37004		36772	46203		43463	55638		49294	63822		42940	77471	20000	49498	78159	42000	46428	79796	42000
	Medium Duty	Assembly	6576	7590		4763	6810		1299	4917		1837	8237		2056	8987		1161	9157		700	8870			7421	
		Housing	6576	7590		4763	6810		1299	4917		1837	8237		2056	8987		1161	9157		700	8870			7421	
		Dif.Carrier	6576	7590		4763	6810		1299	4917		1837	8237		2056	8987		1161	9157		700	8870			7421	
		Gears(set)	6576	7590		4763	6810		1299	4917		1837	8237		2056	8987		1161	9157		700	8870			7421	
	Heavy Duty	Assembly	4589	4796		5185	5638		6366	7211		8362	7211		9088	11444		10552	13825	3000	11193	15668	5000	12953	17539	8000
		Housing	4589	4796		5185	5638		6366	7211		8362	7211		9088	11444		10552	13825		11193	15668		12953	17539	
		Dif.Carrier	4589	4796		5185	5638		6366	7211		8362	7211		9088	11444		10552	13825		11193	15668	5000	12953	17539	8000
		Gears(set)	4589	4796		5185	5638		6366	7211		8362	7211		9088	11444		10552	13825		11193	15668	5000	12953	17539	8000

CHAPTER VII

CONCLUSIONS AND RECOMMENDATIONS

7.1. CONCLUSIONS

7.1.1. Transmission units consist of the gear box and the rear axle. Their demand is derived from that of motorized vehicles.

7.1.2. Vehicle manufacturers require transmission units in one of the following two forms: In the first form, as in diesel engine industry, manufacturer uses the box or the housing specific to the vehicle and requires the gears and shafts as separate or semi-complete units. In the second form, the gear box and or rear axle is required as complete units as in commercial vehicles.

7.1.3. Forecast of domestic demand and comparison with supply .

7.1.3.1. Loose gears and shafts

7.1.3.1.1. Tractor gear sets: Total domestic demand is expected to be about 53,000 sets in 1983 and rise to

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68,000 under minimum and 95,000 under favourable conditions by 1990. Present capacity of possible suppliers totals 60,000 sets.

7.1.3.1.2. Passenger car gears: Total demand is 30,000 in 1983 and is expected an increase to 72,000 in 1990. One of the three car manufacturers has facilities to manufacture his own gears, his installed capacity being 45,000 per annum. Difference between demand and supply in earlier years will depend on the proportions the three manufacturers hold of the domestic market, but is expected to reach a minimum of 36,000 cars per annum by 1990.

7.1.3.1.3. Diesel engine timing gears: Domestic demand in 1983 will be between 100,000 and 105,000 and will rise to a level in the range 158,000-220,000 units by 1990. No manufacturing facilities are presently available. For the purpose of capacity situation 8 timing gear sets are equivalent to 1 set of tractor gears. ./..

7.1.3.2. Gear boxes and Rear Axles.

7.1.3.2.1. Demand for light duty gear boxes and rear axles is expected to be around 27,000 in 1983 and this figure is foreseen to increase to a level of 46,000 under minimum demand and to 79,000 under favourable economical conditions towards the end of this decade. There is no local manufacture at present.

7.1.3.2.2. Demand for medium duty gearboxes and rear axles is estimated to be around 13,000 in 1983 and expected to rise to an average level between 18,000 and 27,000 in the last years of the decade. One firm (HEMA) has recently started the manufacture of medium duty gearbox suitable for vehicles of 12 ton G.V.W (gross vehicle weight)and the installed capacity of this plant is estimated at 20,000 p.a. for this type. There is no manufacturer of complete rear axles of medium duty. One firm EGE INDUSTRIES

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has been producing housings for medium duty axles and is expected to cooperate with HEMA, which is starting to produce differential gears and carriers, to create a matched capacity of 20,000 axles p.a. This capacity seems sufficient for vehicles of 12 ton G.V.W. requiring medium duty axles.

7.1.3.2.3. Demand for heavy duty gearboxes and rear axles is estimated around 5000 in 1983 and foreseen to increase to a level between 13,000 and 17,000 by 1990. Although the quantities of these heavy duty products are low, they cost 2-4 times as much as the lighter ones and hence local manufacture of these is desirable from the point of view of savings of foreign currency. Furthermore with the increase of permissible axle loading from 8 to 10 tons, demand for trucks of 10 ton payload or 14-16 G.V.W. is expected to rise.

7.1.4. TÜMOSAN Project for Transmission Units

7.1.4.1. TÜMOSAN is investing to set up a facility in Konya Integrated Plants to produce a total of 57,000 gearboxes and 42,000 rear axles per annum

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the construction work has neared completion and the project has reached the stage of purchasing production machinery. The total amount invested so far(book value) is 744 million TL and the production of gear boxes is planned to start in 1983 and of axles in 1985.

7.1.4.2. Gearboxes are licensed by ZAhnradfabrik Friedrichshafen of West Germany and the production programme includes 42,000 units of two types of light duty gear boxes and 15,000 units of two heavy duty types.

7.1.4.3. Rear axles are licensed by Dana (U.S.A) and three light duty types are planned at 42,000 units, p.a. capacity to match gearboxes of the same light duty application.

7.1.4.4. There is a considerable unmet demand for high-value heavy duty rear axles.

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7.1.4.5. Two vehicles manufacturers already use the TÜMOSAN licensed gearboxes and one vehicle producer uses their licence axles in their vehicles. Adaptation of ZF gearbox to the jeep has neared completion and work is under way with B.M.C., OTOSAN, GENOTO firms for adaptation on pick-ups and light trucks.

7.2. RECOMMENDATIONS

7.2.1. The structure of the local automotive sector is reflected in the transmissions industry in that many models and types of vehicles, each produced in small numbers, have effectively prevented local manufacture. Tractor and car industry have in the past few years been able to reduce dependency on imports and with the establishment of a new plant specifically for tractor gears and shafts(Hema Plant in Polatlı) this year, it is expected that a certain degree of integration in these sectors will be achieved. Commercial vehicle industry,on the other hand, is heavily dependent on imports. Recommendations for the transmissions industry take into account the following factors:

U.N. BUILDING, 197 ATATÜRK BULVARI P.O. BOX 407, ANKARA CABLES : UNDEVPRO TEL : 26 54 85 TELEX : 42684

- optimum use of existing facilities,
- reduced dependency of manufacture on CKD imports,
- standardisation with respect to gear boxes and rear axles.

7.2.2. Various measures may be taken to reach the ultimate goal of economic and competitive production. Considering the present state of this industry and the automative sector it is recommended that the three following principles be adhered to:

7.2.2.1. Hema Polatlı Plant, about to be commissioned at a capacity to meet gear requirements for 50,000 tractors p.a. (two shifts), should specialize in this field and should extend its capacity in parallel with demand development for tractors to achieve economies of scale. It is felt that tractor manufacturers should not get involved with gear production. This firm should also supply loose gears such as engine timing gears, passenger car gears and shafts (see Fig. 1) to the local automotive industry.

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7.2.2.2. TÜMOSAN should prepare a master plan which will not only cover its project 57,000 light and heavy duty gearboxes and 42,000 light duty rear axle types p.a. but also heavy duty rear axles. A master plan for production and investment has accordingly been suggested for TÜMOSAN including heavy duty axles. While it is recognised that actual investment will depend on availability of resources it is felt that the overall master plan should be retained as for the final section of the project is concerned.

7.2.2.3. Eaton SM475 Gearbox and 1800 differential head for 8 ton truck applications both produced in HEMA plants are in British Imperial units . Measures to switch to metric units should be taken by them. This will help in achieving , in transmission industry, standardisation and integration which are crucial for success in exports.

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