

**2001 Academy of Business and Administrative Sciences International Conference**

**July12-14, 2001**

**Quebec City-Canada**

**CAPACITY PLANNING PROBLEMS IN TURKISH INDUSTRIAL  
ENTERPRISES: AN EMERGING ECONOMIES PERSPECTIVE**

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## **I. Introduction**

The effective use of capacity is gaining importance especially in developing countries, including Turkey, in order to be competitive on a global scale. The main aim of this study is to examine capacity planning problems in Turkish industrial enterprises from the perspective of emerging economies. The research population is the Turkish industrial enterprises. However, in statistics mostly due to the limitations on time and costs, reaching all the population may not be possible. That's why statistical results could be obtained by random sampling method to represent the population<sup>1</sup> Since the population size is enormous, random sampling method is used and ten industrial enterprises in Ankara are examined. Data in field study is collected through interview and observation techniques. CEO managers and/or production managers were interviewed. In the light of the data the reasons of capacity planning problems in Turkey are presented.

Economic approach to the definition of capacity is different than management approach<sup>2</sup>. In this study the term "capacity" refers to the maximum output of a system in a given period. Even though this definition seems to be simple enough, there are difficulties in actually measuring capacity in certain cases. These difficulties arise because of different interpretations of the term capacity. The problem is to identify suitable measures for specific situations. In situations where only one product or service is involved, the capacity may be expressed in terms of that item. However for multiple products the capacity measure must recognize the product mix. When there are frequent changes in the product mix, the preferred alternative is to use a measure of capacity that refers to availability of resources. Thus, a

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<sup>1</sup>R. Atkinson, R.C. Atkinson, E.R. Hilgard, Introduction to Psychology II, Istanbul, Sosyal Yayınevi, 1995, p.798.

<sup>2</sup> For more information for the definition of capacity in perspective of economics see: L. Davut, 1997, p.181; C.G. Krouse, 1990, p.130; J. T. Innes, 1967, p.7; C.E. Ferguson, 1972, p. 327; M. Friedman, 1963, p.67; H. Gravelle, R. Rees, 1981, p.301, W.G. Shepherd, 1997, p.169; D. Begg et al., 1991, p.118, J.R. Canada et al., 1979, p.p.246-248, E. Costa and E.P. Degarmo, 1980, p.284.

For more information for the definition of capacity in perspective of management see: J. Heizer and B. Render, 1988, p. p. 283-285; L. Krajewski and L. Ritzman, 1993:298-300; W. Stevenson, 1986, p.p.174-178, Gules/Burges, 1996, p.32, M.T. Müftüoğlu, 1978, p.18, M. Odabaşı and H. Eke, 1981, p.5.

hospital has certain number of beds and a factory has certain number of machine hours available. Some organizations use total work time available as a measure of overall capacity. So no single measure of capacity must be tailored for the situation at hand.

The capacity of an operating unit is an important information for planning purposes. It enables managers to quantify production capability and make other plans related to those quantities.

The basic questions in capacity planning are the following:

1-What kind of capacity is needed?

2-How much is needed?

3-When is it needed?

The first question relates to the products and services that management intends to produce or provide. The quantity and timing of capacity are also important. These questions involve a number of considerations, but the primary factor relates to predicted quantity and timing of demand. A related issue is whether demand is expected to be relatively constant or whether it will increase or perhaps be cyclical in nature<sup>3</sup>.

Capacity planning decisions involve both long-term and short-term considerations<sup>4</sup>. Long-term considerations relate to the overall level of capacity, such as facility size, while short-term considerations focus on work-force size, overtime budgets, inventories rather than capital investment decisions<sup>5</sup>.

Capacity planning techniques include forecasting (for example, regression analysis is a forecasting tool) decision-tree analysis and financial analysis<sup>6</sup>.

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<sup>3</sup> W.Stevenson, Production/Operations Management, Illinois: Richard Irwin Inc., 1986, p.174.

<sup>4</sup> *ibid.* p.181.

<sup>5</sup> L. Krajewski, L. Ritzman, Operations Management, Strategy and Analysis, USA: Addison-Wesley Publishing Company, 1993, p.297.

<sup>6</sup> J.Heizer, B.Render, Production and Operations Management, Massachusetts: Allyn and Bacon, Inc., 1988, p.285.

In developing countries, capacity planning problems cause unemployment. The first time this problem was investigated in 1970s<sup>7</sup> and the first time it was summarized academically was in 1974<sup>8</sup>.

## **II. CAPACITY PLANNING IN TURKEY**

Data collection and evaluation of capacity utilization rates in Turkish enterprises have been realized by five main organizations. These are, State Planning Organization (SPO), State Statistics Institute (SSI), The Union of Chambers of Commerce, Industry, Maritime Trade and Commodity Exchanges of Turkey (UCCIME), İstanbul Chamber of Industry (ICI), İstanbul Chamber of Commerce (ICC).

These studies have been repeated by UCCIME in every three years since 1956. These studies continued with cooperation of Chambers in every city, contain information concerning capacity of production and consumption. ICI and ICC have been measuring rates of capacity utilization since 1973. These measurements are independent from studies held by UCCIME. While ICI have worked on small sized enterprises, ICC has focused on medium and big sized industrial enterprises. However the studies held by ICI are important, because the observations was held quarterly.

The practice performed by both organizations does not aim to measure the level of capacity utilization, but the aim is to find the reasons causing low capacity utilization rate.

SPO applies “manufacturing industry investment questionnaires” intending to use in preparation studies of annual program and plan. Some questions are related with the rates of capacity utilization and the reasons of low capacity utilization. The rates of capacity utilization have been questioned according to the range determined previously (less than %39, %40-59, %60-69, more than %80).

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<sup>7</sup> L. Emmerij, “Research Priorities Of The World Employment Programme”, International Labour Review, May 1992, p.p. 420-435.

<sup>8</sup> J.P. Arles, “Emergency Employment Schemes”, International Labour Review, January 1974, p.p.74-79.

SSI has begun to use tendency questionnaires in order to determine the rates of capacity utilization and the reasons of low capacity since the first three monthly term of 1977 in addition to its annual industry questionnaires. Capacity ratios are asked by certain intervals in SPO questionnaires. Information is given according to trio classification of manufacturing industry and published quarterly. When previous capacity utilization rates about past years which are published by SSI are viewed, it can be seen that the capacity utilization rates of both private and public sector manufacturing industries followed an increasing trend from 1980s to 1997. However when these data are examined, it can be seen that increase was not regular and not followed termly routes. This progress reflects the results of Turkish economy as a whole and in sector level. These results must be interpreted as the sensitivity of production to this progress.

General manufacturing industry capacity utilization rate data of 1998 can be seen in Table 1. Table 2 illustrates the determinants of capacity planning problems in Turkish manufacturing industry in 1998. According to the data, one of the important determinant is lack of demand. However, taking into account that the production of Turkish manufacturing industry have been mostly for domestic market, the main reason of lack of demand is domestic demand. Lack of foreign demand appeared in sectors in relation with foreign trade. Just as this tendency is quite high in traditional exporting sectors of Turkey such as textile, food, non-metallic mineral products and fabricated metal products.

Although the lack of raw material does not have characteristic importance, it is especially shown that imported input have been affected in food, wood and basic metal industry. There are labor problems mostly in food, textile and wood industries. According to the data, shortage of energy is not a characteristic problem in sector level. Financial problems are important for all economic activity fields. The industrial enterprises are affected from February 2001 economic crisis in Turkey.

**Table 1: Capacity Utilization Rates of Turkish Manufacturing Firms**

Branch of Economic Activity	Year	Period 1			Period 2			Period 3			Period 4			Annual average		
		S	P	T	S	P	T	S	P	T	S	P	T	S	P	T
Manufacturing Industry	1997	78,9	76,3	77	82	78,5	79,4	81,9	80,5	80,9	82,3	79,4	80,2	81,2	78,6	79,3
	1998	77,4	77,5	77,5	76,9	75,8	76,1	84,5	74,5	77,6	85	71,1	75,3	80,9	74,7	76,6
Food, Beverage and Tobacco	1997	60,9	71,9	69,5	70,1	72,1	71,7	69,4	76,3	74,3	79,8	73	74,9	70	73,3	72,6
	1998	77,3	68,9	71,4	71,5	68,2	69,1	75,8	69,6	71,9	79,5	63,5	69	76	67,5	70,3
Textile	1997	47,5	83	81,4	61,5	82,4	81,3	65,4	85,2	84,1	64,2	84,3	83,3	59,6	83,7	82,5
	1998	52,4	81,4	80,3	57,6	79,1	78,2	56	78,7	77,6	45,7	74	73	52,9	78,3	77,2
Wood	1997	71,1	80,4	79,9	58,4	82,9	81,2	67,1	85,1	84,1	74,8	82,9	82,4	67,8	82,8	81,9
	1998	67	81,9	81,1	68,8	77,1	76,7	65,9	82,9	82	65,6	80,8	80,2	66,8	80,6	80
Paper and Printing	1997	69	78,2	76,5	83,1	83	83	78,7	81,7	81,1	82,8	81,4	81,8	78,4	81	80,6
	1998	73,8	83,6	81,4	76,6	81,8	80,6	80,7	82,4	81,9	72,3	77,3	75,8	75,8	81,2	79,9
Chemicals	1997	84,1	73,6	79,7	84,3	77,6	81,3	86	80,2	83,3	81,9	75,5	79,3	84	76,7	80,9
	1998	77,2	77	77,1	77,7	76,5	77,2	88,2	76,9	83,4	89,7	71,6	81,9	83,2	75,5	79,9
Non-Metallic Mineral	1997	64,7	83	82,1	67,4	93,3	92,1	67,1	95,4	94	62,6	89	87,5	65,4	90,1	88,9
	1998	78,6	81,2	81,1	86,1	86	86,5	78,9	88,4	88,2	54,6	83,8	83,4	74,5	84,9	84,8
Basic Metal	1997	79,8	82	81,2	90,2	74,7	80,2	87,8	81,4	83,7	97,1	83	88	88,7	80,2	83,2
	1998	82,8	74	77	83,8	77,2	79,3	90	78	82,1	82,4	77,7	79,4	84,7	76,7	79,4
Fabricated Metal	1997	64,3	71,9	71,7	70,2	77,4	77,2	65,4	75,7	75,3	56,5	79,2	78,6	64,1	76	75,7
	1998	69,6	81,4	81	67	73,6	73,4	69,1	67,4	67,5	65,3	66,8	66,8	67,7	72,3	72,1
Other	1997	90	66	67,8	95	73,8	75,8	90	69,7	71,4	95	59,8	63,2	92,5	67,3	69,5
	1998	95	67,6	69	95	63,7	65,1	60	53,9	54,3	85	50,6	52,3	83,7	58,9	60,1

**T= Total S= State P= Private**

**Source: State Statistics Institute, Manufacturing Industry Statistics, 1998.**

**Table 2: Determinants of Capacity Planning Problems in Turkish Manufacturing Industry (%)**

Branch of Economic Activity	Year Period	Shortage of Raw Material						Labor Problems			Financial Problems			Shortage of Demand						Shortage of Energy			Others		
		Domestic			Imported			T	S	P	T	S	P	Domestic			Foreign			T	S	P	T	S	P
		T	S	P	T	S	P							T	S	P	T	S	P						
Manufacturing Industry	1998/1	3,7	5	3,2	2	0,3	2,6	3,5	5,7	2,7	4	1,8	4,8	44,2	21,1	52,6	13,6	1,5	18,	1,3	0,4	1,6	27,6	64,1	14,4
	1998/2	3	2,5	3	2,2	0,3	3	3	5	2,1	4,3	1,5	5,3	53,2	49,7	54,7	12,6	2,1	16,6	0,9	1,3	0,8	19,3	32,4	14,2
	1998/3	3,2	3,5	3,1	1,8	0,3	2,4	2,8	5,3	1,8	8,1	15,9	5,1	45,7	33,8	50,2	14,9	2,3	19,7	1,1	1,2	1,1	22,4	37,7	126,6
	1998/4	2,7	4	2,3	1,6	0,3	2	3,2	6,9	2,1	4,7	2	5,5	52	34,1	57,4	15	2,8	18,6	1	0,4	1,2	19,8	49,5	10,8
Food, Beverage Tobacco	1998/1	10,5	16,7	8,1	0,9	0	1,3	5,2	16,5	0,9	4,3	2,8	4,8	38,7	12	48,9	12,6	0,2	17,3	1,5	1,4	1,5	26,3	50,3	17,2
	1998/2	7,6	8,8	7,1	2,5	0	3,8	5,5	12,8	1,8	4,1	1,1	5,7	40,5	11,8	55	9,1	0,6	13,4	2	5	0,5	28,6	59,9	12,7
	1998/3	9,9	15,2	7,6	1,8	0,1	2,6	6	16,2	1,5	4,1	1,1	5,5	39,9	15,4	50,7	14	1,5	19,6	1,8	5	0,4	22,4	45,6	12,2
	1998/4	9,1	17,4	6	1,8	0	2,5	7,7	21,7	2,4	5,5	3,9	6,1	44,2	11,8	56,3	13,2	4	16,6	0,8	1,4	0,5	17,7	39,8	9,5
Textile	1998/1	2,9	0,1	3	1,4	0,1	1,5	8,9	49,4	6,7	7	13	6,7	41,6	27	42,4	22,5	3,3	23,5	3,2	0	3,4	12,6	7,1	12,9
	1998/2	2,3	1,3	2,3	1,4	0	1,5	9,9	46,1	7,4	6,4	11,1	6,1	45,7	26,8	47	20,6	4,2	21,7	2,3	0	2,5	11,5	10,4	11,6
	1998/3	4	0,9	4,2	1,7	0	1,8	7,2	47,6	5,1	6,6	11,3	6,4	42,6	24,2	43,6	22,5	4,9	23,4	1,1	0	1,2	14,2	11,1	14,4
	1998/4	1,3	0,5	1,3	1,3	0	1,3	6,5	51,5	4,7	7,5	7,2	7,5	43,4	34,5	43,8	26,6	5	27,4	1,6	0	1,6	11,8	1,3	12,2
Wood	1998/1	11,2	12,9	11,1	4,5	0	4,9	2,8	2	2,9	9,2	18	8,5	36,5	23,1	37,6	6,2	0	6,7	5,7	5,1	5,7	23,8	38,9	22,6
	1998/2	16,9	19,4	16,7	5,8	0	6,2	4,5	1,7	4,7	7,7	1,9	8	44	63,8	42,7	8,4	0	8,9	3,2	3,5	3,2	9,6	9,7	9,6
	1998/3	5,6	6,6	5,5	4,6	0	4,9	3,6	0,9	3,9	9	19,8	8,1	52,7	18,4	55,7	3,3	0	3,6	4	0	4,4	17,2	54,3	14
	1998/4	9,2	0,8	9,6	5,6	0	5,8	2,4	1,3	2,4	6,9	1,3	7,2	52	45,6	52,3	10,9	0	11,4	1,6	0	1,7	11,3	51	9,5
Paper and Printing	1998/1	1,2	0,2	1,7	0,6	0	0,8	1,4	0,3	1,9	2,7	0,4	3,8	67,5	71,6	65,6	8,1	0,8	11,5	1,3	0	1,9	17,2	26,6	12,8
	1998/2	0,3	0,0	0,4	0,2	0,1	0,3	0,7	0,2	0,9	3,6	0,3	5,4	66,6	73,3	63,1	10,4	0,5	15,6	0,5	0,5	0,5	17,7	25,2	12,8
	1998/3	2,2	1,9	2,4	0,4	0	0,6	1	0,3	1,3	7,1	0	10	54,3	39,3	60,3	9,6	0	13,5	2,2	5,1	1,1	23,1	53,3	11
	1998/4	1,3	2,4	1	0,5	0	0,7	1,2	0,5	1,5	3,8	0,2	5,1	61,8	32,7	72	12,6	2,1	16,3	0,6	0	0,9	18,1	62,1	2,6
Chemicals	1998/1	1,5	2,1	0,8	3,1	6	6	1,7	0,4	3,2	1,9	0,4	3,5	45,8	24,5	68,3	4,3	0,7	8,3	0,4	0	0,9	41,4	70,6	9
	1998/2	0,3	0,1	0,6	2,1	3,6	3,6	0,4	0,5	0,5	1,8	0,2	3,3	78	90,6	66,3	7,7	2,9	12,2	0,2	0	0,4	9,4	5,4	13,1
	1998/3	0,5	0	0,9	2	3,8	3,8	0,5	0,9	0,9	16,3	26,4	5,6	56,1	50,3	62,3	9,3	1	18,2	0,3	0	0,6	15	21,7	7,8
	1998/4	0,6	0	1,2	1,4	2,3	2,3	0,6	0,7	0,7	3	0	5,7	48,1	29,9	64,4	5,7	0,1	10,1	0,3	0	0,7	40,3	68,6	15

**Table 2: Determinants of Capacity Planning Problems in Turkish Manufacturing Industry (%) (continued)**

Branch of Economic Activity	Year Period	Shortage of Raw Material						Labor Problems			Financial Problems			Shortage of Demand						Shortage of Energy			Others		
		Domestic			Imported			T	S	P	T	S	P	Domestic			Foreign			T	S	P	T	S	P
		T	S	P	T	S	P							T	S	P	T	S	P						
Non-metallic Mineral	1998/1	1	0	1	0,3	7,2	0,1	3,3	1,1	3,4	1,4	3,6	1,3	44,1	60	43,6	26	18	26,2	3,6	0	3,7	20,3	10	20,6
	1998/2	0,5	0	0,6	0,2	6	0,1	0,7	2,7	0,7	5	0,8	5,2	49,5	73,7	48,8	8,9	13,8	8,8	0,7	0	0,8	34,2	3	35,2
	1998/3	0,9	5,8	0,7	0,5	4	0,3	1,1	1,5	1,1	1,7	3	1,7	46,8	66,4	45,9	14,8	15,4	14,7	6,8	0	7,2	27,3	3,9	28,4
	1998/4	1,2	0,2	1,2	0,5	10,2	0,3	3,2	10	3,1	3,2	6,1	3,1	60,7	40,4	61,1	17,7	31,7	17,5	3,8	0	3,8	9,8	0,9	10
Basic Metal	1998/1	2	0,1	3	3,4	0	5,2	1,4	3	0,6	5	0,2	7,6	22,3	7	30,6	23,4	4,9	33,3	0,3	0	0,4	42,1	84,8	19,3
	1998/2	2,9	0,1	4,3	4,4	0,1	6,5	0,5	0,7	0,4	5	0,3	7,3	20,8	0,7	30,6	20,8	0	30,9	0,4	0	0,5	45,1	98,1	19,3
	1998/3	2	0,1	3	2,7	0	4,1	1,3	2,6	0,7	3,6	2,4	4,2	19,4	2,6	28,1	23,4	6,7	32,1	0,4	0	0,5	47,1	85,5	27,3
	1998/4	1,7	0,1	2,6	3,8	0	5,8	1	1,7	0,6	5	1,4	7	48,4	73,4	34,7	21,1	6	29,3	1,2	0	1,9	17,8	17,3	18
Fabricated Metal	1998/1	1,4	1,9	1,4	1,7	2	1,7	2,2	7,8	2,1	5	32,5	4,3	62	43,9	62,5	14,2	6,3	14,4	0,8	1,5	0,8	0,8	4	12,9
	1998/2	1,9	3	1,9	1,8	1	1,8	1,9	5,5	1,8	6,1	26,1	5,3	59,5	30,9	68	15,9	6,6	16,3	0,4	1	0,4	0,4	25,9	11,8
	1998/3	1,5	3,4	1,4	1,3	1,1	1,3	1,7	8,8	1,5	5,1	26	4,5	54,3	36,9	54,8	14,7	7,1	14,9	1	1,1	1	1	15,6	20,7
	1998/4	1,2	0,5	1,2	0,9	1,6	0,9	1,7	9,9	1,5	4,3	24,9	3,8	67,9	40,7	68,7	16,4	7,8	16,7	0,8	1,7	0,7	0,7	12,9	3,5
Other	1998/1	12,2	30	11,2	1	0	1,1	7,2	30	5,9	11,3	5	11,6	43,1	20	44,4	22,7	0	24	1,1	15	0,3	0,3	0	1,5
	1998/2	1,6	20	0	1,5	0	1,6	4,7	30	2,5	3,7	10	3,1	65,2	30	68,2	22,9	10	24	0,4	0	0,5	0,5	0	0
	1998/3	2,1	0	2,2	1,8	0	1,9	4,2	5	4,2	5,7	0	6,2	49,8	10	52,9	29,5	0	31,9	0,1	0	0,1	0,1	85	0,5
	1998/4	0,3	0	0,3	1,3	0	1,4	5,1	20	4	9,5	40	7,3	50,1	20	52,3	31	0	33,2	0,3	0	0,3	0,3	20	1,2

**T = Total S= State P= Private**

**Source: State Statistics Institute, Manufacturing Industry Statistics, 1998.**

### **III. Field Study Results**

Field study was done on ten industrial enterprises in Ankara. These enterprises are the following:

- 1- Tepe Group
  - 1.1- Tepe Prefabricated Construction Industry and Trade Joint Stock Company (JSC)
  - 1.2- Tepe Betopan Cement Chipping Signboard JSC
  - 1.3- Tepe Furniture JSC
- 2- Demsan JSC
- 3- Almet JSC
- 4- MEKA Hydraulic Industry and Trade Limited Company
- 5- GÖKER Auto Spare parts Selling and Manufacturing Company
- 6- Örümcek Scaffold Industry JSC
- 7- Turkish Aviation and Aerospace Industry JSC (TAI)
- 8- FMC-Nurol Defense Industry JSC (FNSS)

The results of the field study are briefly summarized below:

#### **1. Tepe Group**

Tepe Group was built in 1969 by the Foundation of Hacettepe University. Three enterprises of this group was chosen by random sampling method. Tepe Prefabricated Construction Industry and Trade JSC, Tepe Betopan Cement Chipping Signboard JSC and Tepe Furniture JSC were examined through interview and observation techniques.

##### **1.1. Tepe Prefabricated Construction Industry and Trade Joint Stock Company**

This enterprise has been running in construction sector both in Turkey and abroad since 1975. This enterprise gives service in designing, production, mounting and key handing for well-

qualified and permanent structure like unstitched temporary construction site structure and residence, hotel, motel, holiday village, school, hospital.

During the interview with Production Manager he said that capacity utilization was increased in production. There is quality standardization and intensive quality control process. Therefore, light prefabricated structure system can easily be an alternative to certain types of conventional construction.

The enterprise has been exporting to several countries such as Egypt, Iraq, Saudi Arabia, South Yemen, Spain, Croatia, Bosnia...etc.

Production system in the enterprise completely depend on order. Because of the specifications of the product, mass production can not be done. As long as firm has accepted each kind of structure demand, there is not a certain standardization in models and measurements. Demand of the customers can be various type, dimension and shape. Quantities and prices can be affected by economic conditions.

When the factory was set up in 1975 its capacity was determined according to the market share of the sector. Enterprise capacity reached to 30000 m<sup>2</sup> per year. It is the most advantaged organization in Turkish Construction Sector with this large capacity. Since prefabricated industry completely depend on order, capacity utilization ratio of the factory has changed according to natural disasters, climate conditions, economic and politic events. The factory has worked sometimes with idle capacity and sometimes with excess capacity. There are workshops (for example, Tent Structure Workshop) which are ready to use when an urgent order is received. When demand is very high, subcontractor firm and temporary workers have been used. A new "Automation Unit" has gone into operation in Gluing System of Pin Main Workshop. This unit minimized the production costs.

The zero stock level is the target of the factory. Only some raw material inputs are sometimes stocked. Since the production is based on order, production planning could only be done after the order has been received.

## **1.2. Tepe Betopan Cement Chipping Signboard JSC**

This enterprise started to production in 1984. The data is collected by interviews which were done with Marketing Manager and Production Planning Manager.

There is process production and fixed process standard times in the enterprise. Capacity of daily production is 65 m<sup>3</sup>, it can be expanded to 75 m<sup>3</sup> at maximum. Monthly capacity is 1500 m<sup>3</sup>. It can be expanded maximum to 2000 m<sup>3</sup>. In order to raise capacity utilization, speed of the motors has been increased. Band station has been accelerated, more threshing has been spilled on it. In order to raise capacity utilization, more time and money is needed. Because of process production increasing of capacity in one step can cause bottleneck in the next step. Due to the worn machines and sudden breakdowns it can work with that performance maximum 20 days or one month. Since the process production material which is in the shing can wait maximum two hours, shift system is used. The machinery work without stopping except Sundays. Every day two shifts work. All of the forms have been discharged on Saturday nights. On Sundays the production system is empty.

Tepe Betopan Cement Chipping Signboard production system depends on the orders of the customers. Therefore, long term capacity planning can not be done. Annual capacity is 20000 m<sup>3</sup>. It was determined by marketing manager that sales were realized between 15000-16000 m<sup>3</sup> during budget planning. Approximately 1100 m<sup>3</sup> capacity has been taken into consideration monthly at budget planning. Production amount and estimated errors have been determined by monthly reports. The data of the order (number, dimensions, thickness, date of payment, rate of discount, monthly inputs, conditions of production and cutting, table of stock

quality control reports, general monthly reports, cash flows...ext.) have been evaluated on computers.

Cement Chipping Signboard has been produced in 22 countries in the world. The biggest amount is produced in the countries Czech Republic, Hungary and Turkey. Export amount of the factory differs from 100 m<sup>3</sup> to 500 m<sup>3</sup> to Europe and Middle East. The management center and the factory are in Ankara. Besides there is a distributor system working in different provinces of Turkey.

### **1.2.Tepe Furniture JSC**

This enterprise was built in 1971 by the Foundation of Hacettepe University. In the beginning production was only for Hacettepe University. After that new projects like hotel, motel, residence have started. Since projects are not suitable for mass production and costs increased, standard manufacturing has started and a distributor system has been established. There is standardization of some products like bedroom, dining room, office groups, systems of module wardrobe, chair and armchair. They aim to increase the standard production percent in the factory. Two years ago project jobs which contain 78% of the production has been reduced to 34% and standard production has been raised from 22% to the level of 85-90%.

Data is collected by interview with Production Manager. Factory has capacity of 8000 chair, 4000 armchair and 30000 m<sup>2</sup> furniture in one month. Production Planning Department is responsible of capacity planning. Standard times obtained from work study are used in capacity planning. Material Resource Planning is done. The capacity utilization rates and productivity level is measured. There is overtime payment in the factory although there are capacity planning problems. According to the Production Manager the capacity planning problems are idle capacity problem, lack of quality standards at the raw material, buyer-supplier relationship problems, lack of qualified personnel and on-job training problems, the

difficulties met at assurance of spare parts of the imported machinery and services of guarantee, lack of direct and supplementary material, cutting off electricity, wrong personnel policy and organization errors.

## **2. Demsan JSC**

Through the interview with the owner of Demsan JSC data is collected. It is a small sized company operates in Ankara. He manages the enterprise with his two brothers, a mold technician and a machine technician. The enterprise serves as a sub-industry for big scale defense industry companies such as FMC-Nurol, MKE, ASELSAN, ROKETSAN and TAI. Since the production depends on order, demand changes in time periods. Generally main industry obtain the raw material and want the work to be finished as soon as possible. In emergent demand raises, overtime working and shift systems come into force. Owner of enterprise determined that capacity planning could not been done. Market conditions have been evaluated instead of planning and it has been thought that the relations with customers and workers to prevent idle capacity is important. Besides idle capacity another problem in capacity planning is the long period of counter preparation time. It can be continued two days. Rate of material loss and loss of time are too much. There are average number of 20-30 losses in each order. It is a big deficiency that system of quality control hasn't been set up.

## **3. Almet JSC:**

Almet JSC, a small sized company in Ankara that conducts chemical covering processes, foam press processes, cadmium covering, hard covering and nickel chrome covering. The company owner and a chemical engineer are interviewed.

Covering has been made to strengthen FMC-NUROL armed vehicles and underground equipments. In the near future, relations with Thompson-Tekfen will begin and they will construct surface operations of air radar project for MKE. Another new project that will be

put into force is Scorsky. Moreover, they do coverings for the guns of Under Secretariat of Defense Industry, Armed Forces, General Directorate of Security personnel and civils.

Enterprise owns quality assurance system. It possesses AQUAP Quality Certificate. Quality system controls are being conducted by FMC-NUROL and Under Secretariat of Defense Industry. There are studies for painting armored vehicles. It also manufactures small parts for FMC-NUROL with lathe workbench and drill.

Demand analysis is very important for Almet JSC. Painting procedure will start up in the near future. The enterprise manufactures small parts as well for FMC-Nurol. As long as the enterprise is totally dependent on orders, idle capacity emerges in lack of demand. In emergent demand raises, overtime working and shift systems come into force. For example, although the monthly capacity of foam department was 24 orders, in an urgent demand from FMC-NUROL they had completed 48 orders in 20 days. They worked continuously seven days. Buyer-supplier relationship is good and customer satisfaction is established. Although the unit price is quite high, Almet JSC is preferred as the quality standards of the enterprise is also very high.

The volume of zinc-phosphate bath is 1700 liters. Bath's preparation process lasts fairly long. However the bath can be heated from night shift and the whole process can be completed in an hour in urgent orders. Here idle capacity occurs.

As the enterprise works dependent on orders, demand, delivery date and intensity of enterprise is not clear. It is said that due to this capacity planning can not be made. In case of demand from several businesses, priority is being given to the Under Secretariat of Defense Industry

The owner of the company is planning to employ an industrial engineer for capacity planning in charge of preparing printed forms for every part, converting movement schemes to

operation forms, determining standard times by work study, establishing a cost accounting system and capacity planning.

#### **4. Meka Hydraulic Industry and Trade Company**

This is a 17 years old door arch manufacturer company. This family company operates in Ankara. Data has been collected through an interview with company owner. The company has been managed by two brothers and German technology is being used in production process. The hydraulic arch, being produced, is the first with TSE Quality Assurance Certificate. Total product warranty is two years of use or 500.000 closes of door. The steel is being imported from Germany. Cast iron is being transported from Karabük and aluminum from Seydişehir. Production volume for 36 cities in the country changes according to demand in hardware market. It has been stated that it is almost impossible to fix a monthly production estimate or making capacity planning. It has also been stated that until two years ago the company was working full capacity with three shifts. Company has bought CNC workbench in order to meet the demand. However, sales have fell down due to cheap but poor quality Far-East Asian products. Recently enterprise works on with one shift and produces 2500 arches without using CNC workbench which brings about idle capacity. Besides CNC counter, lathe, borer, drill, rivet machine, painting and casting departments work with idle capacity as well. Ashen oven can shape in a mold two tons per hour, it can be used only one day per week. This also causes idle capacity. High stock level of products in the company can change to additional sales with reduction of the selling prizes (dumping). This is called “utilization of the excess capacity by dumping”. The economy of dumping is based upon the fact that fixed costs are present in nearly all enterprises. When a plant is operating at reduced output, a moderate increase in output will not affect the fixed costs. As a result, these additional increments of production will actually cost less to produce than the others.

### **5. Göker Auto Spare parts Selling and Manufacturing Company**

This is a small sized family enterprise that has been established in 1970 which operates in Ankara. Enterprise owner has been interviewed. Factory mostly produces raw material for Mercedes-Benz Turk and Hidromek Machines JSC. As the production depends on orders from these two factories there is no standard production. Unit production times are different and there is no capacity planning. Factory works one shift but in urgent orders overtime work may be possible. Mercedes Benz has bought 19.400 units last year.

The factory has work benches with sawdust, lathe, drill, stoning and press machines. Decision making is based on experience of the enterprise owner. He decides which parts will be produced when and by which machine. He also decides on product quality and material selection. Computer is only used for accounting. Due to lack of demand, CNC workbench is out of order and this creates idle capacity.

### **6. Örumcek Scaffold Industry JSC**

This is a small sized company operating in Ankara.. Enterprise owner has been interviewed. Scaffold and mould manufacturing company has been established in 1984. Production depends on market and demand. A customer needs based policy has been executed in product composition 60% scaffold and 40% mould respectively. The owner of the company stated that the capacity could be increased by 100% in construction season when excessive demand appears. Production and capacity records of machines and equipments are not being taken. Workloads are not clearly determined. There are no recording systems for production flow and production time. Flow speed and production level are being controlled by masters according to demand and workers' occupation. The owner of the company makes the production planning according to sales estimates and demand. Following it workers cut pipes and iron blocks and do other necessary processes. There are no standard times for these

processes. As long as there is no capacity planning, idle capacity problems are frequently exposed to.

### **7. Turkish Aviation and Aerospace Industry (TAI)**

TAI, a big sized company, has been established in May 15, 1984, under arrangements of Turkish Trade Law and Encouragement of Foreign Capital Law, with Turkish-American cooperation. The capital distribution is 51% Turkish and 49% American. The biggest shareholders are Turkish Aerospace Industry (TUSAŞ) and General Dynamics.

The relevant data has been collected from Purchasing Manager, Production Manager, Method Engineering Chief and an experienced industrial engineer with interviews.

The target of the company is to establish an aviation industry that can manufacture highly modern helicopters, arm systems, modernize aircrafts, do the R&D studies in aerospace and aviation industry, design and manufacture all relevant arm systems that Turkish Armed Forces need. All products manufactured in TAI are convenient with all technical specifications and quality standards of US Air Force. TAI is one of the biggest companies in production. Besides production, high quality education is being given on electricity, hydraulics, aircraft body and in related areas in “Education Center”.

Enterprise aims to fix personnel number as a personnel policy. In case of numerous projects to be completed on the same date, supplementary investments are not undertaken if they are not feasible, during bottlenecks in machines and equipment. Mostly it collaborates in buyer-supplier relationship by using “Make or Buy Analysis”.

Machine and workforce planning are separately calculated in Method Engineering Directory. Materials Requirements Planning (MRP) is being used to determine which parts will start to be produced when, at which amount, when they will be finished and delivered. In addition, “Capacity Requirement Planning” is being conducted to determine MRP load on work centers in terms of machine-hour or man-hour. Whether capacity in work centers are enough or not is

being analyzed according to Capacity Requirement Planning and necessary decrees are being taken. For example, in TAI, capacity stabilization is being adjusted with overtime work, extra shift, buyer-supplier relationship, transportation of personnel and equipment from a work center to another and changing work programme.

#### **8-FMC-NUROL Defense Industry JSC (FNSS)**

FNSS, a big sized company, is founded in 1987 with Nurol Holding and FMC in America pre-joint investment agreement. Data has been collected from Purchasing Manager and Production Manager. FNSS manufactures various armored palette vehicles. Capacity planning is being performed systematically by industrial engineers. Before factory has been constructed, a group has gone to FMC Factory in California, U.S.A. for education. The group specialized in “Material Requirement Planning” and “Capacity Requirement Planning”. They are responsible of these activities in Turkey. Moreover they served in personnel training. Some problems (like delays in delivery and quality problems) are being confronted in materials that should be imported.

#### **IV- Conclusion**

In the light of field study results the reasons of capacity planning problems in Turkish industrial enterprises can be summarized as follows:

##### **a. Facilities**

The design of facilities, including size and provision for expansion, is very important. Locational factors, such as transportation costs, distance to market, labor supply, energy sources and room for expansion are also important. Likewise, layout of the work area often determines how smoothly work can be performed, and environmental factors such as heating, lighting and ventilation also play an important role in determining whether personnel can perform effectively or whether they must struggle to overcome poor design characteristics.

#### b. Product/Service Factors

Product or service design can have a tremendous influence on capacity. When the output is more uniform, there are more opportunities for standardization of methods and materials, which lead to greater capacity.

#### c. Process

The quantity capability of a process is an obvious determinant of capacity. For instance, if quality of output does not meet quality standards, the rate of output will be slowed by the need for inspection and rework activities.

#### d. Human Factors

The task that comprise a job, the variety of activities involved, and the training, skill, and experience required to perform a job all have an impact on the potential and actual output. In addition, employee motivation has a very basic relationship to capacity, as do absenteeism and labor turnover.

#### e. Operational Factors

If there are any differences in equipment capabilities for alternative pieces of equipment and/or for differences in job requirements, there can be scheduling problems. Inventory stocking decisions, late deliveries, and acceptability of purchased materials and parts can all influence effective capacity. Quality inspection and control procedures also have an impact on effective capacity.

#### f. External Factors

Product standards, especially minimum quality and performance standards, can restrict management's options in increasing and using capacity. Thus pollution standards on either products or equipment often reduce effective capacity. So, too, does paperwork required by government regulatory agencies by engaging employees in nonproductive activities. A similar

effect occurs when a union contract limits the number of hours and type of work an employee may do.

As a conclusion, at the capacity planning process contemporary human resources management and qualified personnel is very important for solving the problems and increasing productivity level in Turkish industrial enterprises.

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