

## Manufacturing in Texas: Facts and Fancy

BY TOM L. MCKNIGHT

Regional generalizations are common with respect to various parts of the United States, but it is about Texas that they are perpetuated in greatest profusion. In that state, it has been irreverently remarked, one can "look farther and see less" than anywhere else in the nation. This delightful generalization is but one of myriad that have been composed about our erstwhile-largest state. Indeed, the folklore and autochthonous mythology of this country would be much the sparser were it not for the congeries of cliches concocted concerning Texas.

Although often based on fact, these generalizations range from perceptive to ludicrous in their validity, with the latter frequently predominating. The touchstone of the matter is probably that the variety encompassed within the boundaries of the state renders accurate generalization quite difficult. Uniformity is circumscribed essentially by political and psychological criteria, so that the Texas of generality is more likely to refer to a state of mind than to anything else. Excessive generalization about Texas can give the delusion of sweeping, perceptive vistas which in reality impair the understanding of what is there. Or, to paraphrase the previously mentioned cliché about Texas, one can "generalize more and comprehend less."

Diversity, then, is the keynote to comprehension of the geography of Texas. Nowhere is this more meaningful than with reference to the economy in general and manufacturing in particular. Industry in El Paso is quite different from industry in Texarkana; manufacturing in Angelina County bears little resemblance to that in Deaf Smith County; there are even major variations between Dallas and Fort Worth.

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It is the purpose of this paper to set down some commonly accepted generalizations about manufacturing in Texas, and then examine their validity by analyzing the contemporary industrial scene. As we accept, modify, or reject these generalizations, it is hoped that a valid understanding of the manufactural geography of the state will emerge.

The generalizations listed below were suggested to the writer by graduate students at the universities of Colorado and California. None of the suggestors is a specialist on Texas, but all are purposeful students, and it is to be presumed that the generalizations are at least as sophisticated as any that might be made by intelligent laymen.

*Generalization 1:* "Texas is now a highly industrialized state."

The total amount of manufacturing in the state is impressive, whatever the measuring stick utilized. As of April 1964, there were approximately 11,200 factories, employing 525,000 workers,<sup>1</sup> and the value added by manufacturing during 1962 (the latest year for which data are recorded) was \$6,362,000,000.<sup>2</sup> (Subsequently in this paper employment statistics will be relied upon to demonstrate comparisons and contrasts between different areas and different time spans. Of all the possible measures, only employment has the dual advantage of being easily obtainable as well as being an index that is readily applicable to different sectors of the economy and to different years. Its principal disadvantage is in understanding the significance of highly-automated industries and overemphasizing the importance of labor-intensive industries, problems that become the more serious with the decreasing magnitude of manufacturing in an area.<sup>3</sup>)

This total of 525,000 manufactural employees represents only 3.1 per cent of the national total of 17,093,000.<sup>4</sup> The correspondence between Texas' share of the United States population and of the national manufactural employment is reasonably close—5.5 per cent for the former<sup>5</sup> and 3.1 per cent for the latter.

In comparison with other states, the amount of manufacturing in

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<sup>1</sup> Employment statistics from U.S. Bureau of Labor Statistics: *Employment and Earnings*, Vol. 10, June 1964, p. 24. Number of factories is interpolated from previous years.

<sup>2</sup> U.S. Bureau of the Census: *1962 Annual Survey of Manufactures: Report M62 (AS)-4.0* (Washington, 1964), p. 2.

<sup>3</sup> For a detailed consideration of the relative validity of various measures of manufacturing magnitude, see John W. Alexander and James B. Lindberg: *Measurements of Manufacturing: Coefficients of Correlation*, *Jour. of Regional Science*, Vol. 3, 1961, pp. 71-81.

<sup>4</sup> U.S. Bureau of Labor Statistics: *op. cit.*, p. 14.

<sup>5</sup> U.S. Bureau of the Census estimate, July 1, 1964.

Texas seems less impressive. Although ranking fifth among the fifty states in population, Texas is eleventh in manufacturing employment (Table 1).

TABLE 1  
Manufacturing Employment in the Leading States  
April, 1964

Rank	State	Manufacturing Employment	Per Cent of National Total
1	New York	1,780,700	10.4
2	Pennsylvania	1,410,600	8.3
3	California	1,401,100	8.2
4	Ohio	1,233,600	7.2
5	Illinois	1,216,400	7.1
6	Michigan	988,400	5.8
7	New Jersey	774,900	4.5
8	Massachusetts	644,300	3.8
9	Indiana	613,500	3.6
10	North Carolina	539,400	3.2
11	TEXAS	525,000	3.1
12	Wisconsin	456,600	2.7
13	Connecticut	418,800	2.5
14	Missouri	400,700	2.3
15	Georgia	369,200	2.2
16	Tennessee	350,200	2.0
17	Virginia	299,200	1.8
18	South Carolina	276,200	1.6
19	Maryland	253,800	1.5
20	Alabama	247,400	1.4

DATA SOURCE: U.S. Bureau of Labor Statistics: *Employment and Earnings*, Vol. 10, June 1964, p. 24.

It would be misleading to think of Texas as essentially an industrial state. Manufacturing is only its third largest source of jobs, being exceeded significantly by both Services and Retail Trade among the employment categories recognized by the Bureau of the Census (Table 2).

Manufacturing employs only 19 per cent of the state's nonagricultural workers, which is notably less than in a number of other states. In South Carolina, for example, 43 per cent of all employment is in manufacturing. Every state east of the Mississippi River, except Florida, and nine states west of the Mississippi, have a greater dependence upon manufacturing than does Texas (Table 3). Overall, manufacturing is more important to the economy of thirty-four other states than it is to Texas.

TABLE 2  
Texas Nonagricultural Employment, By Categories  
April, 1963

Rank	Category	Employment
1	Services	779,800
	Business & Personal .....	250,400
	Medical & Professional .....	225,600
	Finance, Insurance, Real Estate .....	152,300
	Household .....	151,500
2	Retail Trade	638,800
3	MANUFACTURING	531,400
4	Government	481,700
5	Transportation, Communications, Utilities	232,100
6	Construction	226,900
7	Wholesale Trade	207,900
8	Mining	119,500
TOTAL NONAGRICULTURAL EMPLOYMENT		3,228,500

DATA SOURCE: Texas Employment Commission estimates.

TABLE 3  
Manufactural Employment as Percentage of Nonagricultural Employment  
Leading States  
April, 1964

Rank	State	Manufactural Employment	Nonagricultural Employment	Mfg. Emp. as Percent. of Nonag. Emp.
1	South Carolina	276,200	636,100	43.4
2	Connecticut	418,800	975,600	42.9
3	New Hampshire	84,800	201,500	42.1
4	North Carolina	539,400	1,302,400	41.4
5	Michigan	988,400	2,426,700	40.7
6	Indiana	613,500	1,510,200	40.6
7	Ohio	1,233,600	3,161,100	39.0
8	Rhode Island	113,100	295,600	38.3
9	Pennsylvania	1,410,600	3,695,100	38.2
10	Wisconsin	456,600	1,230,200	37.1
11	New Jersey	774,900	2,093,400	37.0
12	Maine	97,700	269,100	36.3
13	Delaware	59,500	166,100	35.8
14	Tennessee	350,200	1,021,000	34.3
15	Illinois	1,216,400	3,617,700	33.6
16	Massachusetts	644,300	1,948,500	33.1
17	Vermont	34,000	107,300	31.7
18	Georgia	369,200	1,167,000	31.6
19	Alabama	247,400	813,700	30.4
20	Mississippi	135,100	446,300	30.2

DATA SOURCE: U.S. Bureau of Labor Statistics: *Employment and Earnings*, Vol. 10, June 1964, pp. 23-24.

*Verdict 1:* The generalization is misleading. Texas is not yet highly industrialized; it is in the second order of our industrial states. In absolute terms (total employment in manufacturing) Texas ranks well below its rank on the basis of population, and in relative measure (manufactural employment as percentage of all nonagricultural employment) the state is much beneath the national average.<sup>6</sup>

*Generalization 2:* "The state's industrial growth rate since 1940 has been spectacular."

At the onset of World War II in 1939, factory employment in Texas was about 164,000.<sup>7</sup> This compares with 124,000 twenty years earlier,<sup>8</sup> an increase of only 32 per cent in two decades. The exigencies of the Second World War skyrocketed industrial employment to a peak of 400,000 in 1964, and post-war retrenchment caused a dip to a low of 275,000 in 1946 (Figure 1). In general, since the war there has been a steady rate of industrial growth in the state (except for acceleration in 1950-51 due to the Korean War stimulus and for a decline in reaction to a mild business recession in 1958), averaging more than 9 per cent per year for the two decades following 1939. Beginning in 1959, however, the industrial growth rate abruptly levelled off, remaining approximately static for three years, and starting another upswing in 1961. By 1964, manufacturing in Texas had increased by 220 per cent, as measured by employment, from its position of a quarter of a century earlier.

During this same twenty-five years, manufacturing employment in the United States as a whole had grown from 9,527,000 to 17,093,000, representing a gain of 79 per cent.<sup>9</sup> By regions, absolute industrial growth during this period was greatest in the East North Central, Pacific, and Middle Atlantic States, while the Pacific and Mountain States recorded the most spectacular relative gains (Tables 4 and 5). The proportional increase for the West South Central states other than Texas amounted to 118 per cent.

Among individual states the aggrandizement of manufacturing in the last quarter century has been most notable in California, but industrial developments in Texas also have been very impressive.

<sup>6</sup> The national average is 30 per cent.

<sup>7</sup> A. H. Belo Corp.: *Texas Almanac, 1964-1965*, The Dallas Morning News, Dallas, 1963, p. 417.

<sup>8</sup> A. H. Belo Corp.: *op. cit.*, p. 417.

<sup>9</sup> 1964 statistics from U.S. Bureau of Labor Statistics: *op. cit.*, p. 14; 1939 statistics from U.S. Bureau of the Census: *Census of Manufactures 1947*, Vol. III (Washington, 1950), p. 33.

# MANUFACTURAL EMPLOYMENT IN TEXAS 1919 - 1964

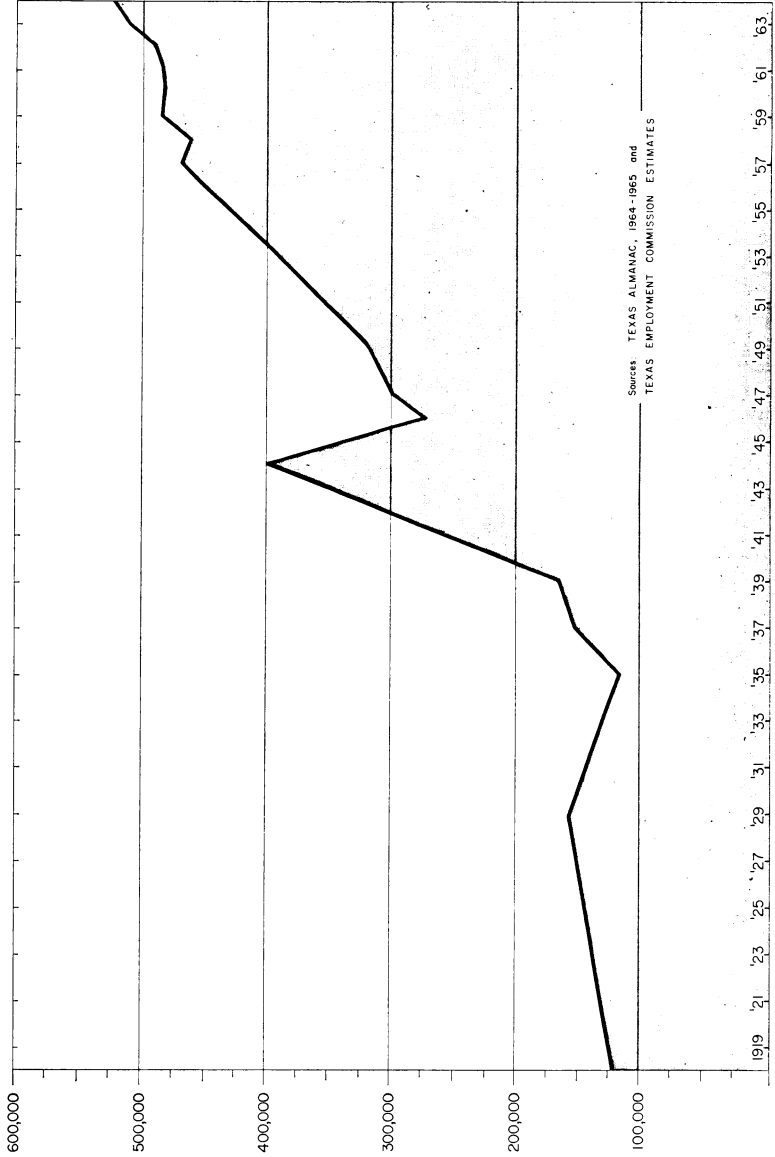


Figure 1

TABLE 4  
Increase in Manufacturing Employment, By regions  
1939-1964

Rank	Region	1939 Manufacturing Employment	1964 Manufacturing Employment	Increase
1	East North Central	2,692,800	4,508,500	1,815,700
2	Pacific	523,400	1,783,700	1,260,300
3	Middle Atlantic	2,757,900	3,966,200	1,208,300
4	South Atlantic	1,110,700	2,163,400	1,052,700
5	West South Central	330,500	884,700	554,200
6	West North Central	490,700	1,020,800	530,100
7	East South Central	410,000	918,700	508,700
8	New England	1,121,200	1,392,700	271,500
9	Mountain	89,400	282,100	192,700

DATA SOURCE: 1939—U. S. Bureau of the Census: *Census of Manufactures, 1947*, Vol. III (Washington, 1950), pp. 33-37.  
1964—U. S. Bureau of Labor Statistics: *Employment and Earnings*, June 1964, pp. 23-24.

TABLE 5  
Proportional Increase in Manufacturing Employment, By Regions  
1939-1964

Rank	Region	Manufactural Employment Percentage	Increase, 1939-64 Absolute
1	Pacific	240.7	1,260,300
2	Mountain	215.5	192,700
3	West South Central	167.7	554,200
4	East South Central	124.1	508,700
5	West North Central	108.0	530,100
6	South Atlantic	94.8	1,052,700
7	East North Central	67.4	1,815,700
8	Middle Atlantic	43.8	1,208,300
9	New England	24.2	271,500

DATA SOURCE: Based on Table 4.

Texas' increment of 361,000 manufacturing workers during this era was exceeded by only six other states (Table 6), and the 220 per cent proportional growth in industrial employment demonstrated the seventh fastest rate of increase among the states (Table 7). Thus, Texas' composite ranking in terms of these two measures (seventh in absolute growth and seventh in relative growth) is the second most noteworthy in the nation.

If only the last decade (1954-1964) is considered, Texas is equally conspicuous. In amount of increase, it ranks third (Table 8), and in proportional growth, it ranks twelfth (Table 9). Although the rate of growth in the immediate past has not been as spectacular as during

TABLE 6  
Increase in Manufacturing Employment, Leading States  
1939-1964

Rank	State	1939 Manufacturing Employment	1964 Manufacturing Employment	Increase
1	California	357,100	1,401,100	1,044,000
2	New York	1,211,000	1,780,700	569,700
3	Ohio	731,700	1,233,600	501,900
4	Illinois	752,700	1,216,400	463,700
5	Pennsylvania	1,015,800	1,410,600	394,800
6	Michigan	618,700	988,400	369,700
7	TEXAS	164,000	525,000	361,000
8	Indiana	337,900	613,500	275,600
9	North Carolina	293,300	539,400	246,100
10	New Jersey	531,100	774,900	243,800
11	Wisconsin	251,800	456,600	204,800
12	Tennessee	152,200	350,200	198,000
13	Georgia	177,000	369,200	192,200
14	Missouri	220,300	400,700	180,400
15	Florida	62,600	237,800	175,200
16	Virginia	150,200	299,200	149,000
17	South Carolina	136,100	276,200	140,100
18	Connecticut	281,400	418,800	137,400
19	Minnesota	102,200	236,900	134,700
20	Alabama	129,300	247,400	118,200

DATA SOURCE: 1939—U. S. Bureau of the Census: Census of Manufactures, 1947, Vol. III (Washington, 1950), pp. 33-37.

1964—U. S. Bureau of Labor Statistics: *Employment and Earnings*, June 1964, pp. 23-24.

the early 1950's (Korean War period), there actually was a 25 per cent gain in manufacturing output from the first quarter of 1961 through the first quarter of 1964.<sup>10</sup>

*Verdict 2:* This generalization is eminently correct.

*Generalization 3:* "The major industry is oil refining and concomitant petrochemical production; there is also much food processing and cotton textile output."

The industrial structure of Texas demonstrates only moderate diversification. Food Processing is the largest segment, employing half again as many workers as the second largest industry, Transportation Equipment. These two industries together account for 25 per cent of the state's total employment in manufacturing (Table 10). Chemicals, Nonelectrical Machinery, and Apparel rank next in order.

<sup>10</sup> Weldon C. Neill: Recent Growth of Texas Industrial Production, *Business Review* (Federal Reserve Bank of Dallas, July, 1964), p. 8.



TABLE 7  
Proportional Increase in Manufacturing Employment, Leading States  
1939-1964

Rank	State	Manufacturing Employment Increase, 1939-64	
		Percentage	Absolute
1	Arizona	621.6	49,700
2	Nevada	362.8	5,300
3	New Mexico	319.5	13,100
4	California	292.4	1,044,000
5	Florida	279.8	175,200
6	Utah	231.7	36,000
7	TEXAS	220.1	361,000
8	Arkansas	193.3	79,600
9	Colorado	179.9	58,000
10	Kansas	178.3	75,900
11	Idaho	170.7	20,100
12	Mississippi	159.6	83,000
13	Delaware	154.5	36,100
14	Nebraska	152.8	40,000
15	Oklahoma	151.7	57,000
16	Kentucky	143.1	109,500
17	Minnesota	131.8	134,700
18	Tennessee	130.3	198,000
19	Washington	114.8	113,700
20	Oregon	110.1	74,000

DATA SOURCE: Based on Table 6.

The combined employment of these five industries amounts to more than one-half of the total for the state.

Although all twenty-one of the major types of manufacturing normally recognized in statistical gathering are found in Texas, one of them (Tobacco Processing) is virtually absent, and six others (Instruments, Leather, Textiles, Ordnance, Rubber, and Miscellaneous Manufactures) are represented by a combined employment that amounts to less than 6 per cent of the state's total.<sup>11</sup>

On balance, then, the industrial structure of Texas represents neither the balanced diversification that characterizes Pennsylvania nor the extreme specialization that is typical of Wyoming.<sup>12</sup> Rather, it is an example of a state without one or two dominant industries,

<sup>11</sup> In the national industrial structure, the seven smallest types of manufacturing combined account for 12 per cent of the total.

<sup>12</sup> A Department of Commerce study, using 1954 data, showed that Pennsylvania, New York, California, and Illinois, had diversification indexes exceeding 70; Texas ranked twelfth with an index of 62.1; and North Dakota and Wyoming were least diversified, with indexes of less than 25. See Roger A. Prior and Murray D. Dessel: *Diversification of Manufacturing Employment for States and Metropolitan Areas, U.S. Department of Commerce Area Trend Series No. 5* (Washington, 1960), Table 1.

TABLE 8  
Increase in Manufactural Employment, Leading States  
1954-1964

Rank	State	1954 Manufacturing Employment	1964 Manufacturing Employment	Increase
1	California	1,052,800	1,401,100	348,300
2	Florida	124,000	237,800	113,800
3	TEXAS	419,200	525,000	105,800
4	North Carolina	434,900	539,400	104,500
5	Tennessee	267,500	350,200	82,700
6	Georgia	303,300	369,200	65,900
7	South Carolina	219,800	276,200	56,400
8	Virginia	242,900	299,200	56,300
9	Mississippi	91,300	135,100	43,800
10	Arkansas	79,200	120,800	41,600
11	Kentucky	151,100	186,000	34,900
12	Arizona	26,300	57,700	31,400
13	Minnesota	208,500	236,900	28,400
14	Alabama	220,100	247,400	27,300
15	Indiana	587,800	613,500	25,700
16	Colorado	65,000	90,200	25,200
17	Utah	30,000	51,500	21,600
18	Washington	194,200	212,800	18,600
19	Missouri	382,400	400,700	18,300
20	Wisconsin	439,200	456,600	17,400

DATA SOURCE: 1954—U. S. Bureau of the Census: Census of Manufactures, 1954, Vol. I (Washington, 1957), Table 4A.  
1964—U. S. Bureau of Labor Statistics: *Employment and Earnings*, June 1964, pp. 23-24.

distinctly lacking in several of the relatively smaller categories of manufacturing, and characterized by eight or ten major types of manufacturing that make up the bulk of the industrial structure.

In response to Generalization 3, stated above, the industrial structure must be analyzed in more detail. Although Chemicals and Petroleum Products rank third and sixth, respectively, among the state's industries on the basis of employment, these are both highly automated, and their true importance is masked by this method of measurement. According to estimates of the Bureau of the Census, the chemical industry of Texas exceeded \$1,437,750,000 in value added by manufacturing during 1962, and is the only major type of manufacturing in the state ever to have exceeded one billion dollars in this measure.<sup>13</sup> The proportion contributed by Chemicals to the state total of value added by manufacturing was 23 per cent, fol-

<sup>13</sup> U.S. Bureau of the Census: *1962 Annual Survey of Manufactures*, p. 219.

TABLE 9  
Proportional Increase in Manufacturing Employment, Leading States  
1954-1964

Rank	State	Manufacturing Employment Percentage	Increase, 1954-64 Absolute
1	Arizona	119.5	31,400
2	Florida	91.8	113,800
3	Utah	72.1	21,600
4	Arkansas	52.5	41,600
5	Mississippi	48.0	43,800
6	Colorado	38.8	25,200
7	California	33.1	348,300
8	Idaho	33.1	7,900
9	Tennessee	30.9	82,700
10	North Dakota	26.7	1,500
11	South Carolina	25.7	56,400
12	TEXAS	25.2	105,800
13	North Carolina	24.0	104,500
14	Virginia	23.2	56,300
15	Kentucky	23.1	34,900
16	Georgia	21.7	65,900
17	Nevada	19.2	1,100
18	New Mexico	14.0	2,100
19	Minnesota	13.6	28,400
20	Alabama	12.4	27,300

DATA SOURCE: Based on Table 8.

lowed in order by Food Processing, 14 per cent; Petroleum Products, 14 per cent; Transportation Equipment, 9 per cent; and Nonelectrical Machinery, 7 per cent (Table 11).

One further refinement is necessary. The category, "Chemicals and Allied Products," includes more than petrochemicals, and the category, "Petroleum and Coal Products," includes more than petroleum refining; thus, the petroliferous aspect of the Generalization 3 is still unproved. Petroleum refining can be isolated from the general heading of "Petroleum and Coal Products," and as far as Texas is concerned, it amounts to approximately 97 per cent of that category. Due to the subcategory definitions employed in compiling statistics, petrochemicals cannot be neatly isolated from the general heading of "Chemicals and Allied Products." However, analysis of product listing from various statistical sources indicates that about two-thirds of the "Chemicals" category consists of petrochemicals. Accordingly, employment in petrochemicals production plus employment in petroleum refining equals about 13 per cent of all manufacturing employment in the state (a close second to food processing),

Table 10  
Industrial Structure of Texas  
April, 1963

Rank	Type of Manufacturing	Employment	Percentage of Manufactural Employment
1	Food Processing	81,700	15.4
2	Transportation Equipment	49,800	9.4
3	Chemicals	49,000	9.2
4	Nonelectrical Machinery	45,000	8.5
5	Apparel	41,900	7.9
6	Petroleum Products	36,100	6.8
7	Fabricated Metals	35,300	6.6
8	Printing and Publishing	33,700	6.3
9	Electrical Machinery	27,900	5.3
10	Stone, Clay, and Glass Products	26,000	4.9
11	Primary Metals	25,700	4.8
12	Lumber and Wood Products	20,400	3.8
13	Furniture and Fixtures	12,400	2.3
14	Paper Products	11,300	2.1
15	Rubber Products	7,300	1.4
16	Textile Products	6,600	1.2
17	Ordinance	5,300	1.0
18	Leather Products	3,200	.6
19	All Other Manufacturing	12,800	2.4

DATA SOURCE: Texas Employment Commission estimates.

TABLE 11  
Texas Value Added By Manufacturing, By Types of Manufacturing  
1962

Rank	Type of Manufacturing	Value Added By Manufacturing	% of Total
1	Chemicals	\$1,437,762,000	22.6
2	Food Processing	880,242,000	13.8
3	Petroleum Products	871,965,000	13.7
4	Transportation Equipment	557,007,000	8.8
5	Nonelectrical Machinery	472,006,000	7.4
6	Primary Metals	353,043,000	5.6
7	Stone, Clay, and Glass Products	278,161,000	4.4
8	Fabricated Metals	269,242,000	4.2
9	Printing and Publishing	264,776,000	4.2
10	Electrical Machinery	255,121,000	4.0
11	Apparel	179,180,000	2.8
12	Paper Products	144,855,000	2.3
13	Rubber Products	85,232,000	1.3
14	Lumber and Wood Products	81,279,000	1.3
15	Furniture and Fixtures	72,100,000	1.1
16	Textiles	35,166,000	.6
17	All Other Manufacturing	123,601,000	1.9

DATA SOURCE: U.S. Bureau of the Census: 1962 *Annual Survey of Manufactures*, (Washington, 1964), pp. 218-220.

and their combined value added by manufacturing amounts to 28 per cent of the state's total, an amount significantly larger than that of any other type of manufacturing.

The significance of these two industries in Texas is further substantiated by their prominent national ranking. Approximately 28 per cent of the national petroleum refining capacity is in Texas, as is some 10 per cent of the nation's output of petrochemicals.<sup>14</sup> Texas is clearly a major supplier of petrochemical intermediates for the nation, and ranks third among the states in value added by manufacturing in the chemical industry.<sup>15</sup> Additionally, about one-half of the synthetic rubber produced in the United States comes from Texas plants, utilizing petroleum as the principal raw material. No other significant categories of manufacturing exhibit much of a concentration in Texas. Employment in aircraft manufacturing in the state is only 5 per cent of the national total, and similar proportions for Food Processing, Machinery, and Apparel are only 5, 3, and 3 per cent, respectively; in each case less than the state's proportion of the national population. Textile production in Texas is distinctly minor. Seventeen other states have a larger textile industry, and of the major cotton-growing states, Texas has a smaller textile industry than all but Mississippi, Arkansas, and Arizona.

*Verdict 3:* This generalization, at first glance spurious, is quite valid except for the reference to cotton textiles.

*Generalization 4:* "The principal growth industry (other than petroleum refining and petrochemicals) has been aerospace."

Since 1939 there has been striking growth in all but three of the sixteen significant types of manufacturing in Texas. Wood Products and Textiles actually declined in employment during this period, and Petroleum Products grew by only a relatively insignificant 50 per cent. All other major industrial groups at least doubled their work force, ranging from a 131 per cent increase in Food Processing to 1,679 per cent in Transportation Equipment and 5,480 per cent in Electrical Machinery. Absolute growth was greatest in Food Processing, which added nearly 48,000 workers, Transportation Equipment, with an increment of 47,000, and Chemicals, which grew by almost 41,000 (Table 12).

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<sup>14</sup> U.S. Bureau of the Census: *1962 Annual Survey of Manufactures*, p. 219.

<sup>15</sup> James Stafford: Behind the NASA Move to Houston, *Texas Business Review*, Vol. 36, April 1962, p. 25.

TABLE 12  
Change in Manufactural Employment, By Types of Manufacturing, Texas  
1939-1963

Rank	Type of Manufacturing	Change in Manufactural Employment	
		Percentage	Absolute
1	Electrical Machinery	5,480	27,900
2	Transportation Equipment	1,679	47,000
3	Fabricated Metals	721	31,000
4	Primary Metals	703	22,500
5	Paper Products	565	9,600
6	Chemicals	483	40,600
7	Rubber Products	462	6,000
8	Stone, Clay, and Glass Products	333	20,000
9	Nonelectrical Machinery	329	34,500
10	Furniture and Fixtures	300	9,300
11	Apparel	277	30,800
12	Printing and Publishing	188	22,000
13	Food Processing	131	47,700
14	Petroleum Products	50	24,000
15	Lumber and Wood Products	-2	-400
16	Textiles	-12	-900

DATA SOURCE: Based on statistics in Francis B. May and Florence Escott: *Economic Statistics of Texas, 1900-1962*, University of Texas Bureau of Business research, 1964; and on Texas Employment Commission estimates.

During the most recent decade (1954-1963), however, the pattern of growth industries has been quite different. Electrical Machinery registered the largest absolute gain, with an increment of 23,000 workers (Table 13). Proportionally, the greatest growth during this period was also exhibited by Electrical Machinery, with a gain of 460 per cent. Most other industrial categories demonstrated advances of between 15 and 90 per cent, although four industries showed actual declines; Textiles (down 23 per cent); Petroleum Products (minus 13 per cent); Transportation Equipment (10 per cent decrease); and Wood Products (down 1 per cent).

Changes in the relative importance of the various types of manufacturing to the total industrial structure are shown in Figure 2. Of the fifteen industries graphed, five remained in about the same position throughout the period (Apparel, Furniture, Stone-Clay-Glass Products, Fabricated Metals, Nonelectrical Machinery), five experienced significant declines in relative importance (Food Processing, Textiles, Wood Products, Petroleum Products, and Printing and Publishing), and five showed notable gains (Paper Products, Chemicals,

TABLE 13  
Change in Manufacturing Employment, By Types of Manufacturing, Texas  
1954-1963

Rank	Type of Manufacturing	Change in Manufacturing Employment	
		Percentage	Absolute
1	Electrical Machinery	460	23,000
2	Stone, Clay, and Glass Products	89	12,300
3	Fabricated Metals	67	14,200
4	Rubber Products	62	2,800
5	Printing and Publishing	50	11,200
6	Apparel	47	13,400
7	Paper Products	40	3,200
8	Nonelectrical Machinery	39	12,700
9	Chemicals	30	12,000
10	Furniture and Fixtures	26	2,600
11	Food Processing	20	13,800
12	Primary Metals	15	3,300
13	Lumber and Wood Products	-1	-300
14	Transportation Equipment	-10	-5,600
15	Petroleum Products	-13	-5,200
16	Textiles	-23	-2,000

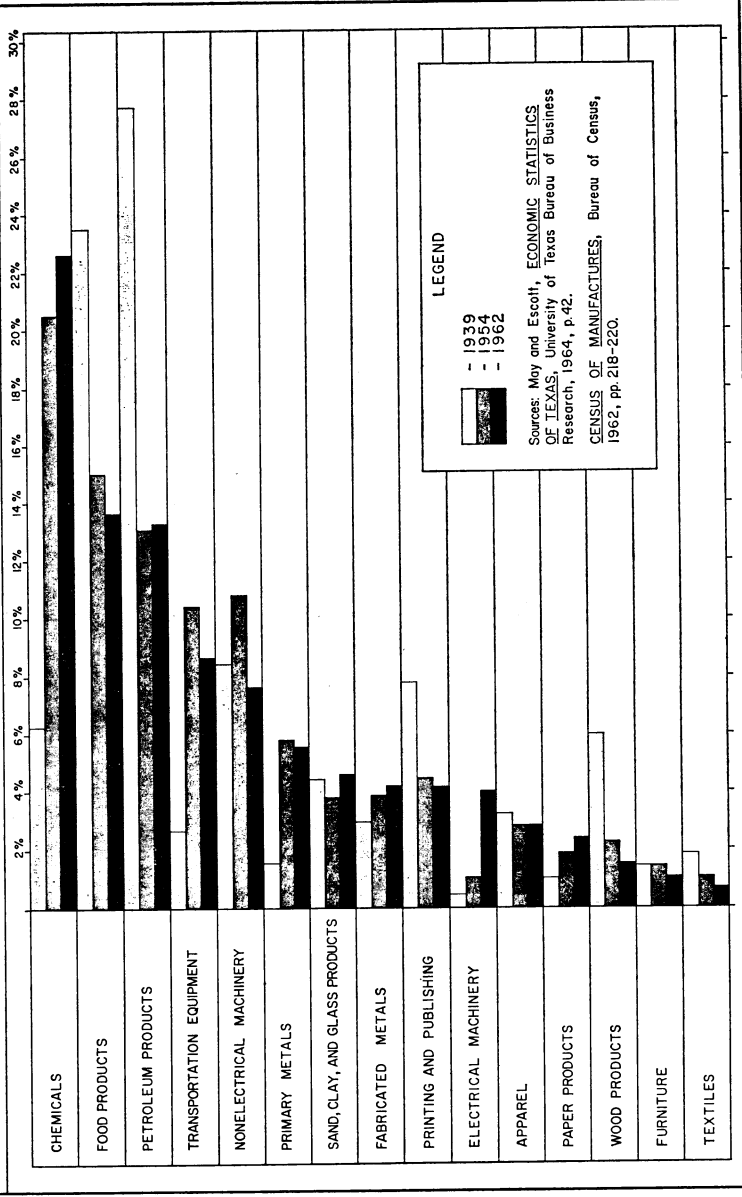
DATA SOURCE: Same as Table 12.

Primary Metals, Electrical Machinery, and Transportation Equipment). During the 1954-1962 period, the most conspicuous relative growth on the basis of value added by manufacturing was made by Electrical Machinery, Fabricated Metals, and Chemicals.

Overall evaluation of changes in the state's industrial structure since the beginning of World War II leads to several conclusions:

- (1) The most dynamic element of the industrial economy has been the aircraft-electronics-missile complex (hereafter called "aerospace"). For the first one and a half decades after 1939 the aircraft segment experienced solid and almost continuous growth, whereas the electronics segment showed substantial gains during these early years but its major expansion has been since 1957. These trends reflect the change from "aircraft" to "aerospace" production, with an essential shift from aircraft to electronics output.
- (2) The petroleum-oriented industries (comprising most of the Chemicals, Petroleum Products, and Rubber Products categories) have experienced spectacular changes during the period. Petroleum refining was well-established prior to 1939, but continued a strong upward trend until the mid-1950's. Since then

# IMPORTANCE OF MANUFACTURING TYPES IN TERMS OF VALUE ADDED BY MANUFACTURING 1939, 1954, AND 1962



**LEGEND**

- ▬ 1939
- ▬ 1954
- ▬ 1962

Sources: May and Escott, ECONOMIC STATISTICS OF TEXAS, University of Texas Bureau of Business Research, 1964, p.42.  
 CENSUS OF MANUFACTURES, Bureau of Census, 1962, pp.218-220.

Figure 2



the industry has remained approximately static, with slightly declining employment and slightly increasing output. Petrochemical production (including synthetic rubber) increased remarkably until the middle fifties, and has grown more slowly in later years.

- (3) The Food Processing and Printing and Publishing industries have shown steady but unspectacular growth. This is a predictable development, as these industries would be expected to keep pace with population increase. However, in neither industry was the rate of growth equivalent to the average rate of total industrial expansion, with the result that both industries slowly declined in relative importance throughout the period. Together, these two industries accounted for nearly one-third of the state's total value added by manufacturing in 1939. By 1954 their share had declined to one-fifth of the total, and by 1963 it was only one-sixth. This transition succinctly mirrors the change of the Texas economy from an agricultural to an industrial orientation.
- (4) The metallic industries (Primary Metals, Fabricated Metals, Non-electrical Machinery) experienced most of their growth during the 1940's, their rates of advance slowing down appreciably since then. It is noteworthy that of the three, Primary Metals has increased at the fastest rate and Nonelectrical Machinery at the slowest.
- (5) The Apparel, Furniture, and Stone-Clay-Glass industries have exhibited essentially the same historical fluctuations during the last twenty-five years. Each has been dependent largely upon the local or regional market, and each has grown approximately at the average rate for all manufacturing in the state. Their pattern has been to expand considerably during the 1940's, and more slowly since then.
- (6) Paper Products showed a pronounced and steady growth rate until about 1960, reflecting in part the increase in pulp and paper manufacture from the pine timber of East Texas. Since 1960 the industry has declined a bit.
- (7) The Wood Products industry grew significantly during the war years, but has been on a slightly declining trend ever since.
- (8) The Textile industry showed minor growth tendencies during

World War II and again in the early 1950's, but in general it has been characterized by steady decline. Such a decline is characteristic of this industry over most of the United States.

In summary, the largest absolute growth in manufactural employment since 1939 has been recorded by the Food Processing (47,700 workers), aerospace (45,000), and petroliferous (44,000) industries, the latter two growing at much the faster rates. Since 1954, Electrical Machinery (especially electronics) and Chemicals (especially petrochemicals) have been the most notable growth industries, while petroleum refining and aircraft manufacturing actually have declined.

*Verdict 4:* The generalization is useful, but somewhat misleading. The electronics component of aerospace has grown spectacularly, as has the petrochemical industry. The aircraft and petroleum refining industries, however, have declined absolutely in the past decade.

*Generalization 5:* "Manufacturing is mostly resource oriented, with minerals, especially petroleum, serving as the prime attraction."

Texas is a richly-endowed state. In addition to an abundant supply of natural resources, it combines large size with a varied environment that affords relatively benign conditions for the output of a diversity of farm and ranch products. The state's principal materials of industrial utility are petroleum, natural gas, sulfur, salt, iron ore, clay, sand, gravel, timber, and such marine resources as fish, shrimp, oysters, and oyster shells. Notable agricultural products that often serve as factory inputs include cotton, wheat, grain sorghums, corn, rice, oats, fruits, vegetables, wool, mohair, hides, cattle, sheep, hogs, poultry, and dairy products.

Industry-by-industry analysis of the consumption of locally-produced materials in Texas factories can be detailed as follows:

**FOOD PROCESSING.** Meat processing is the largest component of this industry, in terms of employment. Livestock packing plants are almost entirely market-oriented, and are thus located mostly in the large cities. The national trend toward decentralization of meat-packing plants in the direction of raw material sources does not show up significantly in Texas. Poultry packing plants, on the other hand, tend to be more resource-oriented, with the principal concentrations in the broiler raising areas of the "piney woods" counties, the Black Prairie country, and in and around Gonzales County. Seafood pro-

cessing is strictly resource-oriented, with almost all significant processors in the coastal counties, particularly around Galveston, Brownsville, and Port Lavaca.

Dairy factories comprise the largest segment of the Texas food processing industry in terms of value added by manufacturing. Most of the dairies are closely tied to market locations, although it is generally the case that the source of materials (dairy cattle) is attracted toward market as well, so that both materials and markets normally are in close proximity.

The various facets of beverage production in Texas are usually in the larger cities, and must be considered to be market-oriented. The only consistent exception is the processing of tea and coffee, which characteristically seeks a tidewater location (particularly Harris, Galveston, and Jefferson counties) for simpler access to imported raw materials.

Soft bakeries (those specializing in bread and soft pastries) depend upon quick sale to local markets, and are to be found in the principal urban areas. Hard bakeries (which produce mostly cookies and crackers) and refrigerated bakeries are concentrated in the larger distribution centers, of which Dallas is by far the most important. Thus, they are located with respect to the regional market, with site selection determined mainly by transportational and distributional facilities.

Fruit and vegetable processing plants are strongly oriented toward materials sources. The great majority of such factories are found in the Lower Rio Grande Valley, especially in Hidalgo and Cameron counties. Also, there are minor concentrations in the East Texas horticultural area, mostly in Smith County; and in Dallas, Fort Worth, Houston, and El Paso, each of which provides the happy combination of materials (local market gardening) and market. The relatively few processing plants that produce pickles, sauces, and seasonings are overwhelmingly concentrated in Dallas, the state's principal distribution center.

Cottonseed oil mills are closely tied to cotton-growing and -ginning areas. Other producers of fats and oils are scattered heterogeneously with no readily perceptible pattern.

Grain mills are variously located. The larger flour mills are in the larger cities, presumably due to the attraction of local markets and

transportation foci (railroads apply advantageous in-transit freight rates to wheat); but many of the smaller flour mills are found in towns and villages of the principal wheat-growing areas. Rice milling is materials-oriented, with most of the mills located in Harris and Jefferson counties. Stock feed manufacturers tend to be located with respect to market, although there is some attraction shown by areas of grain and grain sorghum production.

**TRANSPORTATION EQUIPMENT.** The locational pattern of this industry is almost completely divorced from any consideration of materials. Aircraft manufacturing, comprising nearly three-fourths of total employment in the industry, is found almost entirely in the Fort Worth and Dallas metropolitan areas. Ship and boat building facilities are found in two areas of concentration: the Houston area and the Beaumont-Port Arthur-Orange node. The major automobile assembly plants are in Dallas and Fort Worth, but there is a significant amount of truck, bus, trailer, and auto parts manufacture in many other places, especially Houston.

**CHEMICALS AND ALLIED PRODUCTS.** The segment of this industry that properly can be termed "petrochemicals" comprises about two-thirds of the whole, and its locational pattern is very largely materials-oriented.<sup>16</sup> Most petrochemical plants are found along the Gulf Coast (especially in Harris, Galveston, Jefferson, Brazoria, and Nueces counties), but there are lesser concentrations in the Panhandle (Hutchinson and Moore counties) and in the Permian Basin of West Texas (especially in Ector County). Although the inorganic chemical plants are found in the same general areas (greatest concentration by far is in Harris County), the availability of materials seems to be less important as a location factor. Apparently there is a close relationship with related industries, so that the inorganic chemical factories, in fact, tend to be market-oriented. Carbon black plants are located where there is an abundance of natural gas, so mostly they are to be found in the Panhandle and in the Permian Basin. Factories whose principal products are fertilizers, paints, drugs, and plastics

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<sup>16</sup> "The production economics of most petrochemicals are such that delivered cost at the major fabrication centers (largely in the East and Midwest) is less when they are produced and shipped in bulk from the raw material sources than if they were to be produced at or near the market from locally available or imported raw materials. Moreover, in some cases raw materials are virtually untransportable, except over relatively short distances (ethylene, for instance), so that they have to be utilized within a short radius of their production." Alfred G. Dale: Petrochemicals in Texas, *Texas Business Review*, Vol. 31, October 1957, p. 2.

normally are market-oriented, but in some cases the decisive location factor has been adjacency to other factories that can supply them with production materials.

**NONELECTRICAL MACHINERY.** Approximately one-half of the output of this industry is oil field machinery; otherwise the varieties of machinery produced are quite diversified. The general locational attraction is market. Oil field machinery plants are heavily concentrated in Houston; there are secondary concentrations in Dallas and Fort Worth, and smaller groupings in the oil producing areas (particularly the Panhandle, Permian Basin, around Wichita Falls, East Texas, and Jefferson County). Other machinery factories typically are found in the larger cities, especially Dallas, Houston, and Fort Worth.

**APPAREL.** The principal products of the Texas apparel industry are men's work clothes and women's dresses. Over-all, the output of men's garments exceeds that of women's clothing in a ratio of about three to two. The apparel factories are distinctly not materials-oriented. The major concentration of plants is in Dallas County, the traditional center of the Texas garment industry, attracted by transportational and distributional facilities, capital, labor, and the general metropolitan association of the area; additionally, there are a number of apparel factories located in fifteen or twenty contiguous counties adjacent to Dallas in northeastern Texas, often a result of labor-oriented dispersal from Dallas. Other significant garment producing centers are San Antonio and El Paso, where the availability of inexpensive female Mexican-American workers is an attraction, and in Houston and Fort Worth.

**PETROLEUM PRODUCTS.** All of the large<sup>17</sup> petroleum refineries are located on the Gulf Coast, especially in the Houston-Galveston, Beaumont-Port Arthur, and Corpus Christi areas. The medium-sized refineries are either along the coast or in some of the interior oil-producing areas. Small refineries are found in the oil fields or in important market centers, as Dallas and San Antonio. This industry, then, is heavily dependent upon locally produced petroleum, even though the actual refinery locations are often several hundred miles from the oil fields, to take advantage of tidewater sites.

**FABRICATED METALS.** The locational pattern for fabricated metals

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<sup>17</sup>In excess of 100,000 barrels per day capacity.

factories can be explained essentially by the pattern of larger urban centers, indicating a market orientation. Metropolitan Houston and Dallas, for example, contain more than one-third of the state's total plants, and Fort Worth and San Antonio combined have another sixth.

**PRINTING AND PUBLISHING.** Newspapers comprise more than half of this industry, and commercial printing makes up some 25 per cent of the total. The location of plants, predictably, is market-oriented, with big-city sites dominant, especially in Dallas.

**ELECTRICAL MACHINERY.** This is another industry oriented toward the market and transportation advantages of the larger cities. One-third of the state's plants are in Dallas, one-sixth in Houston, and one-twelfth in Fort Worth.

**STONE, CLAY, AND GLASS PRODUCTS.** Concrete and plaster products comprise 45 per cent of the industry's output, with 25 per cent for cement, and 11 per cent for structural clay products. Most of the concrete, plaster, and cement plants are located with respect to market, even though they utilize some local raw materials. Clay products plants are more completely materials-oriented.

**PRIMARY METALS.** The smaller primary metals plants are located in the large cities, where markets are significant, with Houston, Fort Worth, and Dallas containing more than half of the state's total. The large plants, on the other hand, mostly are located in coastal cities or in El Paso, apparently for ease of materials procurement. There is also some emphasis on location where inexpensive fuel (chiefly natural gas) is available, both along the coast and in the Panhandle. Of the two large steel mills in the state, the one at Daingerfield is materials-oriented, the one at Houston is not.

**LUMBER AND WOOD PRODUCTS.** Approximately one-half of the output from this industry is from sawmills and planing mills; the other half yields quite varied products. The industry in general is strongly oriented toward raw materials, principally southern yellow pine. Thus, nearly all of the major plants are to be found in twenty counties of the "piney woods" area in East Texas.

**FURNITURE AND FIXTURES.** More than half of this industry is comprised of production of wooden household furniture, and much of the remainder is other household furniture, especially mattresses

and bedsprings. Generally the plants are located with respect to market, so that most of the production takes place in Houston, Dallas, Fort Worth, and San Antonio. However, the Black Waxy Prairie, Post Oak Belt, and "piney woods" country also has many furniture factories, indicating that the attraction of cotton (for mattress stuffing) and sawmill lumber undoubtedly has played some role in plant location, at least initially.

**PAPER AND ALLIED PRODUCTS.** Primary pulp and paper production is significantly oriented toward the source of pulpwood, with the plants in the "piney woods" country. Factories making paper products, however, are mostly found in the larger market centers (especially Dallas), and only secondarily in raw materials areas.

**RUBBER PRODUCTS.** Synthetic rubber factories are materials-oriented, *i.e.*, they are found in petroleum refining areas, particularly Houston-Galveston, Beaumont-Port Arthur, and Pampa-Borger. Other rubber products plants tend to be oriented toward markets, and are located in the larger cities, especially Houston and Dallas.

**TEXTILES.** About 75 per cent of this industry consists of cotton weaving mills, most of which are located in the traditional cotton-growing area of the Black Prairie, where availability of raw materials undoubtedly was an initial location factor of some importance.

**OTHER INDUSTRIES.** The minor manufacturing industries of the state (Ordnance, Leather, Instruments, Tobacco, and Miscellaneous) are relatively insignificant in magnitude and varied in their locational patterns. Of this group, only leather factories show some slight influence of materials as a locational attraction.

**SUMMARY.** The summarized results of the foregoing are shown in Table 14. It can be seen that approximately 19 per cent of the total manufactural employment in Texas is in factories whose location shows a strong materials orientation. Another 6 per cent is employed in factories in which the locational attraction of materials is secondary, and the remaining 75 per cent works in industries that show little or no locational orientation toward production materials.

**OTHER LOCATIONAL ATTRACTIONS.** What other factors are operative in attracting industry to Texas? It is beyond the scope of this article to prepare a complete analysis of industrial location factors. However, some light must be shed on the 75 per cent of the factories that are not materials-oriented.

TABLE 14

Summary of Significance of Materials as Location Factor, By Industries, Texas  
(Approximate Employment for Each Group in Parentheses)

Strong Materials Orientation	Secondary Materials Orientation	Little or No Materials Orientation
Seafood & Poultry Processing (4,000)	Flour Mills (2,500)	Meat Packing (11,500)
Fruit & Vegetable Processing (2,500)	Textiles (6,500)	Other Food Processing (57,000)
Cottonseed Oil Mills (3,000)	Other Wood Products (10,000)	Apparel (42,000)
Rice Mills (1,500)	Wooden Furniture (7,000)	Other Furniture (5,000)
Sawmills & Planing Mills (10,000)	Inorganic Chemicals (4,000)	Other Paper Products (8,500)
Pulp & Paper (3,000)		Printing & Publishing (33,500)
Petrochemicals (32,000)		Other Chemicals (11,500)
Carbon Black Plants (2,000)		Other Rubber Products (4,000)
Petroleum Refining (36,000)		Other Stone, etc., Prods. (23,000)
Synthetic Rubber (3,000)		Other Primary Metals (24,500)
Clay Products (3,000)		Fabricated Metals (35,500)
Some Primary Iron & Steel (1,000)		Nonelectrical Machinery (45,000)
		Electrical Machinery (28,000)
		Transport Equipment (50,000)
		All Other Manufacturing (21,000)
<b>TOTALS</b> (101,000)	(30,000)	(400,000)

DATA SOURCE: Based on Texas Employment Commission estimates.



In general, it can be said that all of the traditional industrial location factors are operative to a greater or lesser degree in Texas. Definitive data, unfortunately, are lacking, and an assessment of their relative importance can only be deduced on the basis of limited studies.

The two most extensive studies of the reasons for factory location in Texas were conducted by Florence Escott of the University of Texas Bureau of Business Research, involving 122 manufacturers in the early 1950's and 205 firms in the late fifties and early sixties.<sup>18</sup> She found that market was the prime attraction, being mentioned by approximately 34 per cent of the industrialists queried. The market concept here involves both the expanding sales potential of the Gulf Southwest and the relatively central location that a Texas site provides for supplying the market of both the West and the Southeast. Availability of resources and materials ranked second in the Escott surveys, attributed to 18 per cent of the answers. However, it should be noted that the sample in her latter study was biased toward chemical and natural gas-using firms, which would tend to over-emphasize the significance of materials in the overall tabulation. Labor was a major factor in 17 per cent of the replies. The availability of an adequately skilled labor force was mentioned much more prominently than lower labor costs. A "cooperative labor climate" and the existence of a state right-to-work law were also of significance. Other industrial location factors reported with some regularity were transportation facilities, an equitable tax structure, favorable community attitudes toward industry, and pleasant living conditions for both labor and management.

It is sometimes hinted or stated that a significant reason for industrial growth in Texas is that a large share of federal military contracts is let to Texas manufacturers. Statistics, however, do not bear out this contention. Three studies by regional scientists of the University of Pennsylvania have documented that Texas in fact receives fewer such contracts than might be expected under *ceteris paribus* conditions.<sup>19</sup> The revealing proportions are as follows: Texas con-

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<sup>18</sup> Florence Escott: *Why 122 Manufacturers Located Plants in Texas* (Austin, 1954), 25 pp.; Florence Escott: *Texas Plant Location Survey, 1955-1963* (Austin, 1964), 17 pp.

<sup>19</sup> Walter Isard and James Ganschow: *Awards of Primary Military Contracts by County, State, and Metropolitan Area of the United States, Fiscal Year 1960* (Philadelphia, 1960), 72 pp.; Walter Isard and Gerald J. Karaska: *Unclassified Defense Contracts: Awards by County, State, and Metropolitan Area of the United States, Fiscal Year 1962* (Philadelphia, 1962), 76 pp.; Walter Isard and Gerald J. Karaska: *An Atlas on United States Military Contracts* (Philadelphia, 1963), 32 pp.

tains 5 per cent of the nation's people and 3.5 per cent of its factories; whereas, during the three-year period 1960-62, slightly less than 5 per cent of all prime military contracts were awarded to Texas firms, including only 1 per cent of the significant Research & Development contracts. This ratio has remained fairly constant in recent years; for example, during the half decade 1940-45 Texas firms received 4 per cent of the military contracts awarded, and during the Korean War period (1950-53) 3 per cent of the awards went to Texas. Thus, it is clear that government support has not provided any unusual stimulus to Texas manufacturing.

*Verdict 5:* The natural resources of Texas undeniably are major attractions for industry, and, in terms of proportionate usage, nearly two-thirds of the materials-oriented industries utilize hydrocarbons or hydrocarbon derivatives in their manufacturing processes. However, the great majority of Texas factories are not materials-oriented. Market is undoubtedly a more important location factor than materials; labor may also be more significant; and a number of minor factors loom larger in the aggregate. The generalization, then, is broadly invalid.

*Generalization 6:* "The greatest industrial development is along the Gulf Coast, with Houston as the principal center; although Dallas (in north Texas) is not far behind."

Although there are just a few nodes of major magnitude, manufacturing actually is widely dispersed over Texas. The distribution is shown here by a series of three maps. Even though the state is a large one, it is politically fragmented into 254 counties, so that data plotted on a county-unit basis are likely to show meaningful patterns.

The first map represents the actual distribution of manufacturing over the state. In general, the areas of greatest concentration of industry are in the southeastern and northeastern portions, with the Gulf Coast, "piney woods," and Black Prairie counties conspicuous (Fig. 3). Five counties—Dallas, Harris, Tarrant, Jefferson, and Bexar—are particularly notable (Table 15).

Figure 4 maps the proportional importance of manufacturing in each county's economy, by comparing manufactural employment with all nonagricultural employment. East Texas is most conspicuous by this measure, with proportions exceeding 50 per cent in Morris and Rockwall counties (Table 16). The large population counties

TABLE 15  
 Manufactural Employment in Texas, By Leading Counties  
 April, 1963

Rank	County	Manufactural Employment	Principal Urban Places of Industrial Importance
1	Dallas	101,015	Dallas, Grand Prairie, Garland
2	Harris	95,000	Houston, Pasadena, Baytown
3	Tarrant	50,915	Fort Worth, Arlington
4	Jefferson	27,755	Beaumont, Pt. Arthur, Pt. Neches
5	Bexar	25,230	San Antonio
6	El Paso	15,200	El Paso, Ysleta
7	McLennan	10,275	Waco, McGregor
8	Galveston	10,505	Galveston, Texas City
9	Nueces	8,730	Corpus Christi
10	Smith	7,650	Tyler
11	Brazoria	7,600	Freeport, Angleton
12	Orange	7,020	Orange
13	Lubbock	6,080	Lubbock
14	Travis	6,050	Austin
15	Potter	5,915	Amarillo
16	Gregg	5,580	Longview, Kilgore
17	Bowie	5,550	Texarkana
18	Grayson	5,410	Sherman, Denison
19	Cameron	5,130	Brownsville, Harlingen
20	Harrison	5,050	Marshall

DATA SOURCE: Texas Employment Commission estimates.

that were so prominent on Figure 3 are much less so here; their proportions being, Jefferson 30.7 per cent, Tarrant 23.8 per cent, Dallas 22.3 per cent, Harris 17.0 per cent, and Bexar 11.9 per cent.

A synthesis of the two patterns shown in these figures is attempted in Figure 5, which portrays the variation of "Indexes of Industrialization." These indexes are calculated by multiplying the manufactural employment of each county by the percentage that manufactural employment is of nonagricultural employment.<sup>20</sup> Thus, a composite of "magnitude" and "intensity"<sup>21</sup> is indicated, providing a simple device for recognizing both absolute and relative significance of manufacturing in the economy of an area. The distribution pattern portrayed on this map emphasizes the significance of manufacturing in East Texas, both northeast and southeast. Once again, the Black Prairie and "piney woods" counties are conspicuous (Table 17).

<sup>20</sup> For a more detailed description of this index, see Tom L. McKnight: The Distribution of Manufacturing in Texas, *Annals, Ass'n of Amer. Geog.*, Vol. 47, 1957, pp. 375-376.

<sup>21</sup> A detailed discussion of these two concepts is provided in John Thompson: A New Method for Measuring Manufacturing, *Annals, Ass'n of Amer. Geog.*, Vol. 45, 1955, pp. 416-436.

# MANUFACTURAL EMPLOYMENT

1963

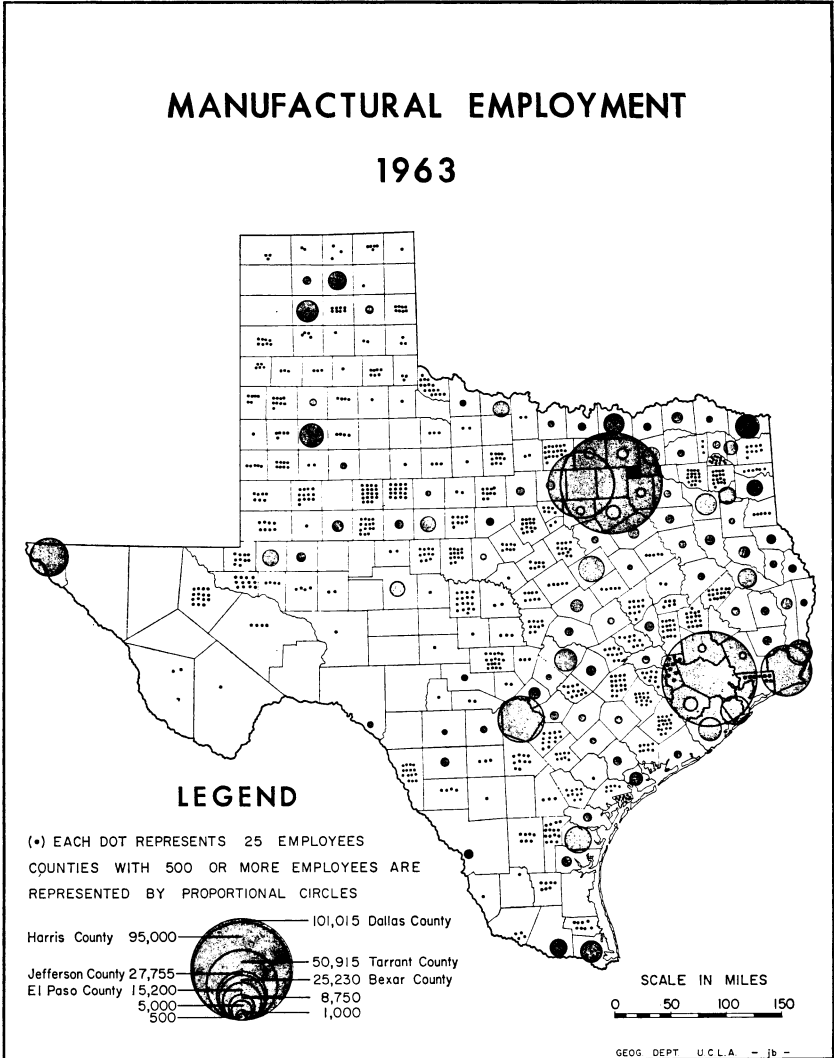


Figure 3

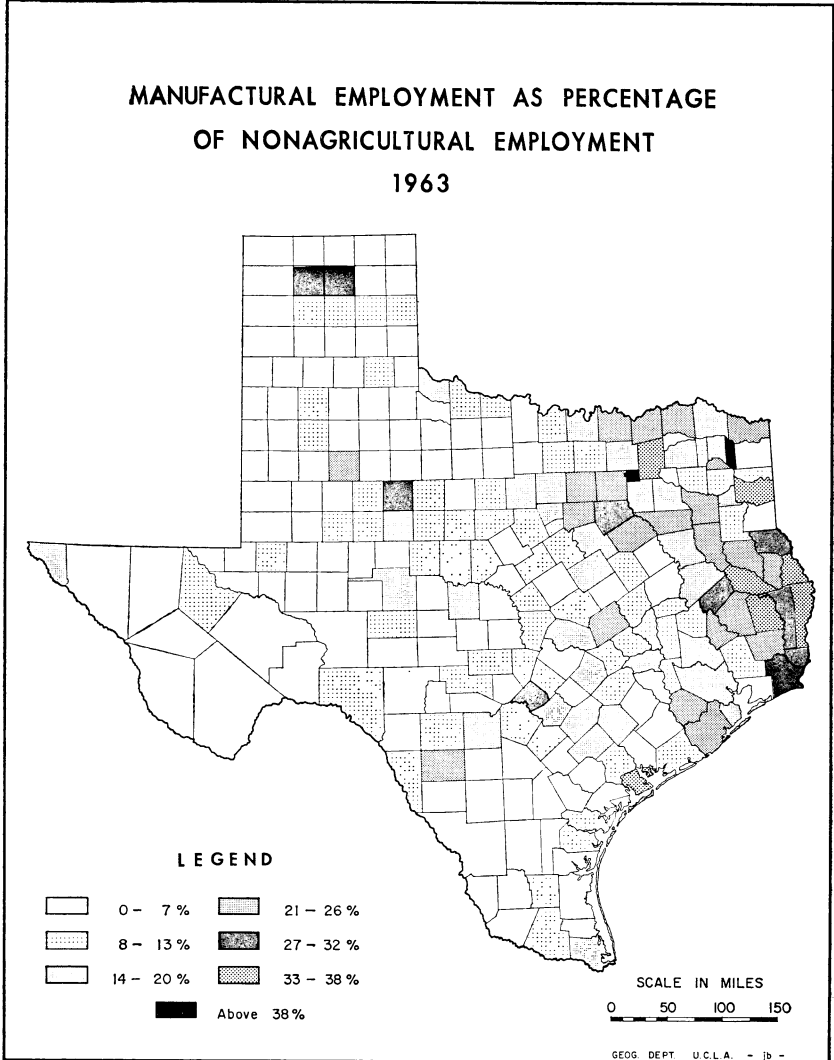


Figure 4

TABLE 16  
 Manufactural Employment as Percentage of Nonagricultural Employment  
 in Texas, By Leading Counties  
 April, 1963

Rank	County	Percentage	Principal Urban Places of Industrial Importance
1	Morris	61.9	Daingerfield
2	Rockwall	50.0	Rockwall
3	Calhoun	37.7	Port Lavaca, Point Comfort
4	Harrison	37.2	Marshall
5	Sabine	36.1	Hemphill
6	Angelina	35.8	Lufkin
7	Tyler	35.3	Woodville
8	Hunt	35.2	Greenville
9	Newton	34.2	Newton
10	Hutchinson	32.3	Borger
11	Shelby	32.2	Center
12	Ellis	31.3	Waxahachie, Ennis
13	Orange	31.2	Orange
14	Jefferson	30.7	Beaumont, Pt. Arthur, Pt. Neches
15	Comal	29.6	New Braunfels
16	Trinity	28.5	Trinity
17	Moore	28.4	Dumas
18	Jasper	28.2	Jasper
19	Fisher	27.5	Rotan
20	Fannin	26.4	Bonham

DATA SOURCE: Based on Texas Employment Commission estimates.

Scattered nodes of importance appear along the Gulf Coast and in the High Plains.

On the basis of the patterns portrayed on these three maps, some clarification of the distribution of manufacturing is possible. The eastern portion of the state shows both the greatest magnitude and intensity of manufacturing, reflecting both the statewide population distribution and the greater development of secondary industry in the regional economy. The principal factory concentrations are associated with the major urban centers of eastern Texas, particularly Dallas, Houston, and Fort Worth. Ten significant industrial areas can be noted: (Table 18).

(1) *Dallas-Fort Worth*: 29 per cent of the state's manufacturing employment. Since World War II the industrial economy of Dallas and Tarrant counties has been altered significantly. The aircraft industry became established at that time, and remains as the dominant element of the industrial structure, employing more than 20 per cent

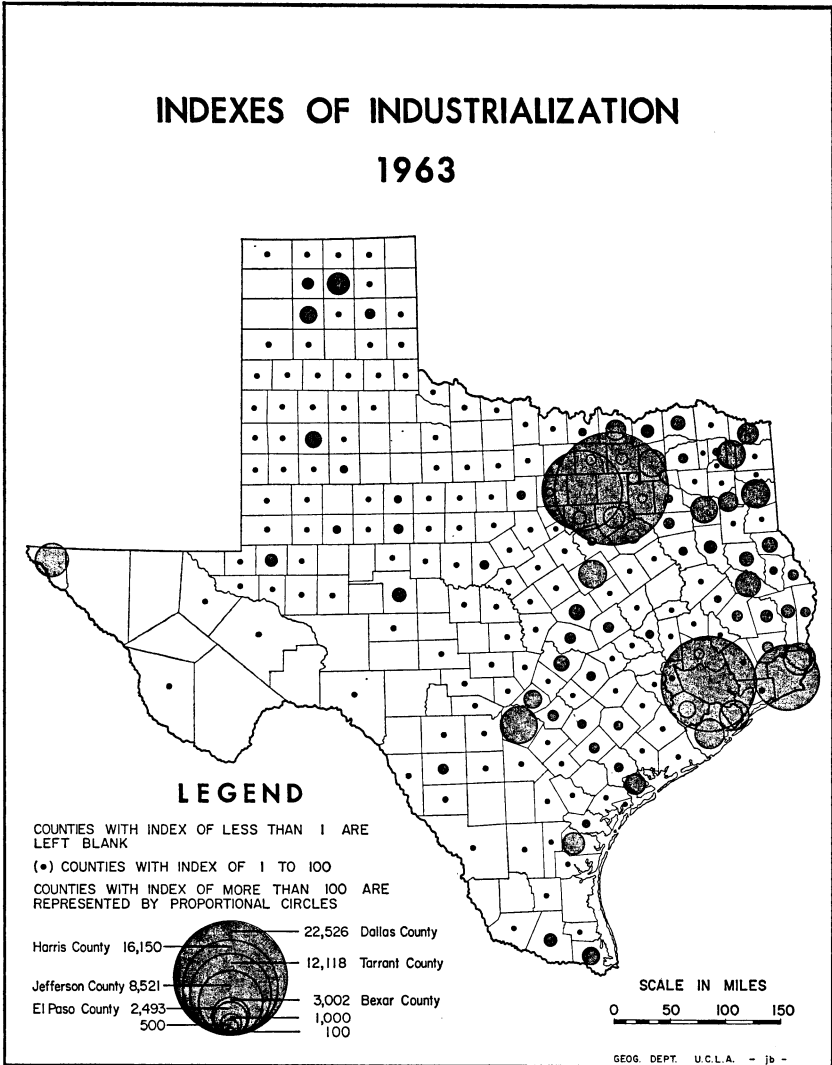


Figure 5

TABLE 17  
Indexes of Industrialization in Texas, By Leading Counties  
April, 1963

Rank	County	Index of Industrialization	Principal Urban Places of Industrial Importance
1	Dallas	22,526	Dallas, Grand Prairie, Garland
2	Harris	16,150	Houston, Pasadena, Baytown
3	Tarrant	12,118	Fort Worth, Arlington
4	Jefferson	8,521	Beaumont, Pt. Arthur, Pt. Neches
5	Bexar	3,002	San Antonio
6	El Paso	2,493	El Paso, Ysleta
7	Orange	2,190	Orange
8	Galveston	2,049	Galveston, Texas City
9	McLennan	2,065	Waco, McGregor
10	Morris	1,950	Daingerfield
11	Brazoria	1,938	Freeport, Angleton
12	Harrison	1,879	Marshall
13	Smith	1,851	Tyler
14	Angelina	1,683	Lufkin
15	Hunt	1,645	Greenville
16	Bowie	1,354	Texarkana
17	Hutchinson	1,276	Borger
18	Grayson	1,201	Sherman, Denison
19	Nueces	1,109	Corpus Christi
20	Ellis	1,017	Waxahachie, Ennis

DATA SOURCE: Calculated from Texas Employment Commission estimates.

of the factory workers in the two counties, though with a much higher proportion in Fort Worth than in Dallas. Food Processing, the pre-war leader, ranks second. Electrical Machinery, sparked by the boom in electronics production (especially in Dallas), is a close third, followed by Nonelectrical Machinery and Apparel. The industrial structure of Dallas is by far the most diversified of any city in the state, and Dallas County is one of only two cities in the southern half of the nation with manufactural employment exceeding 100,000.<sup>22</sup> The distribution and marketing facilities of the area have been a major attraction to industry of all sorts, although the factories on the average are of only moderate size, and heavy industry is not conspicuous.

(2) *Houston-Galveston: 20 per cent of the state's manufactural employment.* In Harris and Galveston counties industrial development is much more specialized, and the emphasis on heavy industry, especially related to the use of petroleum and natural gas, is quite

<sup>22</sup> Los Angeles County is the other.



TABLE 18  
Principal Industrial Areas in Texas  
1963

Rank	Name	Manufactural Employment	Counties Included	Principal Urban Areas Included
1	Dallas-Fort Worth	151,930	Dallas, Tarrant	Dallas, Ft. Worth, Arlington, Grand Prairie, Garland
2	Houston-Galveston	105,505	Harris, Galveston	Houston, Galveston, Texas City, Baytown, Pasadena
3	Beaumont-Pt. Arthur	34,775	Jefferson, Orange	Beaumont, Port Arthur, Port Neches, Orange
4	San Antonio	25,230	Bexar	San Antonio
5	Northeast Texas	18,280	Smith, Gregg, Harrison	Tyler, Kilgore, Longview, Marshall
6	El Paso	15,200	El Paso	El Paso, Ysleta
7	Panhandle	12,815	Potter, Hutchinson, Gray, Moore	Amarillo, Borger, Pampa, Dumas
8	Waco	10,275	McLennan	Waco
9	Corpus Christi	9,990	Nueces, San Patricio	Corpus Christi
10	Lower Rio Grande	9,220	Cameron, Hidalgo	Brownsville, McAllen, Weslaco

marked. Three-fifths of the manufactural output of the area is in five industrial types—Nonelectrical Machinery, petroleum refining, Fabricated Metals, Chemicals, and Food Processing—and most of the production for the first four is associated with the producing and processing of oil and gas. The area is the world's largest producer of oil field machinery,<sup>23</sup> is one of the leading petroleum refining centers in the nation, is an outstanding producer of steel pipe for drillstems and pipelines, and contains some of the largest petrochemical manufacturing complexes in existence. Large, highly-automated plants are characteristic, typically occupying extensive acreages on the shores of Galveston Bay or along Buffalo Bayou (the lengthy dredged channel that connects Houston to the Bay). Most of the factories in the area are located in Houston, but there are also significant concentrations in Galveston, Texas City, Baytown, and Pasadena.

<sup>23</sup> Stanley A. Arbingast: Texas Industrial Expansion: 1963, *Texas Business Review*, Vol. 38, February 1964, p. 5.

(3) *Beaumont-Port Arthur: 7 per cent of the state's manufactural employment.* Manufacturing in Jefferson and Orange counties is broadly similar to that in Houston-Galveston, but is even more specialized toward the petroleum industry. The five major oil refineries in the area account for about 10 per cent of the total United States refining capacity. This is also a principal center for the production of petrochemical intermediates and synthetic rubber. Shipbuilding and repairing are significant, as are steel fabrication (mostly pipe) and rice milling. In addition to Beaumont and Port Arthur, Orange and Port Neches have notable concentrations of factories.

(4) *San Antonio: 5 per cent of the state's manufactural employment.* The industrial significance of San Antonio is most easily expressed in negative terms; it is one of the least industrialized major cities in the United States. Even so, its 25,000 manufactural workers comprise the fourth largest total among Texas industrial areas. Food Processing is the principal industry, with emphasis on meat packing and brewing. The apparel industry is also noteworthy, with children's clothing as the specialty.

(5) *Northeast Texas: 3 per cent of the state's manufactural employment.* In Smith, Gregg, and Harrison counties of the northeastern corner of the state are four small cities—Tyler, Kilgore, Longview, and Marshall—whose original prosperity as agricultural market towns and oil centers has been diversified to include significant industrial components, often as a result of carefully-planned promotion schemes by local people. Factory output is fairly diversified, with an emphasis on chemical and machinery production.

(6) *El Paso: 3 per cent of the state's manufactural employment.* Manufacturing is a rapidly-growing segment of El Paso's economy. Although the city is market center for an extensive (if sparsely-populated) hinterland, its industrial structure is quite specialized. The leading type of manufacturing is clothing, which employs more than 5,000 workers. The attraction of an inexpensive local female labor supply has helped to make El Paso a major center for the production of work clothes and casual western wear. Processing of minerals, mostly copper, lead, and petroleum, is the principal heavy industry of the area. The canning, freezing, and packing of local agricultural produce is also notable, specializing in vegetables, sauces, and Mexican food items.

(7) *Panhandle: 2 per cent of the state's manufacturing employment.* The Panhandle gas field has provided the greatest stimulus for manufacturing in the four-county area extending north and east from Amarillo. Petroleum is refined and zinc is distilled at Amarillo; there is a major refinery and petrochemical complex at Borger; petrochemicals are produced at Pampa; and both oil and zinc are refined at Dumas.

(8) *Waco: 2 per cent of the state's manufacturing employment.* Waco, like San Antonio, is not particularly notable as a manufacturing center; however, its industrial growth has been fairly rapid in recent years. As the principal city in the central part of the Black Prairie, it is surrounded by a productive hinterland, and has a moderately diversified industrial structure, featuring nondurable goods production. The largest factory in Waco manufactures rubber tires.

(9) *Corpus Christi: 2 per cent of the state's manufacturing employment.* Corpus Christi is a new<sup>24</sup> and rapidly growing industrial node on the lower Gulf Coast. Its factories, mostly large and automated, characteristically process local raw materials into intermediate products that are shipped elsewhere for final fabrication. Important local materials include petroleum, natural gas, oyster shell, cotton, grain sorghums, cattle, salt, clay, and sand. Five oil refineries are in the area, petrochemical production is increasing, and there is primary refining of aluminum, zinc, and cadmium.

(10) *Lower Rio Grande: 2 per cent of the state's manufacturing employment.* Manufacturing in Cameron and Hidalgo counties in the past has been directly associated with the processing of local farm products and seafood caught in nearby waters; more recently, however, the apparel industry, based on the attraction of inexpensive labor, has been growing rapidly. Food Processing is still the major activity. Vegetables and fruits are canned, frozen, packed, and preserved; cotton is ginned; and shrimp are frozen and packaged.

*Verdict 6:* Although much of the spectacular industrial development of recent years has been along the Gulf Coast, other sections of the state have experienced considerable manufacturing expansion as well. Houston has been surpassed by Dallas in terms of manu-

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<sup>24</sup> The oldest major factory only dates from 1934. Melvin R. Mason: The Economy of Corpus Christi and the Lower Nueces River Valley, *Texas Business Review*, Vol. 32, September 1958, p. 21.

factural employment and Dallas is "catching up" in terms of value added by manufacturing. This generalization, then, is only partially accurate.

#### CONCLUSION

Six common generalizations about manufacturing in Texas have been examined. Two are judged to be accurate; two are considered as definitely misleading; and two are deemed as somewhat unacceptable without modification.

If there is a lesson to be learned in an exercise such as this, perhaps it is that there is no substitute for accuracy. Generalizing is one of the most difficult problems faced by geographers; problems of scale often render our generalizations too vague or too spurious, as we try to simplify complex patterns and relationships. But we cannot use this dilemma as an excuse for inaccuracy. Meticulous generalization is the quintessence of geographic scholarship.