CHAPTER 3  THE THEORY OF THE FIRM.

3.1  INTRODUCTION

People make a wide range of economic choices as they buy and sell goods and services to satisfy their daily needs. These choices are made within a framework of objectives and can consider many alternative courses of action as well as a variety of constraints that restrict the decision outcome. For firms the overall objective is an economic issue of maximizing the wealth of their owners, while for individuals the objective is that of maximizing satisfaction or utility. There may be other objectives, but these usually are secondary. Thus, decision making occurs only because there are alternatives to consider, and the function of decision making is to select the alternative that best meets the relevant objectives subject to the constraints or limitations placed upon the ability to achieve objectives. This chapter on the theory of the firm establishes a framework for understanding the economic environment of the investment and operating decisions of the firm, given that its primary objective is that of maximizing the wealth of its owners so that they, in turn, can maximize their individual utilities.

3.2  OPPORTUNITY COSTS AND PRODUCTION POSSIBILITIES

Associated with each decision is an opportunity cost: the “loss” that results from not pursuing an alternative course of action. For example, a firm that employs its resources to develop a new design direction may do it at an opportunity-cost of the revenues from conventional projects that are foregone, etc. This implies that something is lost; however, it should be realized that while there may be an opportunity cost, there should be an offsetting benefit at some point. Opportunity costs and benefits can be considered in economic terms, but other value systems (such as social and ethical values) usually are involved as well. Business decisions, therefore, involve trade-offs between “costs” and “benefits” and occur within the various value systems of the firm's owners, the individual decision maker(s), the organization (the firm), and society as a whole.

The existence of opportunity costs and trade-offs gives rise to the concept of production possibilities which describe the allocation of resources. For example, for society to allocate some of its resources to architects to design buildings, it must forego alternative uses of those resources. At a minimum, the opportunity cost includes the annual cost of educating architects, their employment, the facilities and equipment used to support their activities, and the resulting incremental construction costs for buildings designed by architects. Figure 3-A shows the production possibility frontier for architectural services for a given quantity and quality of the factors of production (labor, capital, and natural resources).
The points, A, B, and C, lie on the frontier and represent combinations of design services and other goods and services that can be produced in one year. Points to the right of the frontier cannot be produced, while a point to the left (D) represents inefficient production because some resources are unemployed or wasted. Along the frontier, there is a trade-off among activities. The point of equilibrium, where production occurs, is located where society maximizes the value (both economic and social) of the production possibilities (referred to as static efficiency). The increase in the quantity of design services is achieved at an increasing cost (the frontier is curved) because all resources are not homogeneous. For example, professional design services are highly dependent on human skills. As people vary in their skills, the cost of bringing in more people to provide design services increases at an increasing rate as more are transferred from the production of other goods and services where their skills were used optimally to alternative inefficient uses. The slope of the frontier at any point is the marginal cost of producing that level of design services.

The decision of society to “produce” some quantity of design services (e.g., B) is a function of the value system of society. If society values the work of architects more relative to other goods and services, it will increase its “production” by transferring resources and move to point C. Increasing the public awareness of the role of architecture and the benefits it brings to society is one way of modifying society’s value system and increasing the work of architects, albeit at higher cost.

There are only two other ways to increase the amount of design services consumed by society. One way is for the entire production-possibilities curve to shift outward. This is achieved when the economy grows as a whole; that is, the real gross national product of the country increases (Figure 3.2a). This is dynamic efficiency, where real production is increased for society’s benefit. The other way is for the production of design services to become relatively more efficient so that the opportunity cost is reduced. This changes the slope of the frontier so that society is able to maintain its current production of other goods and services but increase its architectural services. This also means that the economy grows, but the growth is occasioned by the increases in efficiency in architectural service (Figure 3.2b).
Figure 3.2 Production Possibility Frontier (The Guns and Butter Analogy)

For example, the impact of computer-aided design should be to increase the efficiency of providing design services. The actual level “produced” could be anywhere between A1 and A2; but if society’s values are unchanged, then production will occur at A3 with the same opportunity cost (slope).

3.3 THE MARKET FOR ARCHITECTURAL SERVICES

Architectural services occur in an overall market system which is composed of a series of different sub-markets. For most architects, the market in which they supply services is very competitive in nature, although for a few architects the market is an oligopoly or monopoly. The nature of the marketplace is the most important factor in determining the nature of the architectural firm and the type and quality of the work undertaken. It also influences the potential for profitability.

A market is defined to include all the various arrangements that people (in our situation, architects and prospective clients) have for trading with one another. It is a mechanism for coordinating the activities of buyers and sellers of a particular good or service through the interaction of supply and demand to determine the price of the good or service and the quantity that is transacted. Accordingly, the market provides three functions:

a. Transmitting Information: The price system broadcasts information on opportunity costs and the relative scarcity of various goods and services.

b. Providing Incentives: In addition to demonstrating the best use to which a particular resource can be put, the market also provides incentives (as profits) so that the people controlling resources have the incentive to devote them to the best use. The assumption that all people are wealth (or profit) maximizers is, therefore, critical to the efficient function of markets.

c. Distributing Income: This is the wealth-distribution function of the market and is a by-product of the system of incentives provided by the market. People who possess skills or resources are rewarded for putting them to the best possible use, and this operates to distribute the wealth of society. As people differ in their levels of skill and the ownership of resources, then the distribution of wealth by the market is not even. For example, architects who have either above-average skill or specific skills that are in demand are rewarded according to the relative economic value placed on those abilities by the other participants (buyers) in the market and the extent to which those abilities are supplied by others.
An efficient market is one which efficiently transfers resources between buyers and suppliers with a minimum of waste, expense, and effort. Markets may be inefficient if the goods or services transacted in the market are not homogeneous, if buyers and sellers are not well informed, if there are difficulties in finding people with whom to do business, or if government introduces market restrictions. All of these problems give rise to transaction costs and may cause the inefficient transfer of resources, the sub-optimal use of those resources, and the inappropriate distribution of wealth. Based upon several of these criteria, it could be argued that the various sub-markets for architectural services covers a broad range of levels of efficiency. Consider, for example, the diverse range and quality of services offered by architects, the difficulties in reaching potential clients, and the level of information available to potential clients regarding architecture.

While market efficiency is an important and valuable aspect of market performance, it does not mean that efficiency must be promoted at all costs. For example, social values must be introduced to supplement efficiency when economic policies yield different distributions of wealth and welfare. This is the concept of social equity or social justice. Equity is achieved at the cost of inefficiency and has many different meanings according to each individual's social values and ideologies. However defined, equity involves two components: distributive justice and market justice. Distributive justice operates to distribute the resources of society according to need. It is based on the concept of innate merit - that solely by birth, existence, and common humanity, each person has an innate right to some share of the goods and services of society. Market justice is based on the concept of value for value and claims that people have no innate rights to resources but merit only that share which they can acquire as a result of production, exchange, or donation.

For the purposes of developing a theory of the architectural firm, we will assume that markets are both operationally and allocationally efficient. For operational efficiency, transaction costs are minimal while for allocational efficiency, prices are determined so as to equate the marginal rate of return (adjusted for risk) for all buyers and savers. Allocational efficiency is important because it means that goods and services will be supplied to the market up the point where the marginal return to the seller just equals the marginal cost of financing those services (the market interest rate) after an adjustment for risk. Thus, surplus economic resources (savings) are allocated optimally to investment projects (borrowers).

### 3.4 THE CONDITIONS OF DEMAND AND SUPPLY

The principles of demand and supply are fundamental to building a relevant theory of the firm as they underlie all economic activity. Analysis can begin with either demand or supply but always ends with their integration to determine price and quantity equilibrium.

**Demand**

For the buyers of a good or service, the law of demand says that the quantity demanded increases as the price decreases, all other things being equal. The effective demand is the quantity of a good or service that buyers are both willing and able to buy at a particular price. It is not necessarily the same as the quantity that consumers actually want or need because their resources to acquire the good or service must be taken into consideration. The “all other things being equal” condition is necessary because demand is affected by factors other than price; for example, income, tastes and preferences, and the price of substitutes. Changes in the relative prices of goods and services would have an effect on the relative quantities demanded.
A CHANGE IN THE QUANTITY DEMANDED

A change in the quantity demanded results from a change in price (other things being equal). When a change in the quantity of design service demanded occurs as a result of a change in the price of the service alone, then the change alone is represented by a movement along the curve. For example, A > B; then the price changes from $P_A$ to $P_B$ and the quantity demanded changes from $Q_A$ to $Q_B$. (See Figure 3-3.a)

A SHIFT IN THE DEMAND CURVE.

When a change in the quantity of design service demanded occurs as a result of a change in a factor other than price, the demand curve shifts to the left (down) or right (up). Factors influencing demand are: income, tastes and preferences, and the prices or demand for substitutes or complements. For example, the demand curve shifts from $D_1$ to $D_2$ the income of consumers increases (Figure 3-3.b) allowing them to buy more of a particular good or service, the quantity increases from $Q_A$ to $Q_C$ at a constant price $P_A$.

This shift in the demand curve assumes that design services are a “normal good” and that demand increases with positive increases in income, tastes and preferences, and the prices of other goods and services. Some goods are inferior; for example, an increase in income causes demand to decrease as consumers substitute more costly alternatives (e.g., hamburger to steak).

Substitutes are goods and services for which an increase in the price of one (relative to the other) causes an increase in demand for the other, other things being equal. For example, traditional architectural services may be substituted for by design-build services, and an increase in the fees paid to architects will cause some clients to employ design-build services instead.

Complements are goods and services for which an increase in the price of one causes a decrease in the demand for the other, other things being equal. For example, increases in construction costs and interest rates (the price of money) will cause some potential building projects to be postponed or cancelled, resulting in a decrease in the demand for architectural services.

The slope of the demand curve is its price elasticity:

\[
PED = \frac{\text{percent } \Delta Q}{\text{percent } \Delta P} = \frac{(Q_1 - Q_2) \times (Q_1 + Q_2)}{(P_1 - P_2) \times (P_1 + P_2)}
\]

Equation 3.1

where: PED is the price elasticity of demand
A perfectly elastic demand curve would be a horizontal line, while a perfectly inelastic demand curve would be vertical. If the quantity changes by a greater percentage than the change in price, the demand is elastic. If the quantity changes by a smaller percentage, then demand is inelastic; and if the percentage change is the same, then demand is unit elastic.

Many economic decisions hinge upon the elasticity of demand. For an architectural firm, the decision to reduce its fee from six percent to five percent of construction cost depends on the price elasticity of demand for its services. It should be noted that even for a linear demand curve (straight but sloped line), the price elasticity varies along the line, declining as the price decreases and quantity increases. For a demand curve to have constant elasticity, it must be curved.

The price elasticity of demand depends upon the availability of substitutes and complements. For example, if there are close substitutes that are readily available, then demand is elastic because buyers can switch easily. For complements, demand is inelastic if it is a minor complement and elastic if it is a major complement to an important good. Elasticity also depends upon the relative portion of income that the good or service consumes, demand tending to be inelastic when it represents a low proportion of an individual's income. In the short term, demand may be inelastic; but over a long period, changes may occur so that alternatives are employed.

Related to the concept of price elasticity of demand is income elasticity: the ratio of the percentage change in the quantity demanded to the percentage change in the per-capita income of the buyers. These changes are related to shifts in the demand curve.

**Supply**

In order to induce sellers to increase the quantity of a good or service supplied, it is necessary to offer them a higher price, other things being equal. A higher price gives a greater incentive to devote more time and energy to the provision of the good or service and reflects the higher cost to provide greater quantities.

**Figure 3.4** Supply of Design Services (e.g. architectural design, industrial design etc.)

Similar to the demand curve, a change in the quantity supplied is the result of a price change alone and is represented by a movement along a given curve. (Figure 3-F). A change in supply is represented by a shift in the curve to the left or right and is caused by a change in some factor other than price. For example, changes in technology, input prices, or the expectations of suppliers will cause a change in supply. If technology improves and allows a greater output from a
given quantity of resources, such as the impact of the computer on architectural service, the effect would be to cause
the supply curve to shift to the right indicating that a greater quantity of “service” could be supplied for the same price.
A change in the price of inputs such as an increase in salaries paid to employees will cause the curve to move to the
left. That is, for a given quantity of service a higher price ($P_b$) must be changed ($S_1$,$S_2$). (Figure 3-G)

The concept of price elasticity also is relevant to supply. It is defined as the ratio of the percentage change in the quant-
yty supplied to the percentage change in its price and is calculated in a similar fashion to demand elasticity.

### 3.5 THE INTERACTION OF SUPPLY AND DEMAND: MARKET EQUILIBRIUM

Market equilibrium is the condition which results when the separately formulated plans of buyers and sellers of a good
or service exactly mesh so that the quantity supplied is exactly equal to the quantity demanded at the prevailing price.

Figure 3.5 Market Equilibrium of Design Services (e.g. architectural design, industrial design)

A is the position of market equilibrium (Figure 3.). The position of equilibrium changes only when the forces under-
lying demand and supply change and cause the respective curves to shift. These forces are summarized below:

<table>
<thead>
<tr>
<th>DEMAND</th>
<th>SUPPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income of buyers</td>
<td>Input prices</td>
</tr>
<tr>
<td>Buyer expectations about future prices</td>
<td>Technology</td>
</tr>
<tr>
<td>Prices of substitutes</td>
<td>Suppliers’ expectations about prices</td>
</tr>
<tr>
<td>Prices of complements</td>
<td></td>
</tr>
</tbody>
</table>

Many of these factors depend on underlying economic conditions; and when these conditions change, the factors
underlying demand and/or supply curves change causing the curves to shift to new positions, thus bringing about
changes in prices and quantities.
When the market is in disequilibrium, an excess quantity demanded or supplied will exist. Pressure is placed on the price to move upward or downward so that a new equilibrium is established. For example, in Figure 3.1, at Point B the excess quantity will not be purchased by the market, causing the price to drop to $P_A$ and the quantity supplied to fall to $Q_A$; that is, a new equilibrium price and quantity will be established.

Prices may not be able to move freely in response to market pressure if artificial restrictions have been introduced on either price or quantity. For example, price controls such as fixing the price to be charged for a particular good or service below (or above) the equilibrium price requires that excess (or surplus) demand is met by a shortage (or an oversupply).

In Figure 3.6, $S_1$ is the initial supply curve and $P_A$ is the artificial price set for architectural services. At this price, buyers will demand a quantity, $Q_A$; while architectural firms are willing to supply $Q_B$. If the price cannot increase, some sort of rationing is required until changes occur in either the demand or supply curves.

![Figure 3.6 Market Disequilibrium of Design Services](image)

If the price is fixed above the equilibrium price at $P_B$, architectural firms will wish to supply a quantity, $Q_A$, and clients will buy only $Q_B$. This is an oversupply condition; and to meet the reduced need for architectural services, firms might supply $Q_B$ at the higher price, $P_B$. Excess profits might accrue to the firm ($P_B - P_A$), although the quantity supplied is less. The result depends on the firm’s cost structure. The new equilibrium would produce adjustment in either supply or demand or both. For example, there might be reduced employment of architects on the supply side; while on the demand side, architectural services would be used only by the very wealthy.

Even with price controls, the tendency is for demand and supply to move toward equilibrium conditions so that artificial constraints such as price controls are, in the long term, ineffective. There are also many legal restrictions on the ability of firms to set their fees collectively.
3.6 Changing Economic Conditions: A Dynamic Equilibrium

The preceding section implies that markets are adjusting constantly to changing forces and economic conditions. These continuous changes are found in every market since the equilibrium that is reached is one that is dynamic; that is, constantly changing as new information arrives in the market. For example, the demand for architectural services is influenced by several factors: income, expectations, tastes and preferences, and the prices of substitutes and complements.

Tastes and preferences reflect the changing cultural values of society and are both difficult to predict and to measure their influences on demand. The other factors are related directly to economic conditions. Increases in real income (after inflation adjustment) to buyers means that buyers will have more money to spend on goods and services and, accordingly, will demand more.

Expectations of both buyers and sellers regarding future prices will affect the levels of demand and supply. Future prices may change as a result of real or nominal pressures. A real price change might occur as a result of improved technology so that a good or service may be produced more cheaply. A nominal price change occurs as a result of inflation, but both can affect the level of demand.

Prices of substitutes and complements also are important factors. For example, the construction of a building requires both interim financing and long-term financing. As the interest rate rises, the costs of construction and operation increase which results in a decline in the demand for architectural services. If, however, expectations are that interest rates may increase even further in the future, construction activity may increase in the short term. All of these factors are related to economic conditions such as inflation, real economic growth, and interest rates.

To demonstrate the important impact of economic conditions on architectural services, consider the following very simplified scenario that addresses the economic environment of the early 1980s:

**Federal Government Fiscal And Monetary Policy: The Impact On Design Services**

For the U.S. Federal Government, there is a relatively simple formula for the relationship between the sources and uses of revenue: \( \text{INCOME} - \text{EXPENSES} = \text{DEFICIT OR SURPLUS} \)

Deficits can be met by several alternatives, including the monetarization of the debt (print more money); or by borrowing money from the public. The first alternative inevitably leads to inflation because there is more money in the economic system while production usually has not increased accordingly. Inflation is measured by changes in the money supply. It directly affects the interest rate since lenders must be compensated for the loss of purchasing power that occurs during the period of time that their money is borrowed. Funding the deficit by borrowing from the public inevitably leads to changes in the interest rate through increased demand for funds (unless increased savings by the public offset increased demand).

Interest rates reflect market expectations for future economic conditions in three components:

a. The real risk-free interest rate (a result of the demand and supply for loanable funds);

b. The markets' expectations for future inflation during the life of the debt;

c. A risk premium related to the probability of default by the borrower.

Accordingly, the two alternatives described above have different effects on the components of the interest rate; but it should be noted that either alternative increases the cost of capital for the private sector, reducing both investment and consumption. Depending upon how the government spends its revenues, there may be an overall slowing down of the economy or simply a transfer of wealth (if one accepts the proposition that the private sector is generally a more efficient producer of goods and services). In the long term, deficits are reduced by increasing taxes, reducing spending, sustaining long-term economic growth while maintaining the rate of taxation and restricting spending, or running the printing presses at a faster speed.
Now consider the effect of government activities in the first few years of the Reagan administration. During this period, total tax revenue increased despite direct reductions in the tax rate and changes in the deductibility of expenses. However, total expenses increased at a faster rate because spending on some programs (such as defense) increased dramatically while maintaining many other expenses at a constant or increasing level.

The resulting deficit was funded by increased borrowing in the financial markets by selling Treasury bonds, notes and bills. The money supply was restricted so that inflation was at very low levels in contrast to previous years (pre-Reagan). The increased demand for funds, as a shift in the demand curve) established a new equilibrium at a higher quantity of money borrowed and a higher price. The price of money is the interest rate. The interest rate changes can be observed in the following exhibits. Further, the change from high inflation to low inflation caused many business to fail or experience economic difficulties, thus increasing the risk premium. As the interest rate increased, it became less profitable to invest, construct buildings, etc., thereby decreasing the demand for architectural services. This can be observed in Exhibit 3.2 as the decline in total new construction from $260 billion in 1981 to $246 billion in 1982. Reductions in investment and consumer spending can be observed as the U.S. went into a recession in 1981-82, reducing the amount of taxes paid (in 1982 and 1983) and exacerbating the situation. The changes in the U.S. gross national product are shown in Exhibit 3.4.

Of course, economics is far more complex than the preceding discussion would suggest, but the immediate effect of the early Reagan years was a recession in 1981-82 as the economy was transformed from inflation-dependent to real economic growth. Once this transformation was achieved, the U.S. experienced sustained economic growth with a dramatic increase in new construction and demand for architectural services. For example, in 1983 total new construction increased to $281 billion and to $328 billion in 1984.1

Exhibit 3.1

1. A similar approach can be taken to explaining the growth during the later years of the Reagan era and the first two-three years of the Bush administration and the recession that followed.
3.7 THE MARKET FOR DESIGN SERVICES

Many types of professional design services generally occur in competitive markets; but this is not always the case as some firms have demonstrated that under certain conditions, monopolistic conditions are possible. Perfect competition exists when the following six conditions are satisfied:

a. A single supplier or buyer cannot affect the price of a good or service.
   i. If an architectural firm increases the price of its service without modifying the quality offered, it is reasonable to expect that clients will go elsewhere. Loyalty to an expensive firm will be short-lived, and the firm will not survive in the long term.
   ii. Similarly, if a firm reduces its price below the market rate, it will not survive in the long term. The market price is equal to the participants' marginal cost, so the firm will receive less revenue that it is spending to produce the services being supplied.

b. A supplier is able to sell as much of the good or service as desired at the prevailing market price. This is a questionable condition for the market for architectural services because one must consider the costs of reaching additional clients: a market imperfection that can restrict an individual firm's ability to supply the market.

c. All suppliers offer “identical” services or services that are close substitutes (a homogeneous product or service).

d. There are a large number of relatively small firms (both suppliers and buyers) so that no single firm can influence the price or quantity.

e. Low entry or exit costs so that new suppliers or buyers can enter or leave the market at will.

f. Good distribution of information among all participants.

Clearly, many of these conditions do not always hold for the markets for some types of design services. They may be violated in certain geographic regions, in highly specialized building types, or as a result of many other factors. The extent to which the conditions do not hold is an important factor in determining the ability of a firm to operate profitably in the market. As the conditions increasingly are violated, the market becomes less competitive and more monopolistic (single supplier) or monopsonistic (single buyer). In a monopoly a seller is able to increase the price (and restrict the supply) without losing customers. If there are several suppliers, at least one of which has a large market share, the market is an oligopoly.

A pure monopoly is a market structure that consists of only one supplier who is able to restrict the entry of other firms into the market. That is, there are barriers to entry that can protect the firm from potential competition. These can be “technological” barriers; for example, an architectural firm has an expertise that can be protected by copyright or patent. Included in this category could be “name” monopolies in which the “name” of the architect is a barrier to entry for other architects even though the “style” may be replicated. Alternatively, monopolies can be created by a government grant of monopoly privilege: an unlikely franchise for an architectural firm. The advantage of monopoly is that the firm is not a price taker but a price setter in the market and is able to determine price so as to maximize profits, given the cost of its inputs and the market demand curve. Monopolies are discussed further at the end of this section.

In a perfectly competitive market each firm is a price taker as each firm is unable to alter the market price, its own supply being only a small proportion of the total market supply. Even if the firm increased its price by only a small percentage, it would lose customers as its competitors offer a service that is nearly identical. Because the firm cannot control the price, the only decision with which it is faced is how much to produce. This does not contradict the rivalry that persists within competitive markets because each firm attempts to minimize its costs so as to reduce its price and increase the quantity supplied or to overcome some of the market inefficiencies that restrict the ability of firms to gain access to clients (e.g., advertising and marketing).
In a competitive market (at equilibrium), the additional revenue received by the firm for each additional unit of service supplied is equal to the market price. This marginal revenue is the amount by which the total revenue of the firm increases as a result of a one-unit increase in quantity. Further, the marginal revenue to the firm is the same for the first unit as it is for the thousandth unit; that is, marginal revenue is constant and independent of the quantity supplied. For an architectural firm, we can think of marginal revenue as the hourly rate charged for an “average” employee.

The same may not be said for the firm's cost structure which is not constant but exhibits a “U” shape. The marginal cost is the increase in cost required to increase the output of the particular good or service by one unit. The U shape is the result of two factors:

a. **The economy of scale**: At initial levels of “production” the addition of inputs (e.g., employees) will cause the firm to increase in efficiency as the different skills of employees are employed in specific tasks. As a result, the firm's marginal cost curve will decrease.

b. **The law of diminishing returns**: That is, as the quantity of one input in the production process is increased (with the quantities of other inputs remaining fixed) a point is achieved beyond which the quantity of additional output per unit of added input begins to decrease. For example, the successive addition of architectural employees will be such as to make the firm become less effective. The cost of each additional unit of service provided will begin to increase through higher salaries and the decline in performance as the added employees are increasingly less skilled. Thus, the marginal cost curve will begin to increase.

The marginal cost curve of the firm combines both fixed and variable components that vary for different levels of “production.” For example, the average fixed costs decline as “production” increases while the average variable cost increases. The sum of these two costs is the firm's average total cost. The relationships between total costs and average costs are illustrated in Figure 3.7. Fixed costs are costs that are fixed in the short term and include the costs of maintaining the office in which “production” occurs (e.g., rent and leasing costs as well as some salaried workers). Variable costs vary directly with the level of production. For example, some salaried workers can be laid off for periods when there is insufficient work. There also may be incremental fixed costs; that is, costs that change incrementally over ranges of quantity. It should be noted that the marginal cost curve intersects the average variable cost and average total cost at their lowest levels (marginal average rule). The difference between the marginal cost and average total cost curves is a function of their definitions: marginal cost is the incremental cost of "producing" one more unit at some specified level of "production"; while average cost is the average cost of all of the units being "produced"
THE COMPETITIVE DESIGN FIRM

The relationship between marginal cost and marginal revenue for a competitive firm are illustrated in Figure 3.8ii. The marginal cost and revenue curves can be converted to total cost and total revenue by multiplying the output quantity by the appropriate cost or price. This extension is illustrated in Figure 3.8.i.

![Figure 3.8 Profitable Operations for a Design Firm](image)

That is, the firm will "offer a service" to the point where its marginal cost equals marginal revenue (equals the market price) and will maximize its profit at that point.

It should be noted that the firm's marginal cost structure covers all the inputs in the "productive" process. Capital invested by the firm must be considered as input. The marginal cost of the firm, therefore, includes a fair return on invested capital given the risk of its investments. Under these conditions, the firm makes a profit; but the return is only compensation for the risk of loss.

If market conditions were unfavorable, the firm might not make a profit. The firm would then minimize its short-term losses. This situation is illustrated in Figure 3.9
When the average variable cost of the firm exceeds the marginal revenue, the firm “shuts down” to minimize its losses. This is illustrated in Figure 3.10 (i & I).

A firm could pursue this strategy only for a short period of time if it wished to avoid bankruptcy. Although it is covering its variable costs, the output of the firm is not sufficient to cover its fixed costs. This can be seen in Figure 3.9-ii where the average variable cost exceeds the marginal revenue or price for its services but does not exceed the average total cost, which includes the fixed costs of “producing” each unit of service.
THE DESIGN SERVICES MONOPOLY

Architectural firms generally are not in the fortunate position of being monopolies although a few may, by virtue of their special characteristics, exhibit monopolistic qualities for short periods of time. For this reason we will discuss briefly monopolistic behavior in the market. The primary difference between the firm in a monopoly and in competition is that under the conditions of monopoly, the firm is faced by a downward sloping marginal revenue curve that is related to the demand curve. As a price setter, it is able to set the price at a level that maximizes its total profit. A secondary effect is that the firm is not under great pressure to reduce its costs in order to survive (an effect of competition) but will do so only to maximize profits. If the managers of the firm do not maximize profits but, instead, “optimize” profits by trading off the profit against their own interests, then the monopoly firm may be an inefficient producer (because of restricted incentives to be efficient in the operation of the firm).
MONOPOLISTIC COMPETITION AND THE ROLE OF ADVERTISING

While monopolies in architectural practice can be the result of technological innovations that belong to one firm and legally cannot be reproduced or utilized by another firm, some of the conditions of a monopoly are more likely to occur because of architectural “style” or name recognition. Both “style” and name recognition produce “signature buildings” that are able to stand out from the rest and, thereby, both identify and imbue their owners and occupants with a degree of significance. This does not mean that the design of these buildings is any better than non-signature buildings but rather that the building has an identifiable image with the consumer and thus produces a value for its owners.

The product choice of a consumer, or in our own case the choice of an architect by the client, is a complex decision problem. It is complicated because the client only partially is aware of the relative prices and characteristics of the services being offered. Both prices and service characteristics are changing constantly; and, therefore, the client must expend resources (as both time and money) to gather and analyze information. The function of “advertising” is to provide information and, at the most basic level, to make the client aware of the existence of the firm. Thus a firm that successfully “advertises” itself will reduce the search costs of the client and will increase the probability that it will be selected. Advertising by architects occurs in many forms and includes not only the buildings that have been constructed already but design awards; feature coverage in journals, newspapers and television; brochures; and even advertisements in various media forms.
At the basic level, advertising seeks to overcome consumer or client ignorance, but another important function is the potential to induce changes in demand by altering tastes and preferences. If the clients' tastes are changeable, then excess profits might be made by inducing changes that increase a specific demand for the firm's services. The changes in demand can occur either as an outward shift in demand, or by making demand more inelastic, or both. In either situation the firm is able to increase the price of its service or the quantity sold and, thereby, increase profits. In this case the firm has taken on the attributes of monopolistic competition.

The modification of consumer tastes and preferences is a difficult task because tastes and preferences are influenced strongly by others. While some people are innovative and lead in their tastes and preferences, the majority are imitators, modifying their choices only after there has been a degree of acceptance of the new “fashion.” The interaction of innovation and imitation keeps tastes, preferences, and “architectural style” in a state of flux. The impact of the “advertising” age in which we live has been to increase the volatility of tastes and preferences and to promote an acceleration in the change of architectural styles.

The marketing concept of “brand loyalty” also can be applied to architectural practice as well. Brand loyalty is the term given to the shortcut that a consumer takes to select the same product over and over again. For an architectural firm, this is repeat business; and while it is related strongly to the notion of consumer or client satisfaction, it also is a direct function of the consumer/client's effort to minimize search costs and simplify the decision process.

Figure 3.12 Monopolistic-competition Situation.

One of the main complaints about “advertising” is that it violates the sovereignty of the client/consumer. Some people would argue that firms do not develop their products or services to meet the desires and needs of clients/ consumers but use advertising to make people buy things they don't need. This is the position of John Kenneth Galbraith (The Affluent Society), who observes that there is a distinction between “true” innate wants or needs and those “false” needs that are created by advertising and which violate consumer sovereignty. However, such divisions may be irrelevant or arbitrary; and the proposition implies that without advertising, false needs either would not exist or would emerge of their own accord.

Advertising plays an important role in monopolistic competition because it may establish a barrier to entry for other firms by drawing attention to certain attributes or characteristics of a given firm and helping to maintain brand loyalty. Alternatively, in other situations it can be argued that “advertising” does not impede competition but is the means by which competition is achieved. In this case, advertising must be available readily and equally to all firms. However, for some architectural firms this may not be true because of the restrictions, albeit often self-imposed, on any form of advertising beyond having buildings published in journals or, for more liberal firms, sending brochures to potential clients. Thus, the market for architectural services remains somewhat inefficient although still competitive.
The attitude of architectural firms that advertising is unnecessary, vulgar, or unethical both creates the opportunity for and maintains the conditions for oligopolies and monopolistic competition for some “specialized” firms by raising barriers to entry for new firms and changing or biasing the search costs for clients against these firms.

A monopolistically competitive market is identified as having a large number of small firms that offer a differentiated product or service and no significant barriers to entry for new firms. That is, it blends both monopolistic and competitive components into one market setting and probably is the form that best represents the activities of many “design” firms as they practice in a variety of sub-markets.

![Monopolistic-Competition Situation](image)

Under monopolistic competition, each individual firm is confronted by demand and marginal revenue curves that are downward sloping, but the demand curve probably is more elastic than for a pure monopoly. Because each firm's product/service is slightly different, a given firm can raise its price somewhat before losing all of its clients. The analysis considers both long-term and short-term effects. In the short term, the firm produces at the point where marginal revenue equals marginal cost (Figure 3-13.i), and the firm makes excess profits; but in the long term, new firms that offer products or services that are close substitutes are lured by the excess profits. The effect of additional competition is to change the demand by diverting demand away from the original firm. The entry of new firms will continue until profits are eliminated and a long-run equilibrium is established (Figure 3.13-i).

The average total cost of the firm increases because the firm must now expend resources to retain its share of the market. For some design firms, there is an added bonus as young graduates flock to the innovative firms. This tends to reduce the costs of the firm and also can lead to excess profits (the firm becomes a monopolistic competitor for labor), although it is not unusual to see these profits diverted to developing the special design expertise of the firm or subsidizing other activities.

Even when the position of long-run equilibrium has been reached, the monopolistic competitive firm is inefficient because each firm is not operating at the minimum point on its long-run average-total-cost curve. Further, each firm does not produce enough of its product/service; the gap that exists between price and marginal cost (in Figure 3.13 i) represents an opportunity that benefits both buyers and suppliers.
In defense of monopolistic competition as a form of market for some architectural services, it is important to acknowledge that service (and design) diversity is valuable in and of itself and that all architectural firms compete at some level by selling a homogeneous good - architectural design. Even though the individual firm offers a highly differentiated product/service, the variations among firms can be accounted for in terms of technological differences, design detail, design quality, etc. Thus, it may be argued that a market exists solely because of the variety that exists and because diversity and quality have values to society.
THE BAINBRIDGE PARTNERSHIP

In December 1989, Diane White, the partner responsible for Finance and Management of the Bainbridge Partnership, met with the executive committee of the firm to discuss the budget for the following year. The meeting was typical of recent experiences, with several partners expressing their lack of confidence in the marketing department and protesting that in the coming year they would not tolerate a loss like that being experienced during the current year.

The work of the firm had diminished steadily over the last year. While Diane and Fred Longtree (the partner responsible for monitoring the marketing team) could point to a deteriorating economy that affected the speculative office market, the firm's primary client group, it was apparent to them that the firm was not able to compete effectively. The organization of the firm had not changed since John Bainbridge died in 1983. Production technology still lagged behind most of the other firms with which they competed. For example, the only use the firm made of computers was for word processing (primarily correspondence and specifications), while other firms had invested considerable resources to acquire sophisticated hardware and software. However, Diane's attempts to explain this problem were futile and were interpreted as criticism of the productivity of the firm's architects and draftsmen. She left the meeting when the agenda turned to the plans for the office Christmas party.

Diane decided that the only way she could convey the problem effectively to the executive committee was to depict graphically the firm's cost structure and compare it to that of the competition. She began by requesting that the firm's accountant meet her for lunch and to bring whatever cost information he had on the recent operations of the firm. By the following day, she had summarized this information (Exhibit 1) and developed some tentative projections for the costs of the firm's major competitor, KBC. This firm used computers almost exclusively in the documentation phase. KBC had once been smaller than the Bainbridge Partnership but had taken all but one of the last five projects for which both firms had competed.

Given the following data for the two firms, develop the curves for marginal revenue, marginal cost, average total cost, average variable cost, average fixed cost, total fixed cost, total variable cost, total cost, and total revenue. Discuss the differences between the two firms, decide whether or not the Bainbridge Partnership needs to acquire computer resources, and determine the levels of service (quantity) that the firms should supply.

**EXHIBIT 1**

**Cost Structure For The Bainbridge Partnership**

<table>
<thead>
<tr>
<th></th>
<th>BAINBRIDGE</th>
<th>KBC (Est.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Fixed Costs for 1990.</td>
<td>$3,040,000</td>
<td>$3,720,000</td>
</tr>
<tr>
<td>Average hourly charge for architectural services</td>
<td>$38</td>
<td>$37</td>
</tr>
<tr>
<td>Variable costs for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3000-hour week:</td>
<td>$57,000</td>
<td>$53,000</td>
</tr>
<tr>
<td>3500-hour week:</td>
<td>$73,500</td>
<td>$65,000</td>
</tr>
<tr>
<td>4000-hour week:</td>
<td>$89,400</td>
<td>$78,000</td>
</tr>
<tr>
<td>4500-hour week:</td>
<td>$112,000</td>
<td>$80,000</td>
</tr>
<tr>
<td>5000-hour week:</td>
<td>$135,000</td>
<td>$112,000</td>
</tr>
</tbody>
</table>
Mark Bonham started work with F.W. Lacey Architects and Engineers shortly after he was graduated from Texas Tech University in 1984. After two years he had started taking courses at night in the MBA program at Texas Tech; and in 1988, after completing his MBA, he had been promoted to office manager and given associate status. The promotion had meant a substantial increase in salary, but it was problematic in many ways. He was working longer hours, of course, but he had not anticipated the personal problems that came with his change in status.

Most noticeable was the attitude of the junior members of the firm. Where once he had been an equal with whom they had socialized freely, already it was evident that they now associated him with the upper echelon of partners and senior associates. Mark knew that many of the junior members of the firm resented his sudden rise; and while he tolerated some often pointed remarks about being “the golden-haired boy,” he often felt alone and embarrassed about his recent success in the firm. Above all, however, he wanted to prove to Fred Lacey that his trust in him was well placed by demonstrating his competence to manage the firm through the difficult economic times.

Mark was only halfway through the MBA program when the economy of Texas faltered and began to decline as the world oil market collapsed with steadily falling prices. The impact on the company had been almost instantaneous. Within a few months more than one-third of the firm's projects had been either cancelled or postponed indefinitely, and ten draftsmen were laid off. Salary cuts were introduced for the remaining employees and partners, plans to move into new offices were shelved, and everyone was encouraged to seek new commissions for the firm.

Perhaps he had been lucky Mark thought as he reminisced in his new office one evening, but he had studied the problem conscientiously for several weeks using his recently acquired skills from his courses in marketing and economics. He had searched for a market niche where the firm's abilities in architecture and engineering could be brought to bear, but everything he studied seemed to be extremely competitive with existing firms already engaged in a life-and-death struggle with each other. Then one weekend, he had driven down to the Mexican border with his wife, Susan, and two young children. Susan had remarked how many Mexican immigrants and temporary residents there were in the area and how low the wages would be there. She wondered why there weren't more U.S. firms setting up factories in the area to take advantage of the large unskilled and semiskilled labor pool. With the prevailing wage structure being considerably below the U.S. average, many companies would be able to compete effectively with Japanese firms and outperform their American counterparts.

At first Mark hadn't realized the potential ramifications of her observation; but as the weekend progressed, he began to understand the market implications. The major problem, of course, was how to identify the companies which would be interested in locating factories in the area. F.W. Lacey Architects and Engineers already had some experience in the design of factories; and given the large number of unemployed design professionals in the area, could expand easily into a wide range of industrial facility design services.

The next week Mark discussed the idea with the professor of one of his marketing classes and was surprised how easily he would be able to target the market. He began by listing all of the attributes of the region near the Mexican border and the kind of workers that he thought would be available. With this information in hand, he began to develop profiles of firms that would be interested in locating production facilities in the area. After some discussion with the comptroller of F.W. Lacey, he determined that the greatest profit could be obtained by designing factories of at least 50,000 square feet. This meant that the typical client firms would have at least $10 million in annual sales and be experiencing rapid growth and increasing competition that necessitated control of labor prices. Some time later, after he was armed with relevant data from the state and local commerce authorities, Mark met with Fred to lay out his marketing proposal for contacting directly 300 firms with a comprehensive package setting out the economic benefits of locating in south-
ern Texas, a description of the existing infrastructure, the relative costs of land and construction of production facilities and the firm's design strengths, etc. Fred Lacey was impressed and excited by this opportunity at a time when the local market seemed very bleak, and he directed Mark to work closely with the marketing department to develop the brochures, the mailing list, and a team that could follow up quickly and expertly on any inquiries. Within a few months, the firm had ten contacts with potential clients; and by the end of the year had contracted to design a quarter of a million square feet of industrial space.

Over the next two years, F.W. Lacey had outperformed almost all of the firms in Texas and had developed a primary specialization in large industrial facilities, growing 25 percent larger than it had been before the drop in oil prices. The competition in the region had increased, of course; but F.W. Lacey always had managed to stay ahead by maintaining an active search for new clients, improving the quality of its services and reducing the cost of operations by more efficient management of its resources, and technical innovation. The firm's approach to business had been to compete on the basis of price, typically about four percent of the cost of the construction of the factory, and to take advantage of its superior operation to improve its market share and maximize profits by minimizing its costs through improvements in productivity.

With his promotion to office manager and associate, Mark had discovered the responsibility that is an integral part of management's role. During the last few months he had begun to wonder whether the firm's position was as secure as it appeared at first glance. He certainly didn't relish the prospect of laying off any of the junior members of the firm in his first year as office manager; and then there was his recent meeting with Fred Lacey. The partners had formulated an aggressive strategy of expansion, and Fred wanted to beat last year's profit of five percent of gross revenues while meeting the partners' goal. He instructed Mark to develop a business strategy for the next twelve to eighteen months of operation that would draw upon the firm's existing strengths and client base. He noted that the competition would increase in this period as several (six) of the firm's key employees, from both architectural and engineering disciplines, had been lured away by major competitors with offers of higher salaries and promotions. Nonetheless, Fred thought that Mark initially should concentrate his energy on formulating a strategy for industrial facilities in southern Texas where they knew the firm could be successful.

However, there were some clear indications that the market was becoming unstable and that the regional boom would begin to slow down. Many of the companies that had established factories in the area were either high-technology, computer, or electrical component companies, or automotive component and subassembly manufacturers. The consumer sales of electronics, computers and automobiles were sluggish; although the only sign of trouble that the firm had experienced so far was the temporary postponement of an 85,000-square-foot addition to a factory that produced windshield wiper motors, starter motors, and power window assemblies for automobiles.

Mark spent the next few days collecting information and data relevant to the problem of determining a strategy for the Industrial Facilities Division. This information is provided in Exhibits I - V. It seemed unlikely that he could increase the market share of the firm without an aggressive campaign. It appeared that his strategy would have to be based on the pricing structure of the services of the firm for it already offered a complete range of services; but the last thing he wanted to get into was a price war with the firm's major competitor, unless it was absolutely necessary. There was only a slight amount of slack in the operation, so the opportunity to reduce costs even further seemed very limited. The potential for discovering new market niches or clients also would become restricted if the economy declined or competition increased.

Using some marketing reports on past project interviews, Mark attempted to estimate the approximate percentage fee that the competitors had been using to obtain projects. While this assumed that the clients were price-sensitive and did not consider issues such as aesthetic results, quality of service, etc., Mark though it was a reasonable basis from which to proceed because, in many ways, all of the firms were comparable. His task was complicated because not all of the projects had been bid using a percentage-fee approach. Indeed, in many of them the fee had been based on a cost-per-square-foot-of-gross floor area. Using the information he was able to gather on the firm's performance in the southern Texas market over a seven-year period, develop a strategy for the coming year.
EXHIBIT I

RECENT PROJECTS AND PROPOSED FEES

<table>
<thead>
<tr>
<th>Company</th>
<th>Gross Area (sq.ft.)</th>
<th>Fee/ F.W. Lacey</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krypton Tech.</td>
<td>175,000</td>
<td>4.2%</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Space Blades</td>
<td>58,000</td>
<td>$2.80 sq. ft.</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alison Engineering.</td>
<td>85,000</td>
<td>4.2%</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAL Plant</td>
<td>115,000</td>
<td>4.0%</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Softees Inc.</td>
<td>74,000</td>
<td>$1.98</td>
<td></td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dick's Disks</td>
<td>22,000</td>
<td>6.0%</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Western Products</td>
<td>58,000</td>
<td>$2.40</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
<tr>
<td>Davis-Longtree</td>
<td>37,000</td>
<td>$2.60</td>
<td></td>
<td></td>
<td></td>
<td>*</td>
</tr>
</tbody>
</table>

*Indicates project was awarded to this firm.

Note: Architectural and Engineering fees were based either on a percentage of construction cost or as a cost per square foot.

EXHIBIT II

F.W. Lacey Revenue By Division (000s Omitted)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Contract Value</td>
<td>59,293</td>
<td>64,388</td>
<td>56,210</td>
<td>55,217</td>
<td>86,236</td>
<td>91,318</td>
<td>95,236</td>
</tr>
<tr>
<td>Total Billings</td>
<td>3,396</td>
<td>4,060</td>
<td>3,559</td>
<td>2,653</td>
<td>3,881</td>
<td>4,489</td>
<td>4,769</td>
</tr>
<tr>
<td>Office</td>
<td>1,210</td>
<td>1,730</td>
<td>1,460</td>
<td>385</td>
<td>276</td>
<td>197</td>
<td>228</td>
</tr>
<tr>
<td>Retail</td>
<td>836</td>
<td>843</td>
<td>742</td>
<td>674</td>
<td>693</td>
<td>547</td>
<td>936</td>
</tr>
<tr>
<td>Industrial</td>
<td>947</td>
<td>872</td>
<td>896</td>
<td>1,200</td>
<td>2,514</td>
<td>3,277</td>
<td>3,112</td>
</tr>
<tr>
<td>Residential</td>
<td>77</td>
<td>187</td>
<td>204</td>
<td>86</td>
<td>97</td>
<td>134</td>
<td>176</td>
</tr>
<tr>
<td>Other</td>
<td>326</td>
<td>428</td>
<td>257</td>
<td>308</td>
<td>301</td>
<td>294</td>
<td>317</td>
</tr>
<tr>
<td>Earnings Before</td>
<td>197</td>
<td>177</td>
<td>(25)</td>
<td>(87)</td>
<td>147</td>
<td>196</td>
<td>229</td>
</tr>
</tbody>
</table>

Interest and Taxes.*

* An extraordinary loss of $201,000 was recognized in 1985 as a bad debt after a major client declared bankruptcy after defaulting on outstanding construction loans.
### EXHIBIT III

**F. W. Lacey Industrial Facilities Division (000s Omitted)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Square Footage</td>
<td>321</td>
<td>261</td>
<td>266</td>
<td>366</td>
<td>805</td>
<td>987</td>
<td>926</td>
</tr>
<tr>
<td>South Texas Sq. Footage.</td>
<td>0</td>
<td>56</td>
<td>0</td>
<td>250</td>
<td>584</td>
<td>722</td>
<td>643</td>
</tr>
<tr>
<td>Total Value ($)</td>
<td>21,044</td>
<td>19,378</td>
<td>20,013</td>
<td>28,235</td>
<td>61,019</td>
<td>77,051</td>
<td>76,840</td>
</tr>
<tr>
<td>Total Billings ($)</td>
<td>947</td>
<td>872</td>
<td>896</td>
<td>1,200</td>
<td>2,514</td>
<td>3,277</td>
<td>3,112</td>
</tr>
<tr>
<td>Billings for South Texas Projects</td>
<td>0</td>
<td>180</td>
<td>0</td>
<td>810</td>
<td>2,045</td>
<td>2,332</td>
<td>2,109</td>
</tr>
</tbody>
</table>

### EXHIBIT IV

**Southern Texas Industrial Facilities Market Competitor Analysis (000s Omitted)**

<table>
<thead>
<tr>
<th>Year</th>
<th>1986</th>
<th>1987</th>
<th>1988</th>
<th>1989</th>
<th>1990*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Square Feet of Space</td>
<td>862</td>
<td>1,764</td>
<td>2,576</td>
<td>2,398</td>
<td>2,487</td>
</tr>
<tr>
<td>Total Value of Space Contracted</td>
<td>57,092</td>
<td>114,660</td>
<td>115,984</td>
<td>161,721</td>
<td>158,853</td>
</tr>
<tr>
<td>Square Footage by Firm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F.W. Lacey</td>
<td>250</td>
<td>584</td>
<td>722</td>
<td>643</td>
<td></td>
</tr>
<tr>
<td>Competitor 1</td>
<td>84</td>
<td>276</td>
<td>485</td>
<td>414</td>
<td></td>
</tr>
<tr>
<td>Competitor 2</td>
<td>32</td>
<td>218</td>
<td>314</td>
<td>414</td>
<td></td>
</tr>
<tr>
<td>Competitor 3</td>
<td>17</td>
<td>87</td>
<td>212</td>
<td>312</td>
<td></td>
</tr>
<tr>
<td>All Others</td>
<td>479</td>
<td>599</td>
<td>843</td>
<td>736</td>
<td></td>
</tr>
</tbody>
</table>

* estimated

### EXHIBIT V

**Southern Texas Industrial Facilities Market By Client Type (000s Omitted)**

<table>
<thead>
<tr>
<th>Year</th>
<th>1986</th>
<th>1987</th>
<th>1988</th>
<th>1989</th>
<th>1990*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Square Feet</td>
<td>862</td>
<td>1,764</td>
<td>2,576</td>
<td>2,398</td>
<td>2,487</td>
</tr>
<tr>
<td>Computer technologies</td>
<td>246</td>
<td>736</td>
<td>514</td>
<td>437</td>
<td>435</td>
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<tr>
<td>Electronics</td>
<td>327</td>
<td>515</td>
<td>997</td>
<td>1,136</td>
<td>1,178</td>
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<tr>
<td>Automotive</td>
<td>219</td>
<td>393</td>
<td>854</td>
<td>743</td>
<td>771</td>
</tr>
<tr>
<td>Other</td>
<td>70</td>
<td>120</td>
<td>211</td>
<td>82</td>
<td>85</td>
</tr>
</tbody>
</table>

* estimated