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TRIP-GENERATING CHARACTERISTICS OF LIMITED SERVICE/ECONOMY MOTELS

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Mitul Ishwarlal Patel

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DEDICATION

This thesis is dedicated to my parents Ishwarlal and Pannaben Patel whose continuing love and support have provided the incentive to achieve this goal.

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ABSTRACT

This research attempted to develop a data base on trip-generating characteristics of limited service/economy motels. Currently, this land use is not explicitly presented in the 5th edition of the ITE *Trip Generation* manual. Trip generation models based on number of occupied rooms and employees were derived from data collected from 16 representative motel sites in suburban and rural highway locations of Tennessee and compared to those defined for motels in the ITE manual. In addition, a questionnaire study was conducted to evaluate trip rate variations for similar motel sites.

Results of the trip generation analysis for limited service/economy motels differed from those currently provided by the ITE *Trip Generation* manual. Interpretation or use of the current ITE rates for motels could result in errors when estimating site generated traffic for limited service/economy motels which could lead to unnecessary public concern and substantial development fees. The results of the questionnaire study showed that factors such as guest characteristics and proximity to other land uses such as restaurants can strongly affect trip-generating characteristics of similar motel sites.

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CHAPTER I

INTRODUCTION

A major role of local and state governments is the planning and design of the highway system to adequately meet the needs of increasing land development. Government officials frequently must make decisions between encouraging economic stimulation through new development and increasing traffic congestion caused by this development. These planning decisions require that traffic impact assessments be conducted for proposed new developments to insure the adequate provision of highway facilities to accommodate anticipated additional traffic volumes (TRB 1990).

An important part of a traffic impact assessment is the estimation of the number of trips that will be generated by a proposed new development. An accepted methodology utilized by engineers and planners is to use the trip making characteristics of similar existing sites to predict trip-making characteristics for the proposed site. Thus, an extensive effort has been made over the past two decades to develop a data base on the trip-generating characteristics of various types of land uses. However, some specific land uses such as limited service/economy motels are not explicitly presented in general land use categories. The trip-generating characteristics of limited service/economy

motels may vary substantially from the motel category currently provided by the 5th edition of the Institute of Transportation Engineers (ITE) *Trip Generation* manual. Interpretation or use of the current ITE manual could result in errors when estimating site generated traffic for limited service/economy motels that could lead to unnecessary public concern and substantial development fees. The ITE manual defines a motel as "a place of lodging providing sleeping accommodations and often, a restaurant (ITE 1991a)". ITE's definition does not explicitly define a motel absent facilities such as restaurants, lounges and meeting facilities. These secondary facilites are not available at most limited service/economy motels.

Limited service/economy motels provide inexpensive sleeping rooms with limited guest amenities usually located near interchanges or major intersections to capture the passing-by traveler (Lattin 1989). This type of facility in recent years has become a major segment of the lodging industry. One reason for its popularity is that it is not as capital and labor intensive as a full service motel. Another rationale for the segment's popularity is the increasing number of budget-conscious young adults and retired citizens who frequent economy motels. The limited service/economy segment is the second largest growing lodging category, with proportional growth surpassed only by all-suite properties (Rowe 1989). Forty percent of the 90,000 new rooms opened in

the United States in 1990 were classified in the limited service/economy motel category (Brennan 1991). Results of a consumer-research study performed by McNabb/De Soto & Co., an international consumer research firm for the lodging industry, show that this particular segment is becoming more popular to both the business and leisure traveler. The study showed 25 percent of business travelers and 40 percent of leisure travelers frequent budget properties (Fisher 1989). Studies have indicated that continued growth is expected in the economy lodging segment throughout the decade (Brennan 1991). As the limited service/economy motel segment becomes increasingly larger it is important to analyze the impact this particular land use has on the existing transportation system.

With rapidly accelerating public concern about suburban congestion and development pressures the validity of current trip generation rates has been questioned at various times during the public review of proposed new developments. Many jurisdictions are implementing impact fees, development caps, and public facilities ordinances (TRB 1990). Because of the risks involved developers, planners and engineers should not be obligated to use trip generation rates that are not sufficiently representative of the land use being considered. Therefore, the engineering community has an obligation to warrant detailed land use categories with

appropriate trip generation rates to make more appropriate planning decisions.

Research Scope and Objective

The principal objective of this research was to develop a data base on trip-generating characteristics of limited service/economy motels. The approach used by this study consisted of collecting driveway traffic volume counts and recording the appropriate independent variables for representative motel sites. From the above data base representative trip generation models will be derived to predict the number of trips being generated by this particular land use. Trip-generating characteristics of this type of motel will be compared to those given in the ITE *Trip Generation* manual for motels. The results will be representative trip generation rates and other travel characteristics that can be used by planners, engineers, and developers to evaluate the traffic impact assessment of such motels on the transportation system.

The study sought answers to the following questions:

1. What trip generation rates should be used for limited service/economy motels and how does this rate compare with the rate published by the Institute of Transportation Engineers for motels?

2. Does the peak hour of vehicle traffic generated at limited service/economy motels coincide with the street network peak hour?
3. What is the temporal distribution of trips made by this type of motel (time of day, day of week)?
4. Should trips per occupied room or trips per employee be used to predict trip-making for limited service/economy motels?
5. Do such factors as guest characteristics and proximity to other land uses affect trip-making characteristics of this type of motel?

A study of 16 representative limited service/economy motels on suburban and rural highway interchange locations of Tennessee was conducted to investigate these questions and provide assistance to users when estimating trip generation rates and evaluating traffic impacts of this type of motel.

CHAPTER II

LITERATURE REVIEW

Until recently traffic problems were principally associated with major urban areas across the United States. However, that is no longer the case. Suburban activity centers located outside urban areas are experiencing some of the worst traffic problems. People commuting from one suburb to another or just traveling within the suburb area may experience the same or worse traffic congestion as commuters traveling to the central business district (CBD). The costs of this increased traffic congestion include excessive vehicle operating cost, wasted personal time, higher accident rates, and stagnant or declining economic activity. In the last several decades the number of work trips to the CBD has decreased while the number of work trips to suburban locations increased. Suburban congestion has become a politicized concern in some communities where rapid new development is occurring. If present trend continues, the lack of suburban mobility may become the governing issue in the near future (Orski 1985).

The growing awareness of rapidly growing traffic levels and anticipated traffic impacts of new developments has led communities to create traffic ordinances. Development projects would be approved according to a variety of

conditions, such as "the ability to provide less parking, requirements to develop traffic mitigation plans, or meet specifically imposed standards for the amount of traffic to be generated (USDOT 1989)". Understanding the concept between transportation planning and land use will help local governments mitigate traffic congestion created by increasing land development.

Transportation and Land Use

Throughout history, transportation investments and land use changes have been interchangeable. Transportation investments are defended as economic necessities. Public transit facilities are supported as the key to economic strength in the inner cities while new freeways are advocated as the means for economic growth and development in the suburbs. Similarly, traffic congestion created by transportation system constraints is frequently cited as a source of urban deterioration (Hanson 1986). These transportation and land use conflicts can be resolved by proper transportation planning.

Transportation planning decisions are the subject of much controversy, particularly at the local government level. The goal in transportation planning is to provide for the efficient movement of people and goods between and among land uses. The goal in commercial land development is to obtain a functional and profitable project. These goals are

highly interrelated and in constant conflict. Transportation and land development are inextricably linked together. Land development cannot occur without transportation while transportation facilities cannot serve a justifiable purpose without land development. For example, the construction or modification of an arterial street provides greater accessibility of an area. Increased accessibility leads to greater development and higher traffic demands. Strip development along major arterials with poorly designed access creates numerous conflicting points that result in traffic delays, accidents, reduced capacity, and reduced levels of traffic service. The increased traffic demand must than be rectified by further roadway improvements, and a cycle of events occurs as illustrated in Figure 2.1. The model in Figure 2.1 shows that a change in land use will affect transportation, just as transportation affects land use.

Many forces influence the dynamics of land development such as changes in family income and personal preferences, but little can be done with these forces. However, transportation engineers and planners can play a major role in the mitigation process of land development particularly at the local level in the form of site planning and traffic impact assessments (Stover and Koepke 1988, Hanson 1986).

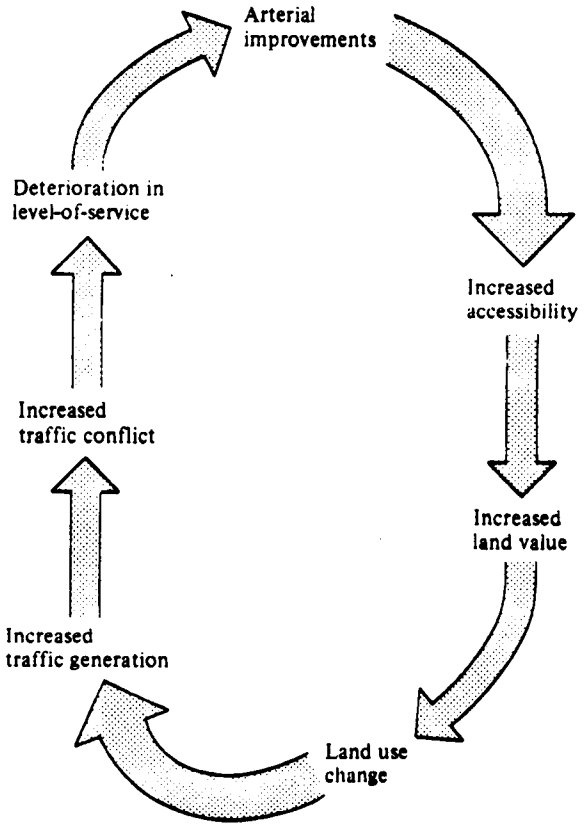

Figure 2.1. Transportation-land use cycle.

Source: Stover, Vergil G. and Frank J. Koepke, *Transportation and Land Development*. Institute of Transportation Engineers, 1988.

Site Planning and Traffic Impact Assessments

Site Planning "involves the analysis of the traffic impact of a specific proposed development, the adequacy of the access drives, and the suitability of the on-site circulation and parking (Stover and Koepke 1988)". Unlike the general urban transportation planning process, site planning is site-specific and micro-scale. The terminology used for the urban transportation planning process and for site planning is similar but the application and uses are different. Site planning analysis of specific proposed development requires more detailed methods and techniques than those of the comprehensive urban transportation planning process. Consequently, different analytical procedures are involved. A diagram showing the general framework for a site-specific analysis is shown in Figure 2.2.

Traffic impact analysis "is a specialized study of the impact a certain type and size of development will have on the surrounding transportation system (Stover and Koepke 1988)". It concerns the generation, distribution, and assignment of traffic to and from a proposed development. The traffic impact analysis seeks to determine what impacts newly generated traffic will have on the existing and proposed roadway system, and what impact the existing and proposed traffic on the roadway system will have on the proposed development (Stover and Koepke 1988).

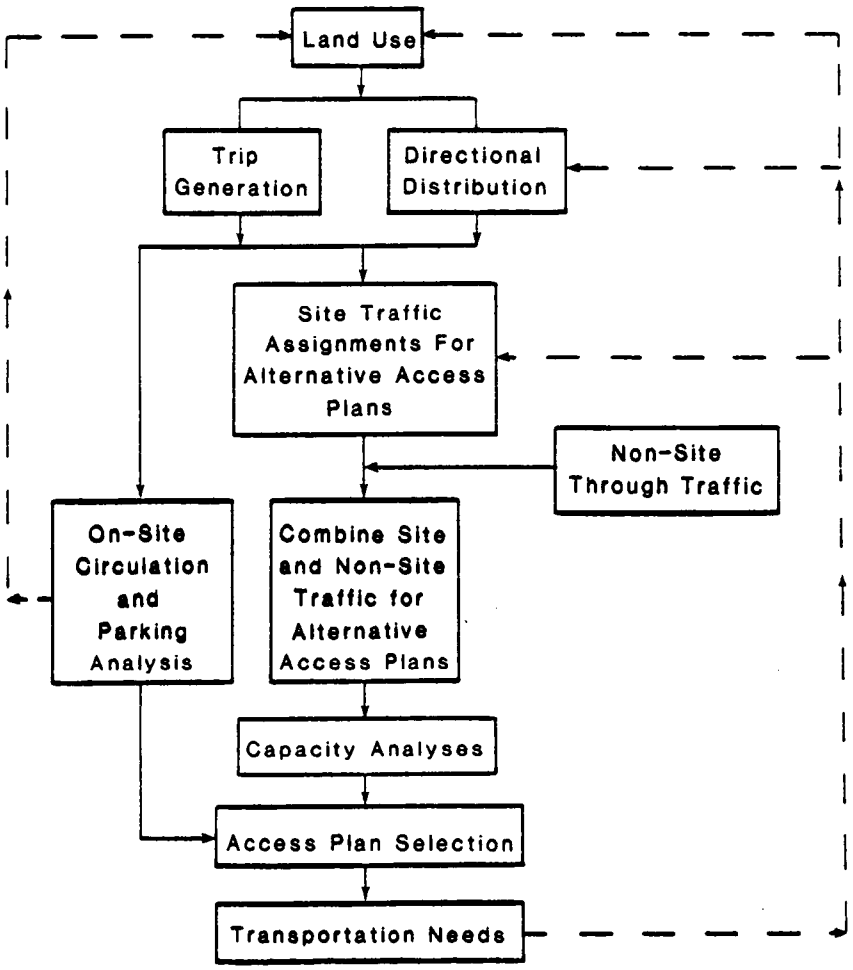

Figure 2.2. Site-traffic analysis: flow diagram.

Source: Stover, Vergil G. and Frank J. Koepke, *Transportation and Land Development*. Institute of Transportation Engineers, 1988.

Since every development is different, traffic impact studies will vary depending on the amount of traffic generated by the development and requirements of local traffic ordinances (Illinois Section of ITE 1992). An important question regarding transportation aspects of land development is: "When is a traffic impact study needed?" According to Boscher (1991) the following situations or thresholds commonly trigger a requirement for a traffic impact analysis:

1. When development will generate a specified number of peak hour trips.
2. When development will generate a specified number of daily trips.
3. When a specified amount of acreage is being rezoned.
4. When development contains a specified number of dwelling units or square footage.
5. At the judgment or discretion of staff.
6. When development will occur in a sensitive area.
7. When financial assessments are required and the extent of impact must be determined.

There is little consistency in specific threshold quantities for the criteria listed above. Each agency should provide their own quantitative threshold for requiring a traffic impact study based on local policies and conditions.

Suggested baseline criteria for a site traffic impact analysis for urban or suburban areas are contained in Table 2.1. Thresholds for small cities and rural areas may need to be lower than urban and suburban areas (Boscher 1991).

The specific contents of a traffic impact study will vary depending upon the site and prevailing conditions. The following are minimum suggested guidelines for a traffic impact study (Bochner 1991, Illinois Section of ITE 1992).

1. **Existing Conditions.** Existing background traffic conditions must be established.
2. **Non-Site Traffic Forecast.** Estimates of non-site traffic (without the subject site being developed) must be determined.
3. **Site Traffic Generation.** The amount of traffic to be generated by the proposed development must be estimated.
4. **Trip Distribution and Traffic Assignment.** Traffic expected to be generated by the proposed development must be distributed and assigned to the roadway system so that the impact of the new development on the existing roadway system can be analyzed.
5. **Analysis.** Capacity analysis should be performed at each of the major street and site access intersection locations within the study area.

Table 2.1.

Suggested Baseline Criteria for Traffic Impact Studies

Criteria	Suggested Threshold
Need for Study	Locally established criterion based on trip generation, development size, other development or area characteristic, or localized conditions. In lieu of another locally preferred criterion, development generation of 100 *added* vehicle trips in the peak direction (inbound or outbound) during the site's peak traffic hour is suggested.
Study Area Limits	All site access drives, adjacent roadways, and major intersections, plus the first signalized intersection in each direction from the site up to a distance determined locally. Additional areas may be added based on development size and specific site or local issues and policy

Source: Bochner, Brian S., Chairperson, *Traffic Access and Impact Studies for Site Development*. Institute of Transportation Engineers, 1991.

Level of service (LOS) of future traffic conditions must be compared to the LOS of the existing site.

6. **Traffic Improvements.** Alternative traffic improvements must be identified and evaluated.

Trip Generation

One of the most critical elements of traffic impact assessments is the estimating of the amount of traffic to be generated by a proposed land development. This is usually done by using trip generation rates or trip rate equations (Bochner 1991). Trip generation rates can be defined as "estimates of the number of vehicles or persons entering or leaving a particular site during a specified time period, usually a peak hour or a whole day (TRB 1990)." Trip generation rates are intended to be used by planners, traffic engineers, and city officials to estimate the number of vehicle trips likely to be generated by a particular land use.

As mentioned earlier the use of trip generation estimates is often the most important component of a traffic impact study. Costly transportation decisions can be significantly changed by using slightly different trip generation rates or equations. Using inappropriate trip generation rates can affect the outcome of a traffic impact study. Inappropriate estimates of traffic impacts lead to unnecessary community concerns and monetary consequences.

Trip generation rates and equations should therefore be determined carefully using available data and proper judgment (Bochner 1991). Elements that should be taken into consideration when selecting trip generation rates are presented below (Stover 1988, ITE 1991a, ITE 1991b).

1. **Age of data base.** The trip generation data base extends back to the early 1960's. It is important to use rates that are current to the market conditions of the development.
2. **Daily and seasonal variations.** Average weekday, Saturday, and Sunday trips are usually reported. Many land uses such as banks, shopping centers, and restaurants exhibit substantial daily variation which should be taken into account. In this case, the highest weekday, rather than the average weekday, trip rate should be used in the design or analysis period for those land uses. For some land uses seasonal variations are also important. For example, shopping centers should be analyzed for the period between Thanksgiving and Christmas, which is traditionally the busiest time of the year for shopping.
3. **Location variation.** Nearly all the data currently in the ITE manual were collected in suburban areas throughout the United States and Canada. Specific site conditions, such as proximity to the

development, the availability of transit, and walk-in traffic, can result in substantially different trip generation rates.

4. **Pass-by traffic.** It is usually assumed that all trips entering and exiting a new development are trips attributed to the new development. In some cases, such as fast food restaurants and gas stations, significant amount of traffic is attracted from traffic passing by on the way to one place to another on the adjacent street. Studies have shown that the percentage of trips drawn from traffic on the adjacent street system can range from 20 percent to as much as 70 percent. An average percentage of pass-by trips was found to be 72 percent of the total trips according to a study of convenient store trip generation (Ghezawi 1992).
5. **Mixed-use development.** Most trip generation rate data are derived from isolated individual developments. Trips being made internal to a mixed-use development would cause the total trip generation rate to be overestimated due to the internal trips being made among the on-site land uses.
6. **Vehicular trips.** Trip generation rates assume vehicular trips of average vehicle occupancy.

7. **Variability in rates.** There may be substantial variations in trip rates for similar development sites. This is indicated by observing the minimum and maximum rates.
8. **Sample size.** In some cases the sample size can be extremely small. Sometimes the resulting trip rates are based on one or two studies only. Extreme caution must be taken when using trip rates from these studies.

ITE *Trip Generation* Manual

A principal source for trip generation rates is the Institute of Transportation Engineers (ITE), *Trip Generation* manual. This document first published in 1976 and later updated in 1979, 1983, 1987, and 1991, provides planners and engineers with the number of vehicle trips likely to be generated for a wide variety of land uses. The 5th edition of the *Trip Generation* manual is based on more than 3,000 trip generation studies conducted by developers, consulting firms and public agencies and reported to the Institute of Transportation Engineers (ITE 1991a).

The ITE manual provides three methodologies to assist in determining the average number of trips generated by a land use (ITE 1991a):

1. Weighted average trip generation rate, or the number of weighted trip ends per one unit of the

independent variable (i.e., per employee or per 1000 square feet of gross floor area).

2. A plot of the actual trip ends versus the size of the independent variable for each study. The numbers represented on the plots are not trip generation rates; they are actual trip ends plotted against the size of an independent variable. Slightly different results may occur when using the plot as opposed to the rate.
3. Regression equation of trip ends related to the size of the independent variable. Slightly different results may occur when using the equation as opposed to the rate.

The ITE trip generation rates are based on independent variables such as number of employees and gross square footage. The choice of independent variable can be one of the most important decisions in predicting trip generation rates. Variables with the best correlation should be used. However, it is also important to check the size of the sample for each independent variable. The variable with the larger sample size should be chosen in the case of two variables with similar correlation coefficients. The minimum and maximum rates are provided to show the full range of the data. An approximation of the standard deviation for the weighted average trips is provided together with a plot of

the actual measured trip ends versus the size of the independent variable for each study.

The user is advised to examine the range of rates for the different time periods to define the relationship between the peak generation and the peaking of the adjacent street. For example, residential and general office development share the same peak periods as the adjacent street system. However, some land uses such as shopping centers, may not share the same peak periods. Thus, a shopping center may not have a considerable impact on the adjacent street system during the streets normal peak period. Therefore, the peak hour of the generator and the peak hour during the adjacent street peak hour must be analyzed to determine the design requirements (ITE 1991b).

Trip rates in the ITE *Trip Generation* manual are included for nine different time periods and include average rates as well as minimum and maximum rates. The trip rates for different time periods include the following (ITE 1991b):

1. **Average Weekday Vehicle Trip Ends.** The average one day of the total trips entering and exiting a site between Monday and Friday.
2. **Peak Hour of Adjacent Street Traffic.** The one-hour volume measured entering, exiting, or both between 7 and 9 a.m. and between 4 and 6 p.m. The total of the entering and exiting may not equal the total

because the rates for all three of these measurements may have been calculated from a different number of data sets.

3. **Peak Hour of Generator.** The one-hour volume measured entering, exiting, or both during the a.m. and p.m. peak of the site. For some land uses, such as residential and office, the peak hour of the generator would be the same as that of the adjacent street traffic. However, other land uses, such as retail centers, restaurants, and banks, the peak hour of the generators would occur at different times than the peak hour of the adjacent street traffic. The exact time of this hour is not indicated in the ITE manual and must be obtained from other sources.
4. **Saturday Vehicle Trip Ends.** The 24-hour volume of traffic entering and exiting a site on Saturday.
5. **Saturday Peak Hour of Generator.** The one-hour volume measured entering, exiting, or both on a Saturday. This hour could be in the a.m. or p.m. The exact time is not indicated in the ITE manual and must be provided from other sources, if needed.
6. **Sunday Vehicle Trip Ends.** The 24-hour volume measured entering and exiting a site on Sunday.
7. **Sunday Peak Hour of Generator.** The one-hour volume measured entering, exiting, or both on Sunday.

These data are presented similarly to the Saturday data.

Trip Generation for Motels Reported by the ITE Manual

Currently, the 5th edition of ITE *Trip Generation* manual serves as the primary source of information for establishing trip generation at motels (land use 320). The ITE manual, also, provides trip generation rates for the land use categories of hotels, all-suites hotels, and business hotels. The ITE publication defines these land uses as following (ITE 1991a):

1. **Hotel (Land Use 310).** A place of lodging providing sleeping accommodations, restaurants, cocktail lounges, meeting and banquet rooms or convention facilities, and other retail and service shops.
2. **All-Suites Hotel (Land Use 311).** A place of lodging which provides sleeping accommodations, a small restaurant and lounge, and a small amount of meeting space. Each suite includes a sitting room and separate bedroom; often limited kitchen facilities are provided within the suite.
3. **Business Hotel (Land Use 312).** A place of lodging aimed toward the business traveler. It provides sleeping accommodations and other limited facilities, such as breakfast buffet bar and an afternoon beverage bar.

4. **Motel (Land Use 320).** A place of lodging providing sleeping accommodations and often, a restaurant.

Interpretation or use of the current ITE manual could result in significant errors when predicting site generated traffic at motels. The ITE manual provides a land use category for motels including both limited service/economy motels and full-service motels. Full service motels are more expensive, larger and often provide restaurants, meeting facilities and other guest amenities. Limited service/economy motels are inexpensive, smaller and provide only sleeping rooms with limited guest amenities. Limited service/economy motels are usually located near interchanges or major intersections to capture the passing-by traveler. The markets of economy properties primarily include vacationing families and cost-conscious business travelers (Lattin 1989). Table 2.2. and 2.3 provide a summary of trip generation rates for motels reported by the ITE *Trip Generation* manual using the number of occupied rooms and the number of employees, respectively, as the independent variable. The ranges of rates are provided to show the full range of the data.

Trip Generation Study for "Budget-Style" Motels

A study reported by *ITE journal* was conducted by Ms. Sandra M. Woods of JHK & Associates concerning trip

Table 2.2.

Summary of ITE Trip Generation Rates per Occupied Room for Motels (Land Use 320)

Time Period	Weighted Average Trip Rate (trips/ occ.room)	Range of Rates (trips/ occ.room)	Average Number of Occupied Rooms	Number of Studies (n)
Weekday	10.19	4.7-14.6	123	13
Peak Hour of Adjacent Street of Traffic				
7-9 a.m.	0.66	0.41-1.18	134	18
4-6 p.m.	0.60	0.31-0.90	141	16
Peak Hour of Generator				
a.m.	0.73	0.41-1.33	117	18
p.m.	0.76	0.37-1.33	122	20
Saturday	8.84	4.72-12.57	141	11
Peak Hour of Generator	0.74	0.45-1.94	141	11
Sunday	7.39	3.81-11.81	141	11
Peak Hour of Generator	0.59	0.37-0.97	141	11

Source: *Trip Generation*. Fifth Edition. Institute of Transportation Engineers, 1991.

Table 2.3.

Summary of ITE Trip Generation Rates per Employee for Motels (Land Use 320)

Time Period	Weighted Average Trip Rate (trips/ employee)	Range of Rates (trips/ employee)	Average Number of Employees	Number of Studies (n)
Weekday	12.81	7.20-41.00	101	10
Peak Hour of Adjacent Street of Traffic				
7-9 a.m.	0.91	0.60-3.30	144	11
4-6 p.m.	0.73	0.40-3.00	173	8
Peak Hour of Generator				
a.m.	1.16	0.62-4.00	87	13
p.m.	1.24	0.48-4.00	87	13
Saturday	12.40	5.90-33.33	101	11
Peak Hour of Generator	1.04	0.48-5.00	101	11
Sunday	10.37	4.75-23.33	101	11
Peak Hour of Generator	0.83	0.38-3.33	101	11

Source: *Trip Generation*. Fifth Edition. Institute of Transportation Engineers, 1991.

generation for "budget-style" motels. Ms. Woods states that "budget-style" motels are "a major component of the motel/hotel industry (Woods 1987)" and should be acknowledged by ITE. According to the publication this type of motel provides inexpensive sleeping quarters with only limited amenities and the trip-generating characteristics of this type of motel differ from those of motels defined in the ITE *Trip Generation* manual.

A study of seven "budget-style" motels with no secondary facilities such as restaurants and meeting facilities were conducted in the Washington, D.C. Metro area. The study found that trip generation rates per occupied room for this type of motel were lower than the trip generation rates reported by the ITE publication. The study suggested trip rates for this type of land use are closely related to the minimum rates reported for motels in the ITE manual (Woods 1987). Table 2.4. provides a summary of the trip generation rates per occupied room developed in the study for "budget-style" motels. Trip generation rates per employee were not mentioned in the study.

Summary

Adverse traffic impacts created by continued development has been a major concern for communities with suburban traffic problems. Communities must make decisions between economic stimulation provided by new development and

Table 2.4.

Summary of Trip Generation Rates per Occupied Room for "Budget-Style" Motels.

Time Period	Weighted Average Trip Rate (trips/ occ.room)	Range of Rates (trips/ occ.room)	Average Number of Occupied Rooms	Number of Studies (n)
Weekday	5.23	4.42-7.40	131	7
Peak Hour of Adjacent Street of Traffic				
7-9 a.m.	0.40	0.32-0.57	131	7
4-6 p.m.	0.39	0.27-0.57	131	7
Peak Hour of Generator				
a.m.	0.40	0.32-0.57	131	7
p.m.	0.45	0.31-0.57	131	7
Saturday	3.17	2.92-3.42	130	2
Peak Hour of Generator	0.40	0.32-0.47	130	2
Sunday	3.25	2.83-3.67	130	2
Peak Hour of Generator	0.35	0.30-0.39	130	2

Source: Woods, Sandra M., *Trip Generation Rates: "Budget-Style" Motels*. Final Report, JHK and Associates, June 1986.

increasing traffic congestion. Local governments are requiring traffic impact assessments be made to insure that proposed new development will not over burden the existing transportation system. One of the most critical elements of traffic impact assessments is the estimating of the amount of traffic to be generated by a proposed land development. The *Trip Generation* manual published by ITE is the principal source of trip generation information of various types of land uses. However, some rapidly growing land uses such as limited service/economy motels are currently provided as part of the general motel category in the ITE manual. Interpretation and use of the current ITE rates could result in significant errors when estimating the amount of generated traffic of this type of motel. A limited study conducted by Ms. Sandra M. Woods of JHK and Associates reveal that trip-generating characteristics of economy motels differ substantially from the ITE motel category. Studies determining representative trip generation rates and other travel characteristics of limited service/economy motels are needed by planners, engineers, and developers to evaluate the traffic impact of such motels on the transportation system.

CHAPTER III

DATA COLLECTION AND ANALYSIS PROCEDURE

Sixteen limited service/economy motels were selected for developing a database on trip generation rates and trip characteristics of this type of motel. From this data base trip generation models were developed to predict the number of trips being generated by this unique land use. The methodology used for developing the trip generation models comprised of two distinct phases. First, measurements of traffic volumes on the driveways of each study site were taken. Second, independent variables were determined for each study site for the period when the traffic counts were taken. Trip generation models representing trip generation rates and equations were derived from the above data collected. Trip generation models were developed for each of the nine time periods defined by the ITE *Trip Generation* manual (ITE 1991a):

1. Weekday volumes
2. Weekday a.m. peak hour of generator
3. Weekday p.m. peak hour of generator
4. Weekday peak hour of adjacent street traffic, one hour between 7 and 9 a.m.
5. Weekday peak hour of adjacent street traffic, one hour between 4 and 6 p.m.

6. Saturday volumes
7. Saturday peak hour of generator
8. Sunday volumes
9. Sunday peak hour of generator

It is important to note that weekend time period data was limited to only five studies.

A questionnaire study was also conducted to evaluate variations in trip rates for similar motel sites. The questionnaire study procedure and results are presented in Chapter V. The following sections describe the trip generation data collection and analysis procedures.

Site Selection

Sixteen limited service/economy motels at highway interchange locations in Tennessee were selected for the trip generation survey. The limited service/economy motels surveyed in this study are moderate sized chain operations offering sleeping accommodations only. No secondary facilities such as restaurants, lounges and meeting facilities are present at any site. All of the motels are conveniently located off the interchanges of three major interstate highways (I-75, I-40, and I-24). Eight of the motels studied are located in active suburban areas of three large cities; Nashville, Knoxville, and Chattanooga. The remaining eight motels are located on developed interchange

locations in medium size cities primarily attempting to attract passing travelers from the interstate highways. Table 3.1 provides a list of the study sites with the respective number of rentable rooms and driveways.

The motels were selected based on cooperation by the management of these establishments. All the motels studied are open 24 hours a day and seven days a week. The sites were also selected based on the following criteria.

1. Separate buildings
2. Isolated parking lots
3. No secondary facilities
4. No more than three ingress/egress points

It was important that the data collection procedures be conducted during the busiest time of the year for motels in order for the results to be applicable for a traffic impact study. Thus, the procedures were conducted during the Summer months of 1992, which is traditionally the busiest time of the year for motels. The data collection effort consisted of the following tasks:

1. A field observation of each site was made to determine specific characteristics such as the number, location and width of driveways; the number of rentable rooms; characteristics of vehicles entering and exiting motel driveways; and proximity to other generators such as restaurants.

Table 3.1

List of Motel Study Sites

Motel Number	Property	Number of Rentable Rooms	Number of Driveways
1	Econo Lodge, Cleveland TN	84	1
2	Days Inn, Cleveland TN	58	2
3	Best Western, Cleveland TN	52	3
4	Econo Lodge, Chattanooga TN	61	2
5	Days Inn, Chattanooga TN	82	1
6	Best Western, Chattanooga TN	54	1
7	Days Inn, Athens TN	55	1
8	Howard Johnson, Athens TN	58	1
9	Days Inn, Manchester TN	54	1
10	Hampton Inn, Manchester TN	51	2
11	Days Inn, Nashville TN	70	1
12	Econo Lodge, Knoxville TN	112	1
13	Econo Lodge, Lenoir City TN	42	1
14	Comfort Inn, Knoxville TN	61	1
15	Days Inn, Knoxville TN	120	1
16	Hampton Inn, Knoxville TN	68	1
	Average	68	

2. 24-hour weekday traffic counts, using automatic counters, were conducted at driveway entrance and exit locations for each site.
3. 24-hour Saturday and Sunday traffic counts, again using automatic counters, were conducted at driveway locations for five individual sites
4. The number of occupied rooms and the number of employees for each site were recorded for the period when the traffic counts were taken.

Driveway Traffic Volume Collection and Analysis

For any traffic and transportation planning studies information on traffic volumes is generally the primary and most important data collection procedure. There are several methods of collecting traffic volume data. Manual traffic counts are most useful when collecting data for relatively short durations such as a two hour peak period. Because of the large amount of secondary data that may be obtained such as vehicle types, occupancy, direction and turning movements, manual traffic counts are often preferred to mechanical means of counting.

For counts that are needed for extended periods of time such as 24-hour data for calculation of average daily traffic volumes, an automatic traffic counter is usually preferred. Automatic traffic counters usually utilize a rubber road tube stretched across the width of the roadway

or driveway. As vehicle wheels pass over the flexible tube, pneumatic pulses of air close electrical circuits. The counts register one vehicle for each passage of two axles, thus these volume counts can be subject to error. Over counting errors may occur when multi-axle vehicles drive over the tubes or when vehicles approach the tubes at an angle, causing the vehicles to be registered twice. Under counting errors may occur when two vehicles pass over the tubes simultaneously in adjacent lanes causing the two vehicles to be registered only once (ITE 1982).

Site Specific 24-Hour Counts

For this study it was necessary to obtain the number of daily trips generated per motel for a 24-hour period. In addition, traffic volume counts must be collected for each of the nine design time periods defined by the ITE manual to develop and compare the desired trip generation models. Automatic traffic counters were used to collect the traffic volume data at driveways for each individual site. To minimize counting errors, manual counts were taken for two 15-minute intervals to calibrate and correct machine count data. In rare events such as moisture entering the tube chamber, traffic counts for that particular motel were re-counted. The counts were recorded and tabulated using Traffic Analysis Software (TAS). A summary of the weekday driveway volume counts for each of the 16 individual study

sites is presented in Table 3.2. A summary of the weekend driveway volume counts for five individual study sites are presented in Table 3.3.

Peak Hour Analysis

When conducting a traffic impact assessment for a proposed new development it is necessary to know the peak hours of traffic of the representative land use to determine design requirements. The ITE *Trip Generation* manual states that "motel traffic generally peaks at times other than when the adjacent street traffic peaks (ITE 1991a)." Thus, a motel may not have a considerable impact on the adjacent street system during the streets normal peak period. Peak hour analysis of motel traffic for the study sites was performed to determine if this is true for limited service/economy motels.

Individual Study Sites

Peak hours of the generator (peak hours of motel traffic) for each individual site were analyzed to determine peak hour trends of motel traffic. Table 3.4 provides a summary of the morning and evening peak hours of business for each motel surveyed. The table indicates that, of 16 motel locations, seven have a morning peak hour of the generator between 7 and 9 a.m. Eight of the motels have

Table 3.2.

Driveway Vehicular Volume Counts: Weekday Time Periods

	Driveway Vehicular Counts				
Motel Number	24-Hour	A.M. Peak Hour of Generator	P.M. Peak Hour of Generator	A.M. Peak Hour of Adjacent Street (7am-9am)	P.M. Peak Hour of Adjacent Street (4pm-6pm)
1	478	40	60	15	45
2	338	18	43	12	25
3	218	16	28	11	21
4	379	29	38	29	38
5	572	26	71	22	33
6	459	33	51	21	25
7	305	16	39	15	28
8	164	14	22	11	11
9	442	33	40	33	28
10	279	20	32	20	24
11	548	38	50	31	28
12	557	39	69	30	30
13	236	17	33	13	30
14	585	48	60	48	33
15	624	31	70	25	45
16	507	37	51	37	33

Table 3.3.

Driveway Vehicular Volume Counts: Weekend Time Periods

		Driveway Vehicular Counts	
Time Period	Motel Number	24-Hour	Peak Hour of Generator
Saturday	1	427	52
	3	349	23
	14	429	46
	15	636	67
	16	546	63
Sunday	1	249	27
	3	162	18
	14	383	52
	15	352	45
	16	416	57

Table 3.4.

Summary of Peak Hour of Generator (Motel Traffic) Times

Motel Number	Property	A.M. Peak Hour	P.M. Peak Hour
1	Econo Lodge, Cleveland TN	11:00-12:00	7:30-8:30
2	Days Inn, Cleveland TN	8:45-9:45	6:00-7:00
3	Best Western, Cleveland TN	6:15-7:15	6:00-7:00
4	Econo Lodge, Chattanooga TN	8:00-9:00	5:00-6:00
5	Days Inn, Chattanooga TN	9:15-10:15	10:15-11:15
6	Best Western, Chattanooga TN	10:45-11:45	8:15-9:15
7	Days Inn, Athens TN	8:15-9:15	6:00-7:00
8	Howard Johnson, Athens TN	10:15-11:15	2:15-3:15
9	Days Inn, Manchester TN	7:15-8:15	5:45-6:45
10	Hampton Inn, Manchester TN	8:00-9:00	6:15-7:15
11	Days Inn, Nashville TN	9:15-10:15	6:00-7:00
12	Econo Lodge, Knoxville TN	11:00-12:00	7:30-8:30
13	Econo Lodge, Lenoir City TN	10:45-11:45	7:00-8:00
14	Comfort Inn, Knoxville TN	8:00-9:00	8:30-9:30
15	Days Inn, Knoxville TN	10:30-11:30	8:30-9:30
16	Hampton Inn, Knoxville TN	8:00-9:00	7:45-8:45

morning peaks between 9 a.m. and 12 noon. The remaining motel has a morning peak starting at 6:15 a.m.

Only one motel has an evening peak hour of the generator between 4 and 6 p.m. Fourteen of the motels have evening peaks varying between 6 p.m. and 12 midnight. The remaining motel has a peak hour starting at 2:15 p.m. Peak hour analysis of the individual sites surveyed indicate that the a.m. and the p.m. peak hours of the generator are too varied to draw any conclusions.

Composite Temporal Distribution of Trips

A composite temporal distribution of trips for the 16 sites surveyed is provided to give further insight on the peak hours of motel traffic. Figure 3.1 shows the volumes, expressed as a percentage of the total daily volume, occurring during each hour of the day for an average weekday. The figure shows a traffic distribution slightly different from normal street traffic distributions. Normal street traffic distributions have two peaks, one in the morning between 7 and 9 a.m. and the other during the afternooon between 4 and 6 p.m. The figure shows two peaks, one in the morning between 8 and 9 a.m. and the other during the evening between 6 and 9 p.m. It is fair to assume from the figure that a majority of the a.m. peak period of motel traffic will coincide with the street network peak hour but

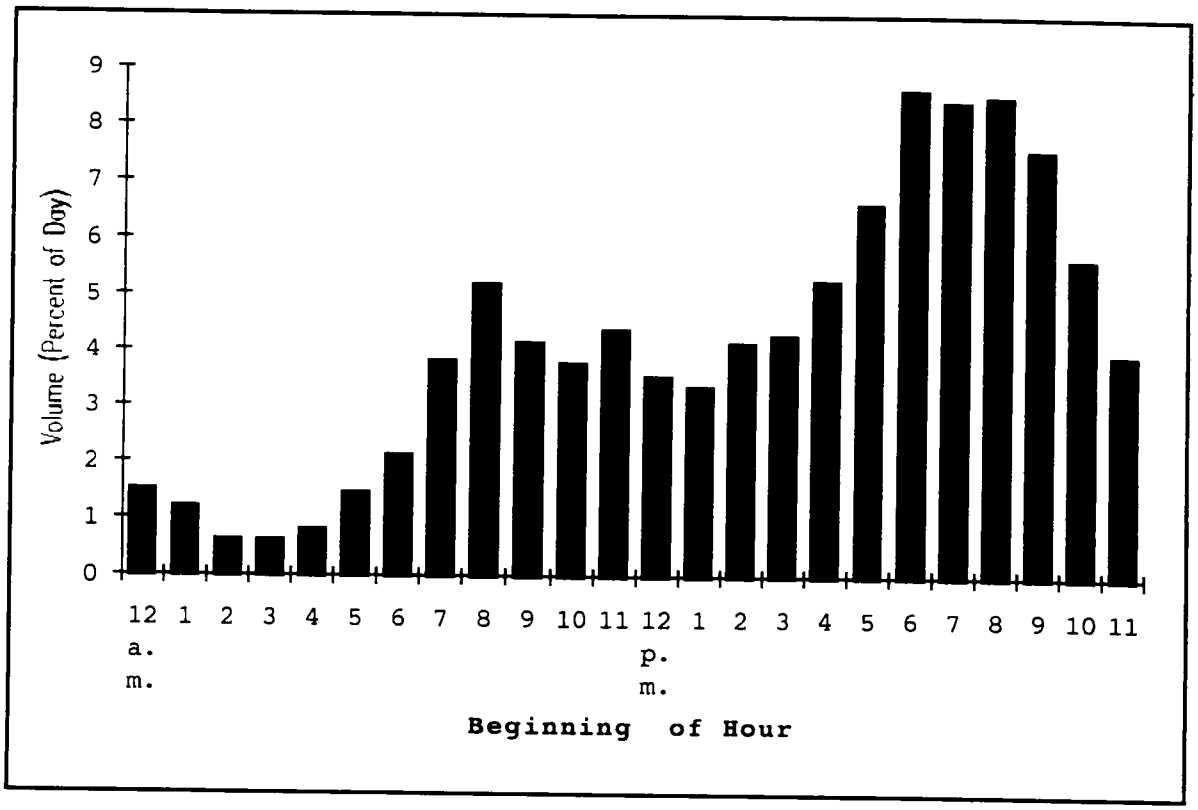

Figure 3.1. Composite temporal distribution of trips for an average weekday (n=16).

the p.m. peak period of motel traffic does not peak at the same time as the adjacent street traffic.

The magnitude of trip making for Saturday and Sunday is shown in Figure 3.2 and 3.3, respectively. Both figures show traffic distributions slightly different when compared to the weekday traffic distribution figure by showing a greater distribution of trips between 11 a.m. and 1 a.m. Fridays and Saturday evenings are the busiest time of the week for a motel and this is reflected in the weekend traffic distribution figures.

Independent Variables

Trip generation rates are based on independent variables. An independent variable is "a physical, measurable, or predictable unit describing the study site or generator (e.g. floor area, dwelling units, seats) (ITE 1991a)". Independent variables must be established and determined before trip rates can be developed. The ITE *Trip Generation* manual relies on the total number of occupied rooms and the number of employees of a motel as an indicator of its trip-generating potential. Other factors such as floor area, average daily traffic (ADT) and competing facilities are not as accurate or are harder to readily quantify.

The number of occupied rooms and the number of employees are used as the independent variable in this

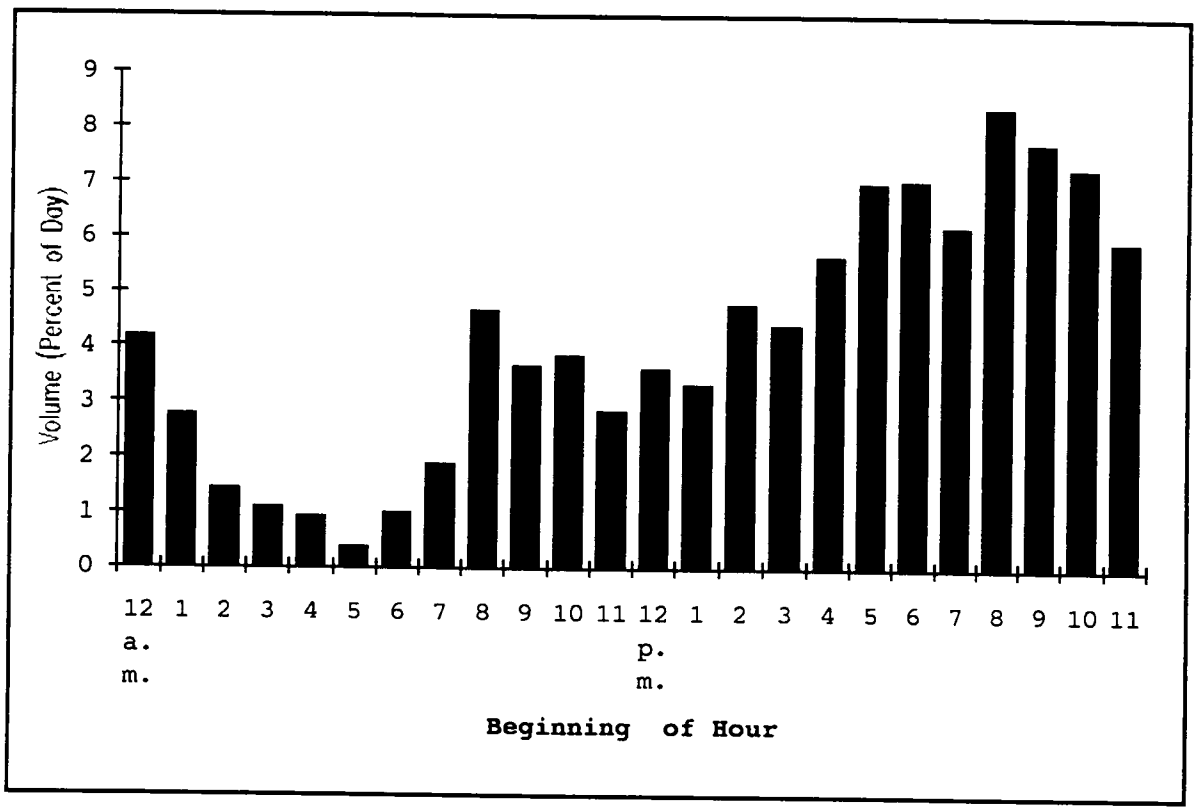

Figure 3.2. Composite temporal distribution of trips for an average Saturday (n=5).

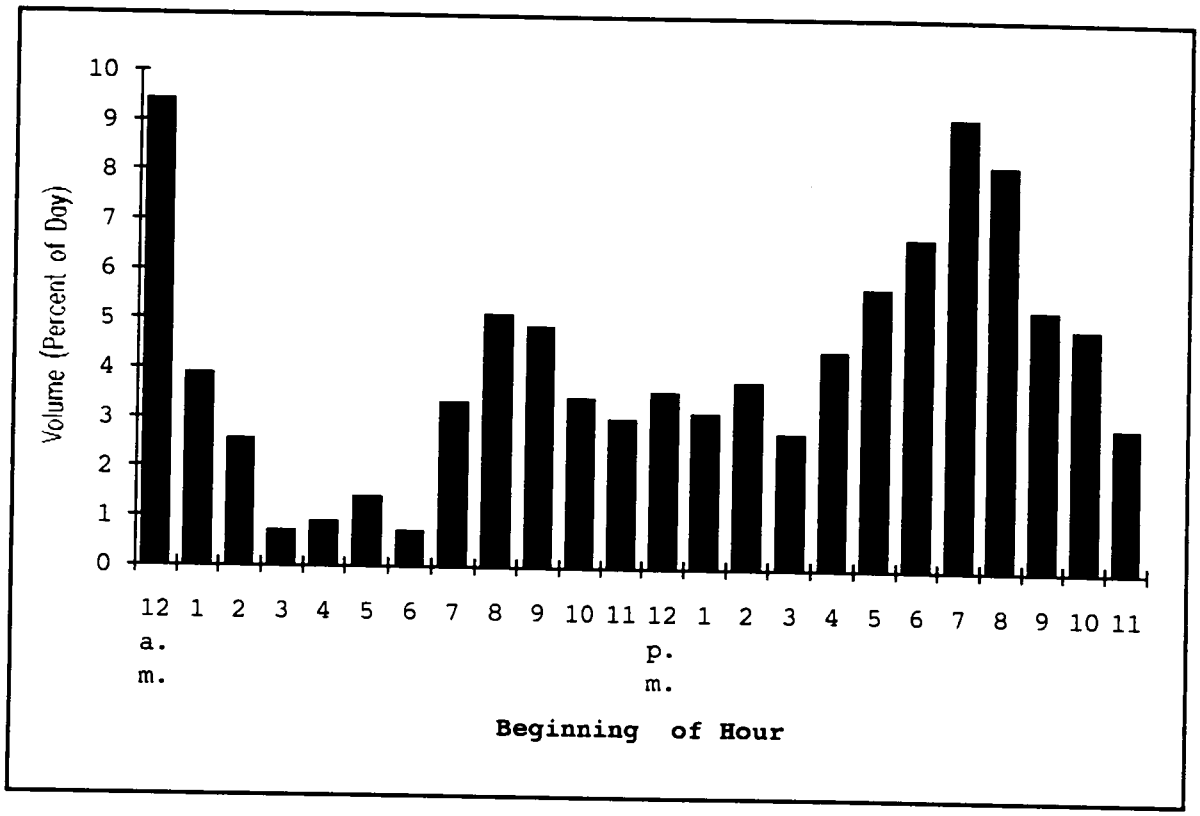

Figure 3.3. Composite temporal distribution of trips for an average Sunday (n=5).

in order to compare the results found in this study with those given in the ITE manual. The number of occupied rooms were recorded for each study site during the period when the driveway vehicular traffic counts were taken. It should be noted that occupancy would have to be high in order for the results to be applicable for a traffic impact study. Data collected should be representative of the normal volumes when the motels are fully utilized. An average of 90 percent of the rooms were occupied during the 16 motel weekday driveway counts, 100 percent of the rooms were occupied during the Saturday traffic counts while 72 percent of the rooms were occupied during the Sunday traffic counts. The number of employees for each site were determined based on the total number of employees on payroll. The methodology used to determine the number of employees is not defined in the ITE manual. Table 3.5 and Table 3.6 lists the independent variables and the representative sites for the weekday and weekend trip generation analysis, respectively.

Trip Generation Model Analysis

A major objective of this study was to establish a relationship between the number of vehicular trip ends to the appropriate independent variable to predict the amount of traffic to be generated by this type of motel. The trip generation models developed in this study will predict site

Table 3.5.

Summary of Independent Variables for Weekday Trip Generation Analysis

Motel Number	Property	Number of Occupied Rooms	Number of Employees
1	Econo Lodge, Cleveland TN	84	14
2	Days Inn, Cleveland TN	50	12
3	Best Western, Cleveland TN	30	9
4	Econo Lodge, Chattanooga TN	61	13
5	Days Inn, Chattanooga TN	82	15
6	Best Western, Chattanooga TN	54	13
7	Days Inn, Athens TN	36	11
8	Howard Johnson, Athens TN	20	9
9	Days Inn, Manchester TN	54	12
10	Hampton Inn, Manchester TN	51	9
11	Days Inn, Nashville TN	70	14
12	Econo Lodge, Knoxville TN	91	17
13	Econo Lodge, Lenoir City TN	38	7
14	Comfort Inn, Knoxville TN	61	14
15	Days Inn, Knoxville TN	120	19
16	Hampton Inn, Knoxville TN	68	15
	Average	61	13

Table 3.6.

Summary of Independent Variables for Weekend Trip Generation Analysis

Time Period	Motel Number	Number of Occupied Rooms	Number of Employees
Saturday	1	84	14
	3	52	9
	14	61	14
	15	120	19
	16	68	15
	Average	77	14
Sunday	1	45	14
	3	27	9
	14	54	14
	15	86	19
	16	64	15
	Average	55	14

generated traffic volumes for limited service/economy motels using the number of occupied rooms and the number of employees as independent variables. The trip generation models will be represented by both average trip generation rates and equations.

Average Trip Generation Rates

Average trip generation rates for limited service/ economy motels were developed based on the weighted average number of vehicle trips per unit of independent variable using a site's driveway. The weighted average trip generation rate is calculated by summing all trip ends and all independent variable units where paired data are available. The sum of the trip ends is divided by the sum of the independent variable units. The ITE manual uses the weighted average rate rather than the average of the individual rates because of the variance within each data set or generating unit (ITE 1991a). Use of trip generation rates assumes a linear relationship between trip ends and the independent variable. Non-linear relationships between the two variables are described by trip generation equations.

Trip Generation Equations

In addition to trip generation rates, trip generation regression equations, accompanying data plots, and

coefficient of determination (R^2) values were used in this study. Regression analysis was conducted to determine the correlation between the dependent variable and the appropriate independent variable. The dependent variable was defined as the number of vehicle trip ends for each design time period. The independent variables were defined as the number of occupied rooms and employees. Trip rates provide a linear relationship between the number of trips and the independent variable, while trip generation regression equations provide the optimal mathematical relationship between the two variables. STATGRAPHICS software was used to develop the trip generation equations and determine which regression model (linear, multiplicative, exponential, and reciprocal) had the highest R^2 value (STATGRAPHICS 1992). The coefficient of determination (R^2) is the percentage of the variance in the size of the independent variable. As the R^2 value approaches 1, the better the relationship between the number of trips and size of the independent variable. If the linear model was not the model with the highest R^2 value, but its R^2 value was only slightly lower (no more than 0.05) than the linear model was chosen (ITE 1991a). The trip generation regression models will allow the user to predict the average number of trips being generated by limited service/economy motels in terms of the number of occupied rooms and employees.

Summary

Sixteen representative limited service/economy motels were selected for developing a database on trip-generating characteristics of this type of motel. The approach used by this study consisted of collecting driveway traffic volume counts and recording the number of occupied rooms and employees for each representative motel site. Trip generation models representing trip generation rates and equations were derived from the above data. Peak hour analysis indicated that the a.m. peak hour of traffic generated at limited service/economy motels coincides with the street network peak hour but the p.m. peak hour of motel traffic does not peak at the same time as the adjacent street traffic. The analysis indicated a p.m. peak hour of motel traffic between 6 p.m. and 9 p.m. for this type of motel.

CHAPTER IV

RESULTS

Results of the trip generation model analysis using the number of vehicle trip ends as the dependent variable and the number of occupied rooms and employees as the independent variables are presented in the following sections. These models can be used by engineers and planners to predict the amount of site generated traffic for evaluating traffic impact assessments for limited service/ economy motels. Trip generation models representing both trip generation rates and equations were developed for each of the nine design time periods defined by the ITE *Trip Generation* manual (ITE 1991a):

1. Weekday volumes
2. Weekday a.m. peak hour of generator
3. Weekday p.m. peak hour of generator
4. Weekday peak hour of adjacent street traffic, one hour between 7 and 9 a.m.
5. Weekday peak hour of adjacent street traffic, one hour between 4 and 6 p.m.
6. Saturday volumes
7. Saturday peak hour of generator
8. Sunday volumes
9. Sunday peak hour of generator

Trip Generation Rates

Trip generation rates for limited service/economy motels were developed based on the weighted average trip rates. As previously discussed, the analysis utilized both occupied rooms and employees as the independent variable for comparison purposes with the ITE rates. Table 4.1 summarize the weighted average trip generation rates per occupied room for each of the nine design time periods. Table 4.2 summarize the weighted average trip generation rates per employee for the design time periods. Appendix A provides tables containing trip generation rates per occupied room and employee for each individual site.

As would be expected, the results of the trip generation analysis of limited service/economy motels differ from those reported by the ITE *Trip Generation* publication for motels. Table 4.3 compares trip generation rates per occupied room for limited service/economy motels with those reported for motels in the ITE *Trip Generation* manual and those developed by Ms. Woods in her study titled *Trip Generation Study: "Budget Style" Motels*. As noted in Table 4.3 the observed trip generation rates per occupied room are lower than those reported by the ITE manual and somewhat more conservative than those reported by Ms. Woods. The study found an average trip rate for the weekday time period of 6.88 trip ends per occupied room, while the corresponding ITE rate and Ms. Woods' rate are 10.20 and 5.23 trips per

Table 4.1.

Summary of Observed Average Trip Generation Rates per Occupied Room Per Day

Time Period	Weighted Average Trip Rate (trips/ occ.room)	Range of Rates (trips/ occ.room)	Average Number of Occupied Rooms	Number of Studies (n)
Weekday	6.88	5.20-9.59	61	16
Peak Hour of Adjacent Street of Traffic				
7-9 a.m.	0.38	0.18-0.79	61	16
4-6 p.m.	0.49	0.33-0.79	61	16
Peak Hour of Generator				
a.m.	0.45	0.24-0.79	61	16
p.m.	0.78	0.58-1.10	61	16
Saturday	6.20	5.08-8.03	77	5
Peak Hour of Generator	0.65	0.44-0.93	77	5
Sunday	5.66	4.09-7.09	55	5
Peak Hour of Generator	0.72	0.52-0.96	55	5

Table 4.2.

Summary of Observed Average Trip Generation Rates per Employee Per Day

Time Period	Weighted Average Trip Rate (trips/ employee)	Range of Rates (trips/ employee)	Average Number of Employees	Number of Studies (n)
Weekday	32.96	18.22-41.79	13	16
Peak Hour of adjacent Street of Traffic				
7-9 a.m.	2.14	1.43-3.43	13	16
4-6 p.m.	3.73	2.44-4.73	13	16
Peak Hour of Generator				
a.m.	1.84	1.07-3.43	13	16
p.m.	2.35	1.22-4.29	13	16
Saturday	33.62	30.50-38.78	14	5
Peak Hour of Generator	3.54	2.56-4.20	14	5
Sunday	22.00	17.79-27.73	14	5
Peak Hour of Generator	2.80	1.93-3.80	14	5

Table 4.3.

Comparison of Observed Trip Generation Rates per Occupied Room with ITE Rates and Ms. Woods' Rates

Time Period	Weighted Average Rate (trips/occ.room)			Range of Rates (trips/occ.room)			Average Number of Occupied Rooms			Number of Studies (n)		
	Study	ITE	Woods	Study	ITE	Woods	Study	ITE	Woods	Study	ITE	Woods
Weekday	6.88	10.19	5.23	5.2-9.6	4.7-14.6	4.4-7.4	61	123	131	16	13	7
Peak Hour of Adjacent Street of Traffic												
7-9 a.m.	0.38	0.66	0.40	0.2-0.8	0.4-1.2	0.3-0.6	61	134	131	16	18	7
4-6 p.m.	0.49	0.60	0.39	0.3-0.8	0.3-0.9	0.3-0.6	61	141	131	16	16	7
Peak Hour of Generator												
a.m.	0.45	0.73	0.40	0.2-0.8	0.4-1.3	0.3-0.6	61	117	131	16	18	7
p.m.	0.78	0.76	0.45	0.6-1.1	0.4-1.3	0.3-0.6	61	122	131	16	20	7

Table 4.3.

(Continued)

Time Period	Weighted Average Rate (trips/occ.room)			Range of Rates (trips/occ.room)			Average Number of Occupied Rooms			Number of Studies (n)		
	Study	ITE	Woods	Study	ITE	Woods	Study	ITE	Woods	Study	ITE	Woods
Saturday	6.20	8.84	3.17	5.1-8.0	4.7-12.6	2.9-3.4	77	141	130	5	11	2
Peak Hour of Generator	0.65	0.74	0.40	0.4-0.9	0.5-1.9	0.3-0.5	77	141	130	5	11	2
Sunday	5.66	7.39	3.25	4.1-7.1	3.8-11.8	2.8-3.7	55	141	130	5	11	2
Peak Hour of Generator	0.72	0.59	0.35	0.5-1.0	0.4-1.0	0.3-0.4	55	141	130	5	11	2

Sources: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

Woods, Sandra M., *Trip Generation Study: "Budget Style" Motels*. Final Report, JHK and Associates, June 1986.

occupied room, respectively. The observed trip generation rate per occupied room will yield a much lower number of trip ends than the ITE trip generation rate. For example, a 68 room limited service/economy motel (average size motel for the study) when fully occupied would expect to generate a total of 453 trip ends per average weekday according to the study trip rate, while the same motel according to the ITE trip rate would expect to generate a total of 693 trip ends per average weekday. Inappropriately using the ITE method results in a 48 percent overestimation of traffic. According to Ms. Woods' trip rate on budget motels the 68 room motel would expect to generate a less conservative 356 trip ends per average weekday.

Ms. Woods' research found budget motels with its limited facilities will have less traffic impacts than motels reported by the ITE *Trip Generation* manual. The study also indicated that ITE trip generation values near the minimum are more applicable than the average or maximum values, for this type of motel (Woods 1987). Ms. Woods' study on budget motels supports the results found in this study. This comparison of trip generation results on occupied room basis indicated that limited service/economy motels will generate fewer trips than motels defined in the ITE manual and subsequently will have lower traffic impacts.

Table 4.4 compares average trip generation rates per employee for limited service/economy motels with those

Table 4.4.

Comparison of Observed Trip Generation Rates per Employee with ITE Rates

Time Period	Weighted Average Rate (trips/ employee)		Range of Rates (trips/employee)		Average Number of Employees		Number of Studies (n)	
	Study	ITE	Study	ITE	Study	ITE	Study	ITE
Weekday	32.96	12.81	18.2-41.8	7.2-41.0	13	101	16	10
Peak Hour of Adjacent Street of Traffic								
7-9 a.m.	2.14	0.91	1.4-3.4	0.6-3.3	13	144	16	11
4-6 p.m.	3.73	0.73	2.4-4.7	0.4-3.0	13	173	16	8
Peak Hour of Generator								
a.m.	1.84	1.16	1.1-3.4	0.6-4.0	13	87	16	13
p.m.	2.35	1.24	1.2-4.3	0.5-4.0	13	87	16	13

Table 4.4.

(Continued)

Time Period	Weighted Average Rate (trips/ employee)		Range of Rates (trips/employee)		Average Number of Employees		Number of Studies (n)	
	Study	ITE	Study	ITE	Study	ITE	Study	ITE
Saturday	33.62	12.40	30.5-38.8	5.9-3.3	14	101	5	11
Peak Hour of Generator	3.54	1.04	2.6-4.2	0.5-5.0	14	101	5	11
Sunday	22.00	10.37	17.8-27.7	4.8-23.3	14	101	5	11
Peak Hour of Generator	2.80	0.83	1.9-3.8	0.4-3.3	14	101	5	11

Source: *Trip Generation*, Fifth Edition, Institute of Transportation Engineers, 1991.

reported for motels in the ITE *Trip Generation* manual. The study found an average trip rate for a weekday of 32.96 trips per employee, while the corresponding ITE rate is 12.81 trips per employee. The observed trip generation rates per employee will yield a much higher number of trip ends than the ITE trip rate. According to the observed trip rate a limited service/economy motel with 13 employees (average number of employees in the study) would expect to generate a total of 429 trip ends per average weekday, while the same motel with the same number of employees would generate a total of 167 trip ends per average weekday according to the ITE rate. This represents a 61 percent underestimation of traffic.

As noted in Table 4.4 ITE trip rates per employee near the minimum are more applicable than the average or maximum values for this type of motel. Using the average ITE rate per employee could result in significant errors when estimating the amount of site generated traffic for limited service/economy motels. This is primarily due to low employment densities for limited service motels. The ITE report gives an average employment density of 0.44 employees per room for motels with a range of 0.14 to 0.58 (ITE 1991a). The observed employment density is 0.19 employees per room with a range of 0.16 to 0.22. Employment densities for this type of land use are closely related to the minimum rates reported for motels in the ITE manual. The higher

observed trip rates on the number of employee basis appear to be the product of lower employee densities for this type of motel rather than higher business activity.

Trip Generation Equations

Along with trip generation rates, trip generation regression equations were developed using STATGRAPHICS software utilizing occupied rooms and employees as the independent variable. Trip generation regression equations provide the optimal mathematical relationship between the number of trip ends and the independent variable. Diagrams showing plots of the actual observed number of trips versus the independent variable and representative regression curves for each design time period are presented in the following sections. For comparison purposes the diagrams provide trip generation regression curves and representative equations for motels presented in the ITE *Trip Generation* manual. Representative number of studies (n) and R^2 values are also presented for both research efforts.

Average Weekday

The dependent variable used in developing this model was the total vehicle trip ends measured entering and exiting a site for a 24-hour period on an average weekday. Figure 4.1 shows the diagram of the average weekday trip generation model using the number of occupied rooms for the

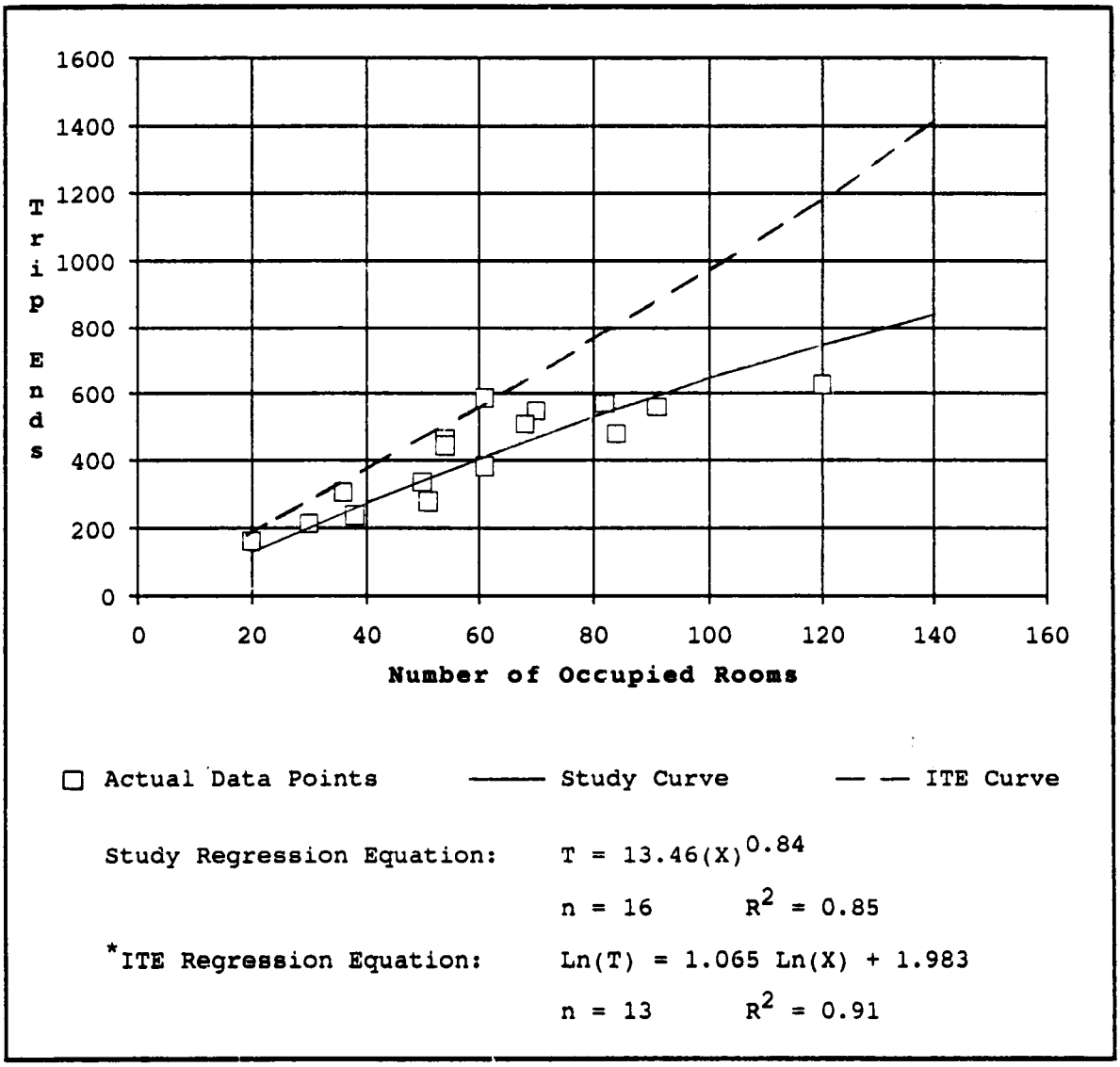

Figure 4.1. Plot of the number of trip ends on a weekday versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

24-hour period as the independent variable. As can be seen on the graph, there is a significant correlation based on regression analysis between the number of occupied rooms and the average vehicle trip ends (R^2=0.85). This means 85 percent of the variance in the number of trips is accounted for by the variance in the size of the independent variable (ITE 1991a).

As shown in the Figure 4.1 the observed trip generation model will yield a much lower number of trip ends than the ITE trip generation model. For example, a 68 room limited service/economy motel (average size motel for this study) when fully occupied would expect to generate a total of 466 trip ends per average weekday according to the study model, while the same motel according to the ITE model would expect to generate a total of 650 trip ends per average weekday. This represents a 40 percent overestimation of traffic.

Similarly, Figure 4.2 shows the relationship between average vehicle trip ends and the number of employees. Again, there is significant correlation based on regression analysis between the two variables (R^2=0.84). According to this regression model a limited service/economy motel with 13 employees (average number of employees in this study) would expect to generate a total of 421 trip ends per average weekday, while the same motel with the same number of employees would generate a total of 322 trip ends per average weekday according to the ITE model. As previously

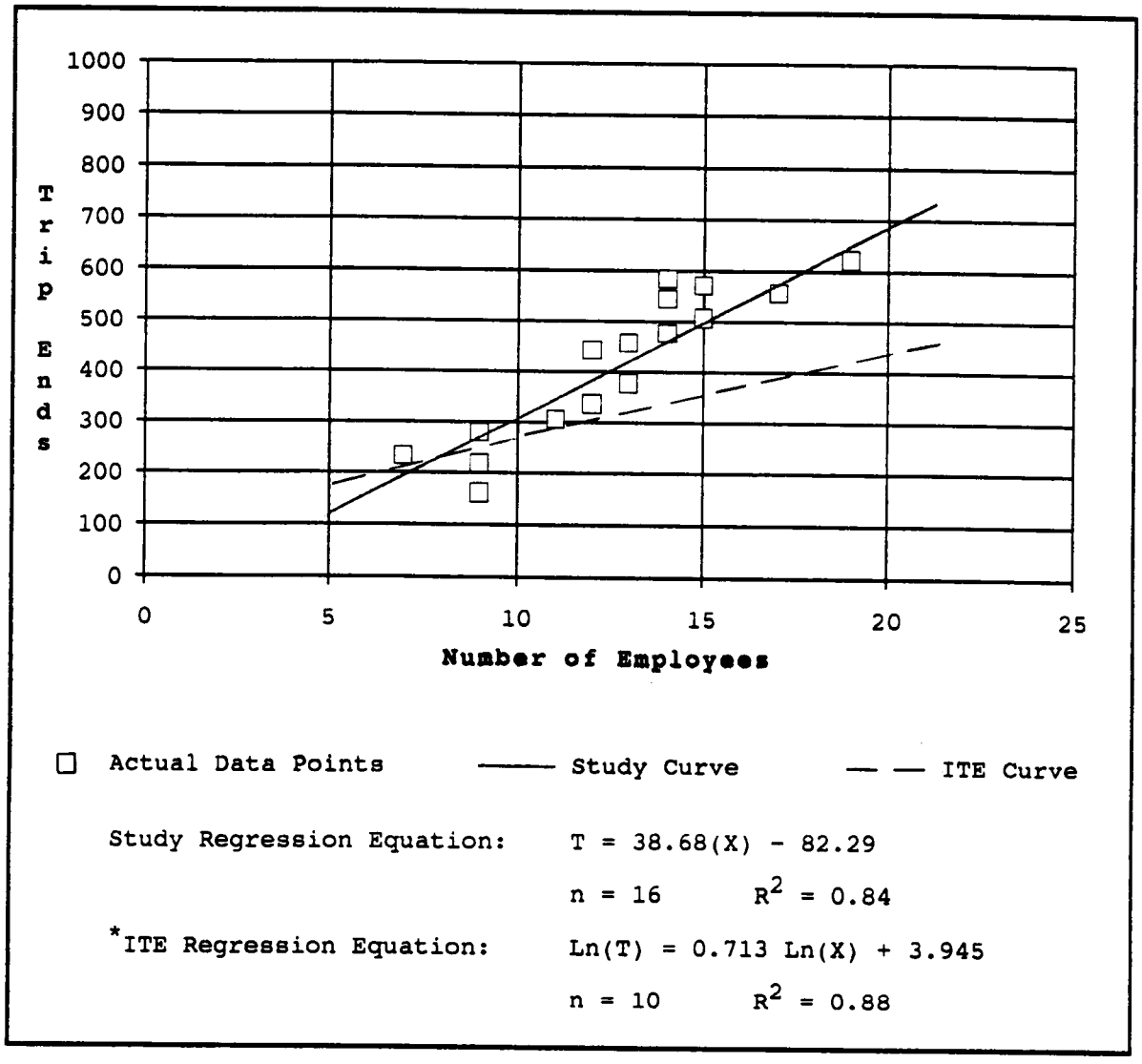

Figure 4.2. Plot of the number of trip ends on a weekday versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

discussed this is primarily due to low employment densities of limited service motels and not amount of business.

A.M. Peak Hour of Generator For an Average Weekday

The a.m. peak hour of generator model uses the highest number of vehicle trip ends entering and exiting the site during the morning hour as the dependent variable. Figure 4.3 shows the diagram describing the relationship between the dependent variable and the number of occupied rooms. The data show a somewhat significant correlation between the two variables (R^2=0.46).

Figure 4.4 shows the relationship between the a.m. trip generation during the peak hour of the generator and the number of employees. Similarly, the graph shows a somewhat significant correlation between the two variables (R^2=0.44).

P.M. Peak Hour of Generator for an Average Weekday

The p.m. peak hour of generator model uses the same variables used for the a.m. peak hour of generator model with the exception of the time of day. Figure 4.5 shows the diagram describing the relationship between the p.m. peak hour of generator and the number of occupied rooms. The graph shows a significant correlation based on regression analysis between the two variables (R^2=0.84).

Figure 4.6 shows the relationship between the p.m. trip generation during the peak hour of the generator and the

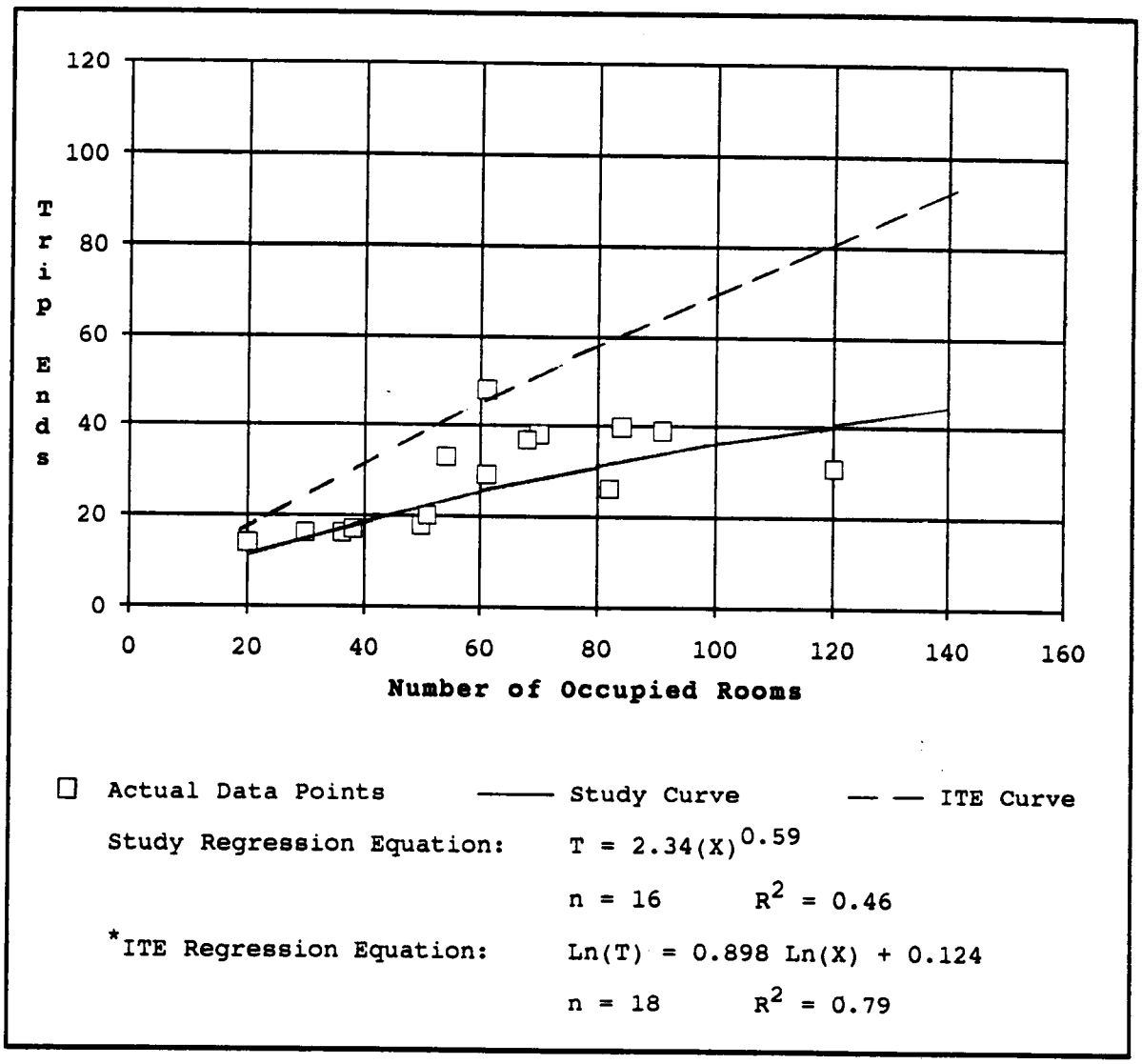

Figure 4.3. Plot of the number of trip ends for the weekday a.m. peak hour of generator versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

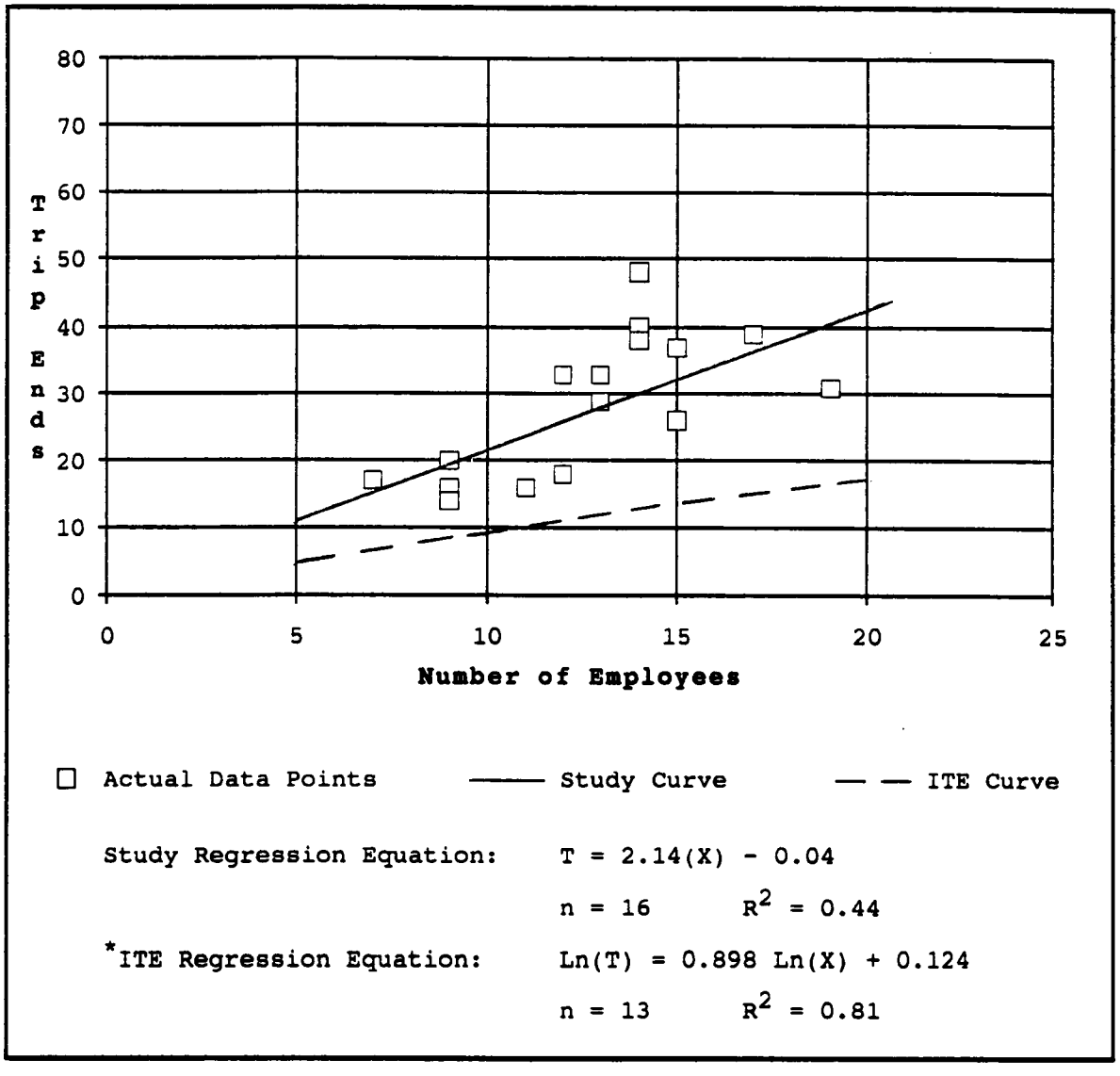

Figure 4.4. Plot of the number of trip ends for the weekday a.m. peak hour of generator versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

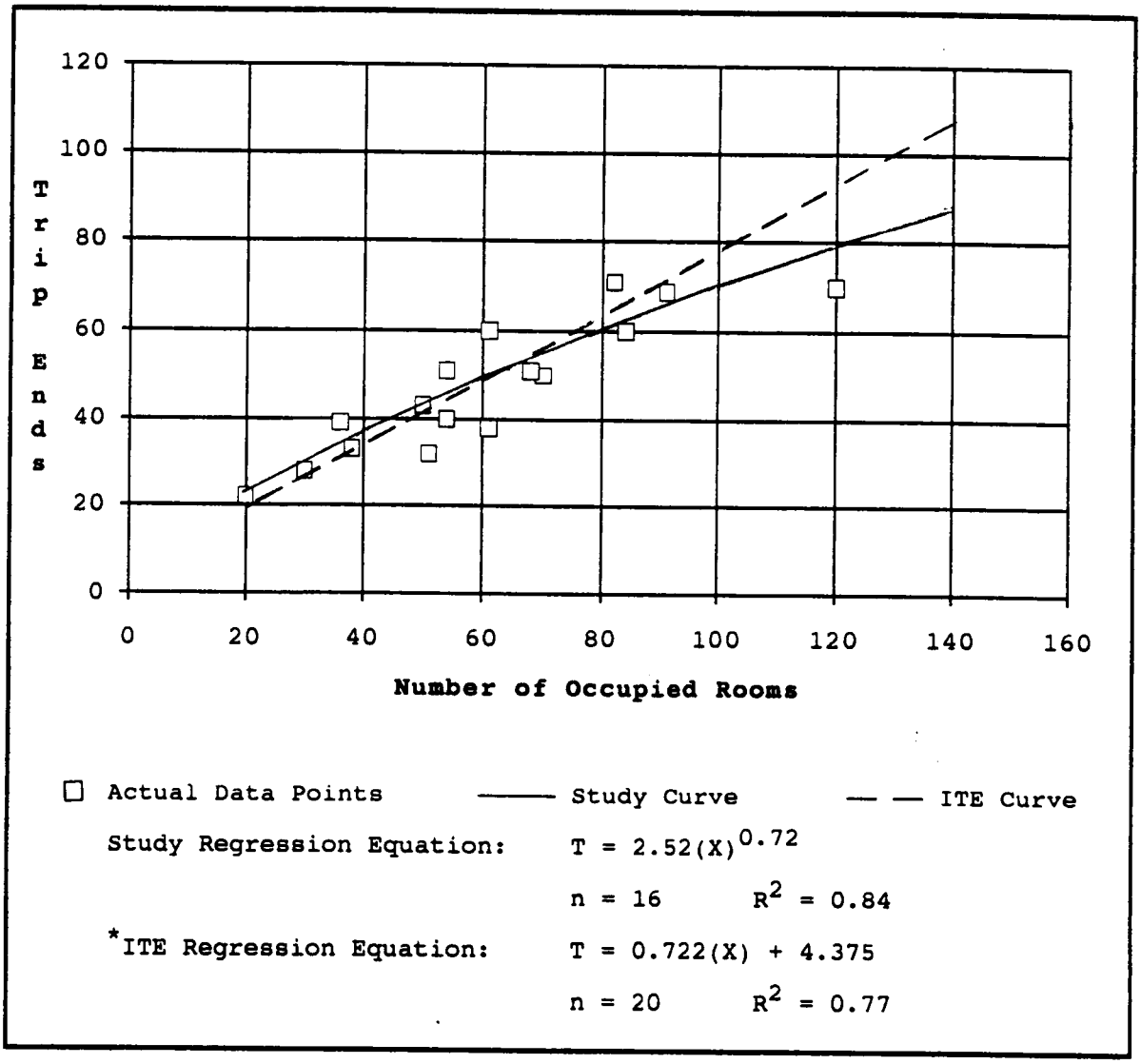

Figure 4.5. Plot of the number of trip ends for the weekday p.m. peak hour of generator versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

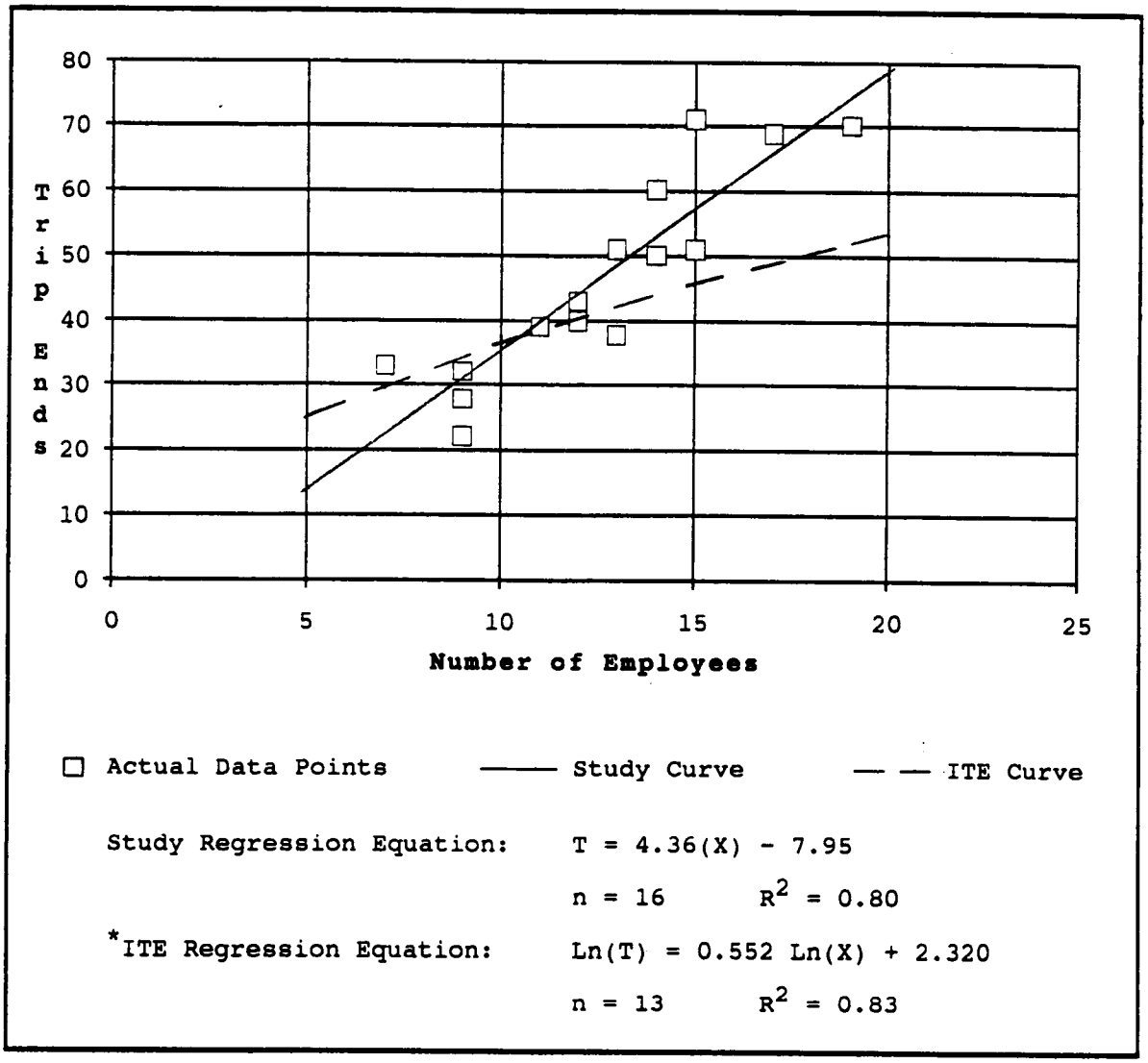

Figure 4.6. Plot of the number of trip ends for the weekday p.m. peak hour of generator versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

number of employees. The graph shows significant correlation based on regression analysis between the two variables (R^2=0.80).

A.M. Peak Hour of Adjacent Street for an Average Weekday

In order to assess the impact of trips generated by motels on adjacent streets and intersections, it is important to calculate the number of trip generated during the peak hours of traffic on these adjacent streets or intersections. The a.m. peak hour of adjacent street model uses the highest one-hour trip generation between 7 and 9 a.m. when the adjacent street traffic is at its peak as the dependent variable. The independent variables used are the number of occupied rooms and the number of employees. Figure 4.7 shows the diagram describing the relationship between the a.m. peak hour volumes and the number of occupied rooms. The graph shows a weak correlation between the two variables (R^2=0.38).

Similarly, Figure 4.8 shows the relationship between the a.m. peak hour volumes and the number of employees. Again, the graph shows a weak correlation between the two variables (R^2=0.30).

P.M. Peak Hour of Adjacent Street for an Average Weekday

The p.m. peak hour of adjacent street model uses the highest one-hour trip generation between 4 and 6 p.m. when

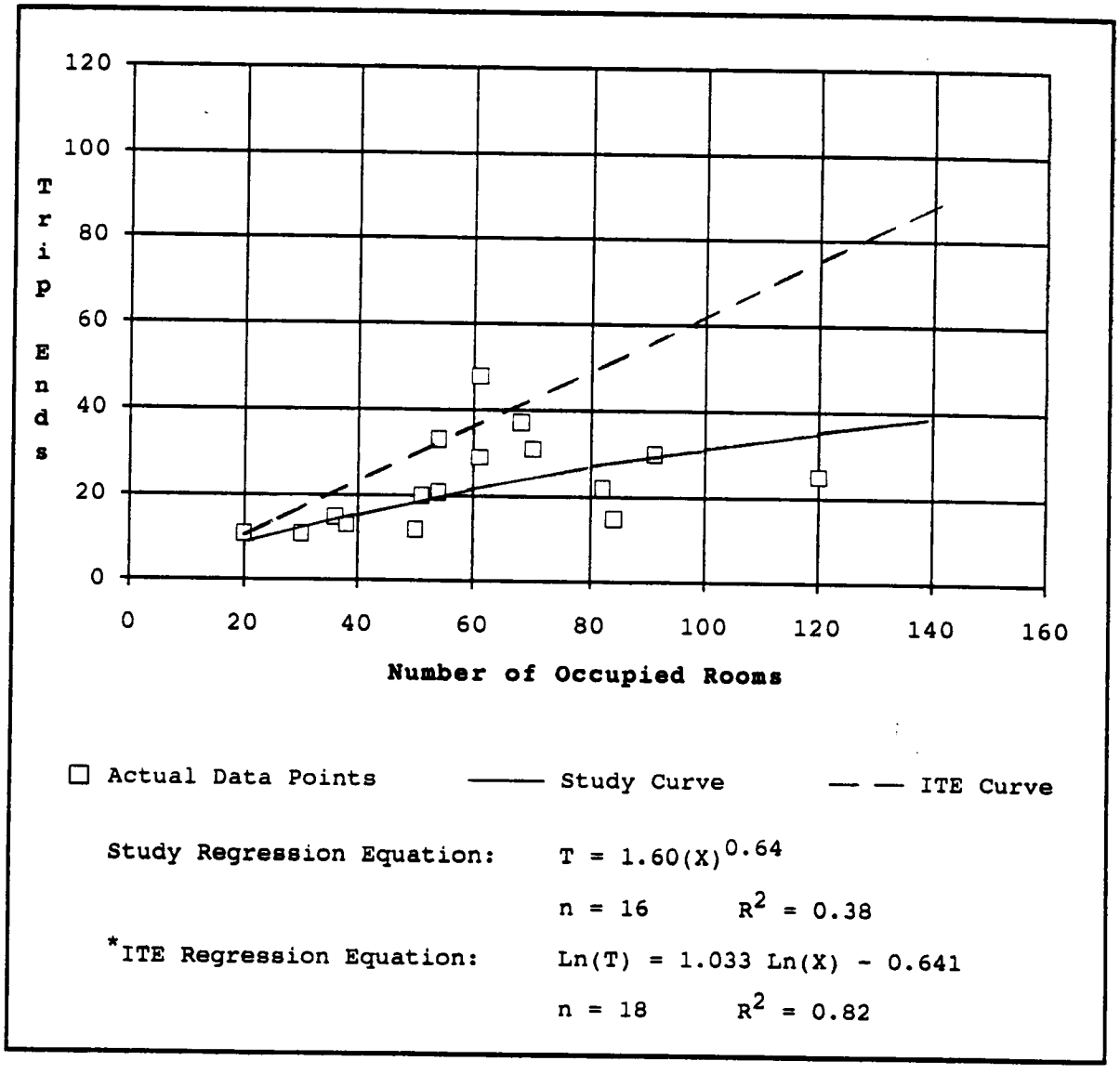

Figure 4.7. Plot of the number of trip ends for the weekday a.m. peak hour of adjacent street traffic, one hour between 7 and 9 a.m. versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

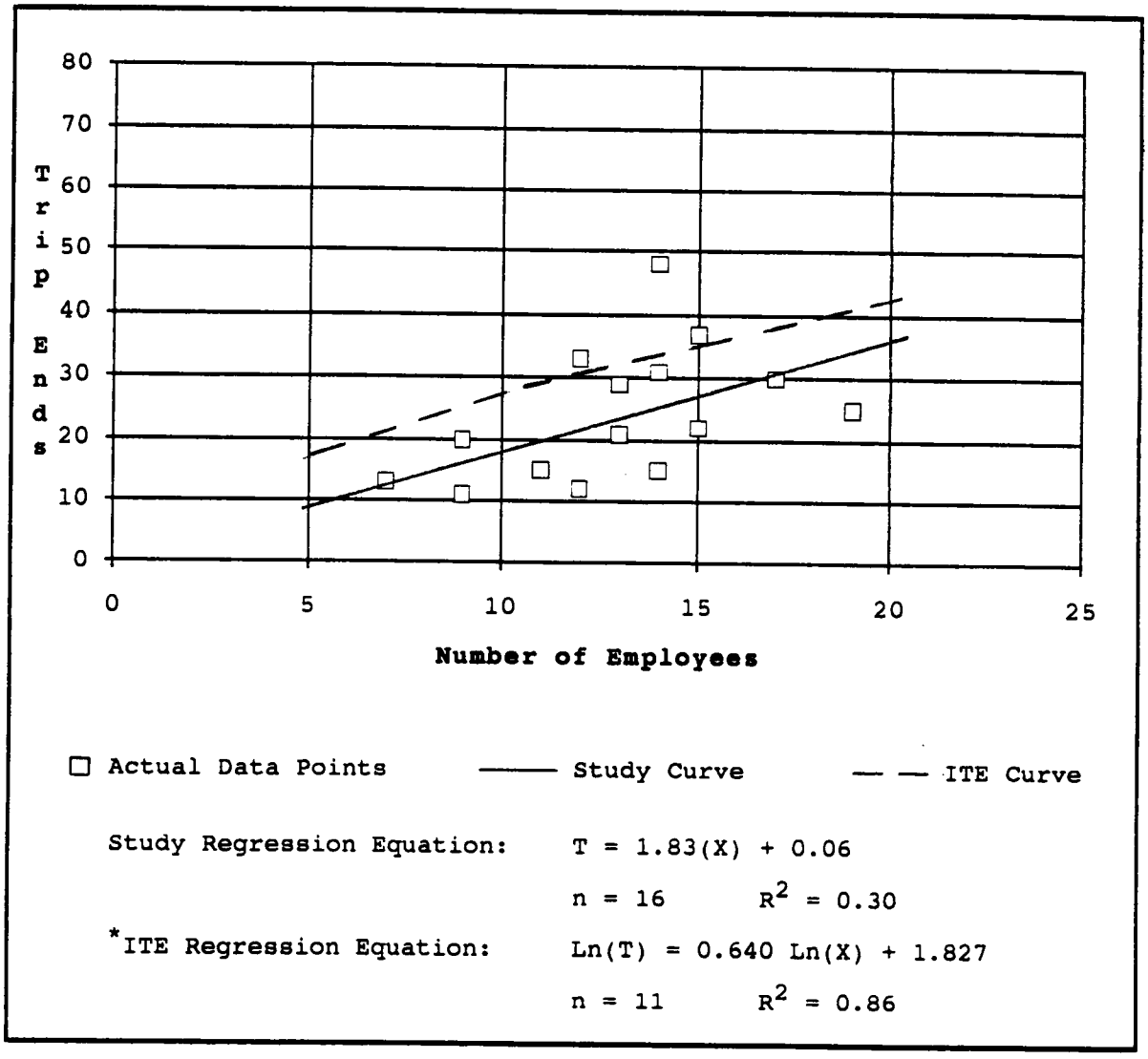

Figure 4.8. Plot of the number of trip ends for the weekday a.m. peak hour of adjacent street traffic, one hour between 7 and 9 a.m. versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

the adjacent street traffic is at its peak as the dependent variable. Figure 4.9 shows a diagram of the relationship between the p.m. peak hour volumes versus the number of occupied rooms. Regression analyses reveal a significant correlation between the two variables (R^2=0.72).

Figure 4.10 shows the relationship between the p.m. peak hour volumes and the number of employees. The graph shows a weaker correlation between the two variables (R^2=0.43).

Average Saturday

The trip generation model for an average Saturday uses the 24-hour volume of traffic entering and exiting a site on Saturday as the dependent variable. Figure 4.11 shows a diagram of the relationship between the Saturday volumes and the number of occupied rooms. Regression analysis reveals there is significant correlation between the two variables (R^2=0.66).

Figure 4.12 shows the relationship between the Saturday volumes and the number of employees. The graph shows a significant correlation between the two variables (R^2=0.87).

Peak Hour of Generator for an Average Saturday

The dependent variable used in developing this model is the one-hour volume measured entering and exiting on a Saturday. Figure 4.13 shows a diagram describing the

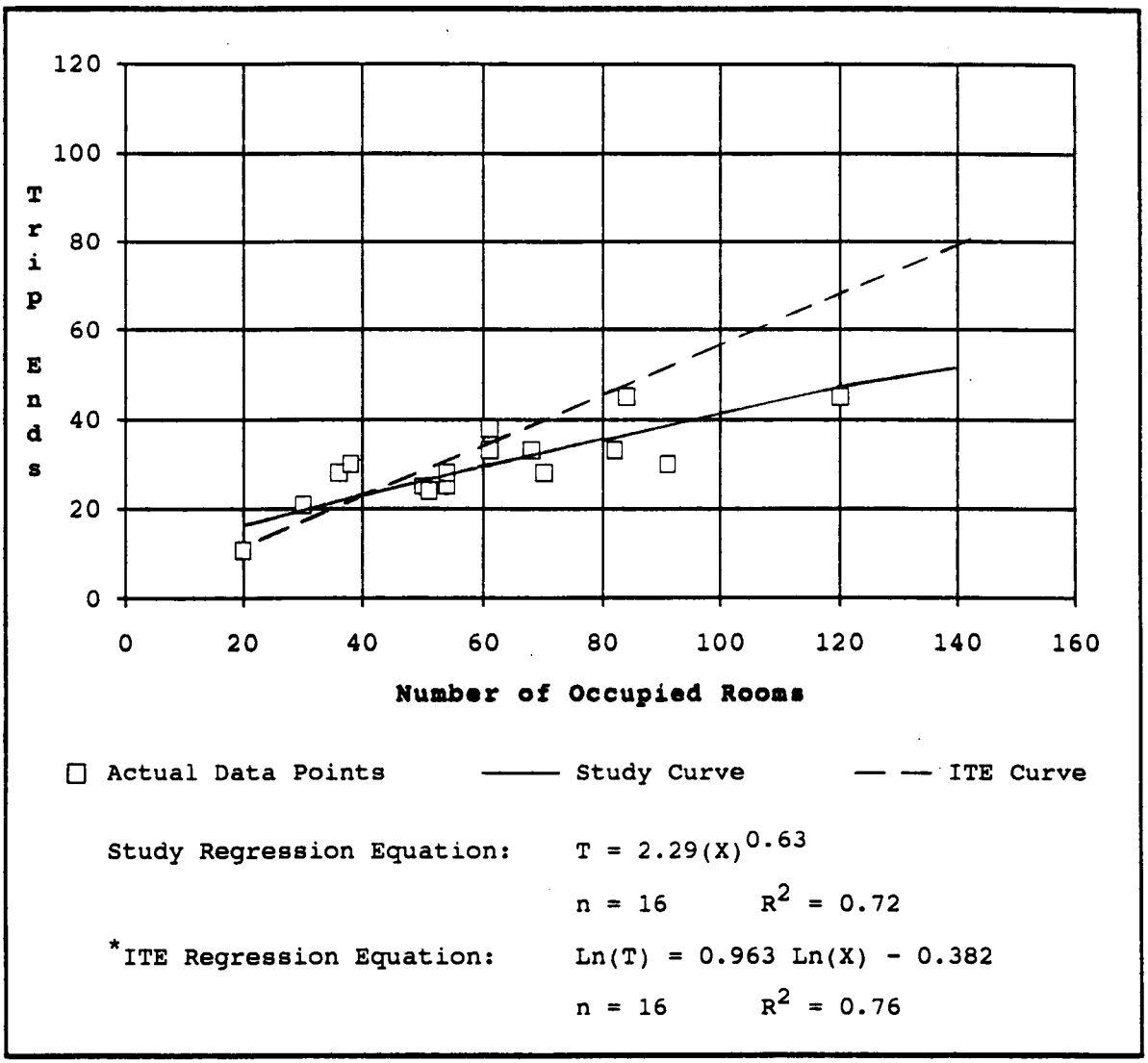

Figure 4.9. Plot of the number of trip ends for the weekday p.m. peak hour of adjacent street traffic, one hour between 4 and 6 p.m. versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

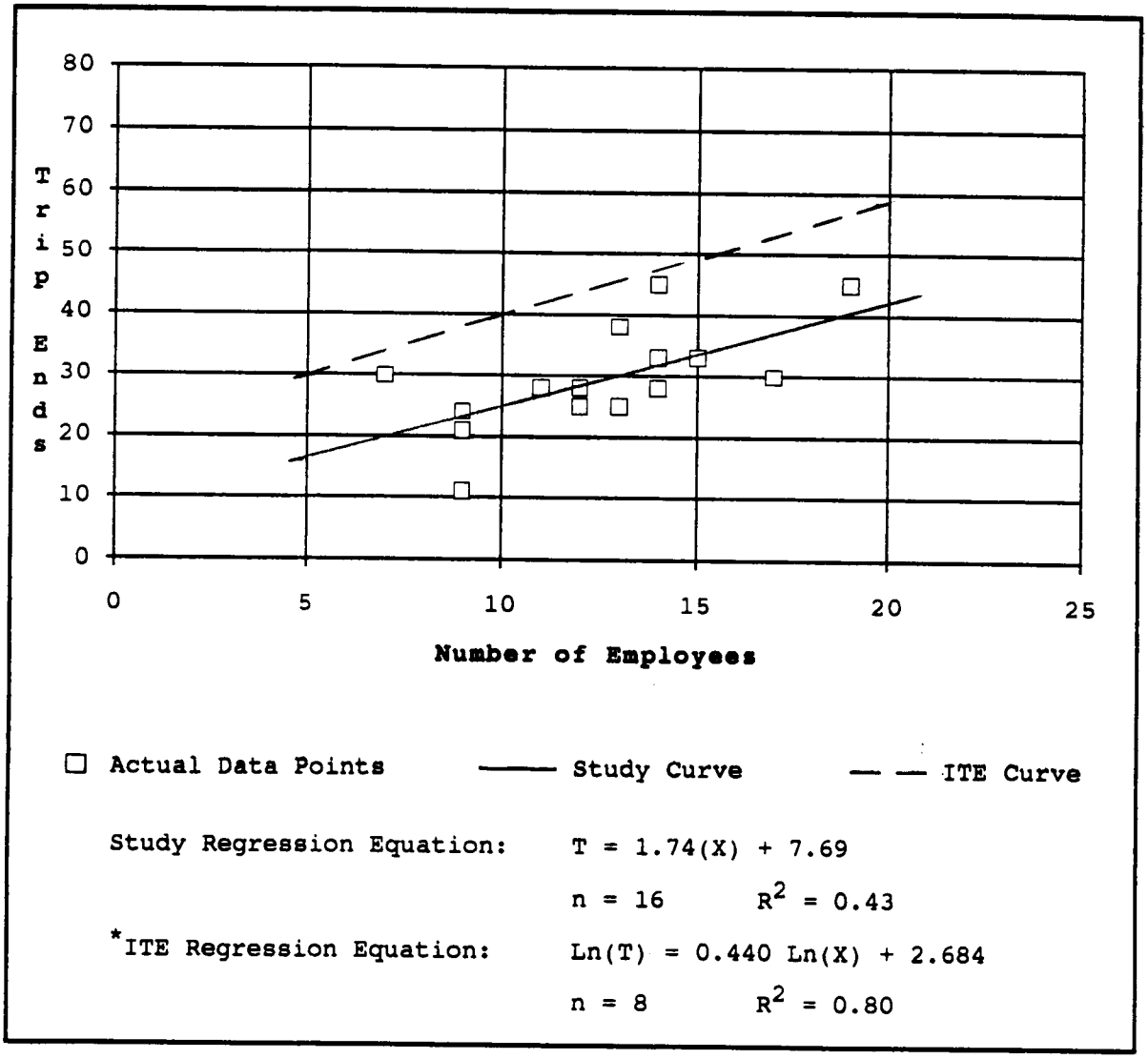

Figure 4.10. Plot of the number of trip ends for the weekday peak hour of adjacent street traffic, one hour between 4 and 6 p.m. versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

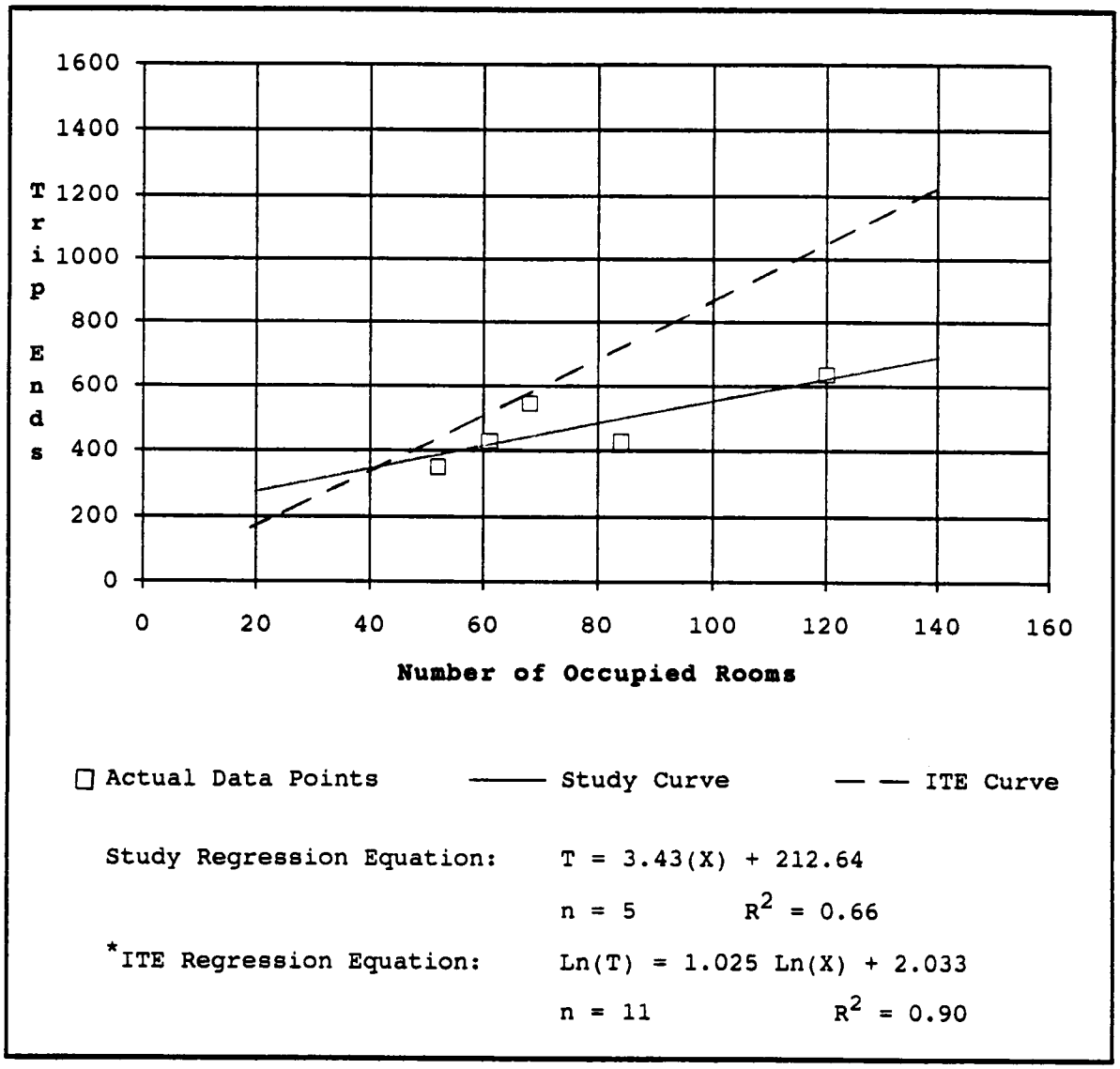

Figure 4.11. Plot of the number of trip ends on a Saturday versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

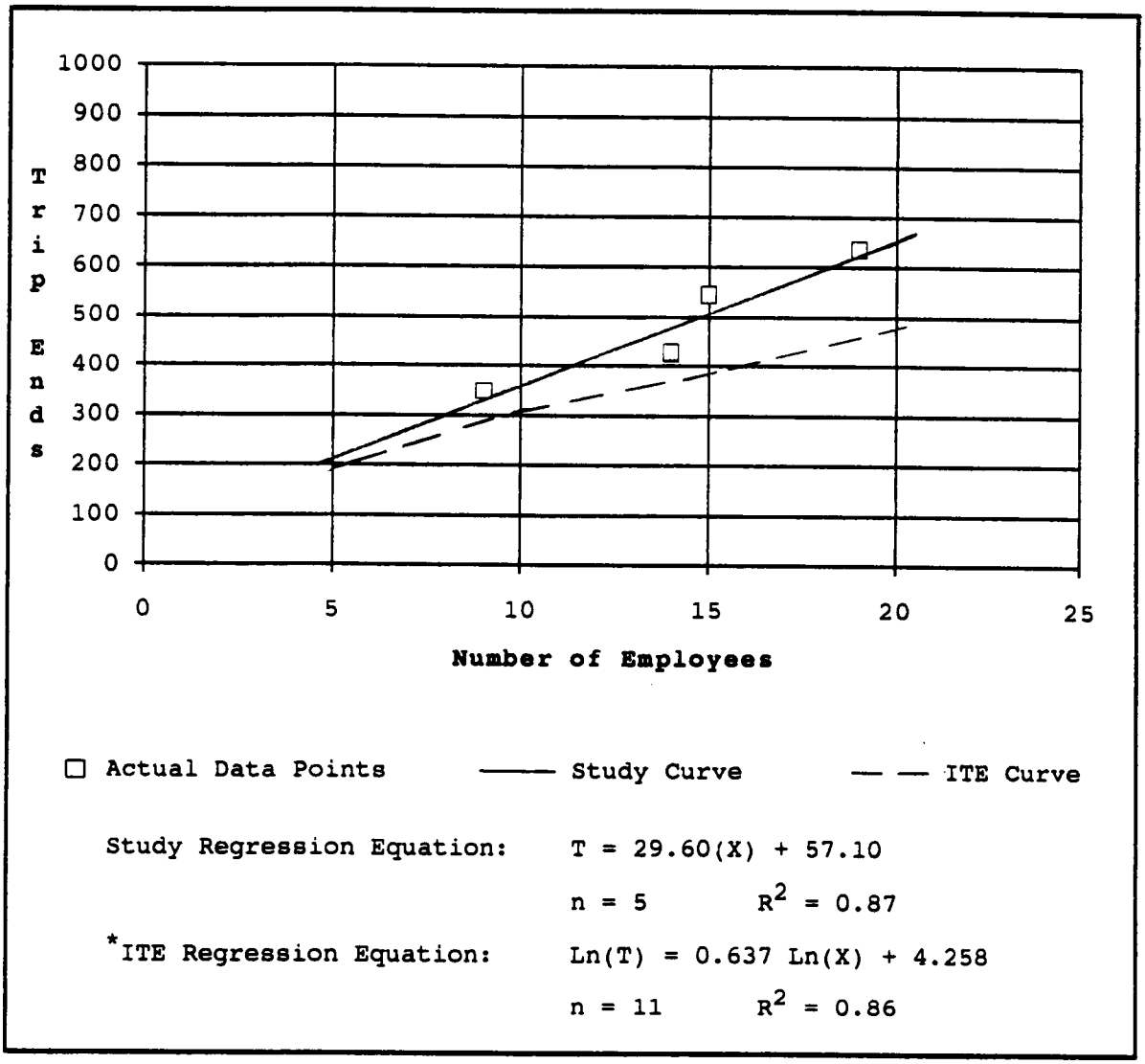

Figure 4.12. Plot of the number of trip ends on a Saturday versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

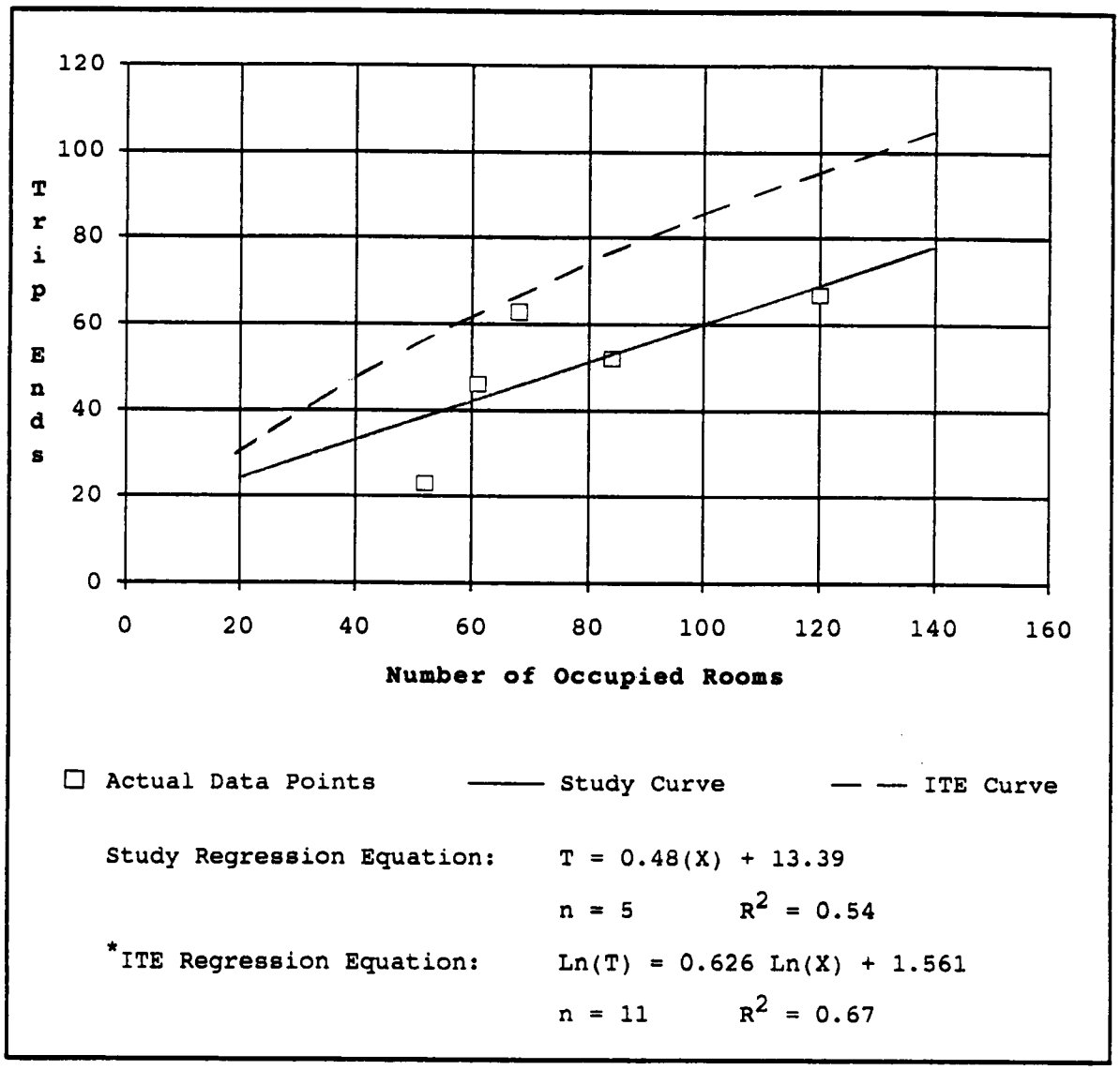

Figure 4.13. Plot of the number of trip ends for the Saturday peak hour of generator versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

relationship between peak hour volumes for a Saturday and the number of occupied rooms. Regression analysis reveals a significant correlation (R^2=0.54).

Figure 4.14 shows the relationship between peak hour volumes and the number of employees. The data show a significant correlation based on regression analysis between the two variables (R^2=0.88).

Average Sunday

The trip generation model for an average Sunday uses the 24-hour volume measured entering and exiting a site on a Sunday as the dependent variable. Figure 4.15 shows a diagram of this model using the number of occupied rooms as the independent variable. Regression analysis reveals significant correlation between the two variables (R^2=0.76).

Figure 4.16 shows the relationship between the dependent variable and the number of employees. The graph shows a significant correlation between the two variables (R^2=0.66).

Peak Hour of Generator for an Average Sunday

This model uses the peak one-hour volume measured entering and exiting on a Sunday as the dependent variable. Figure 4.17 shows a diagram describing the relationship between the dependent variables and the number of occupied

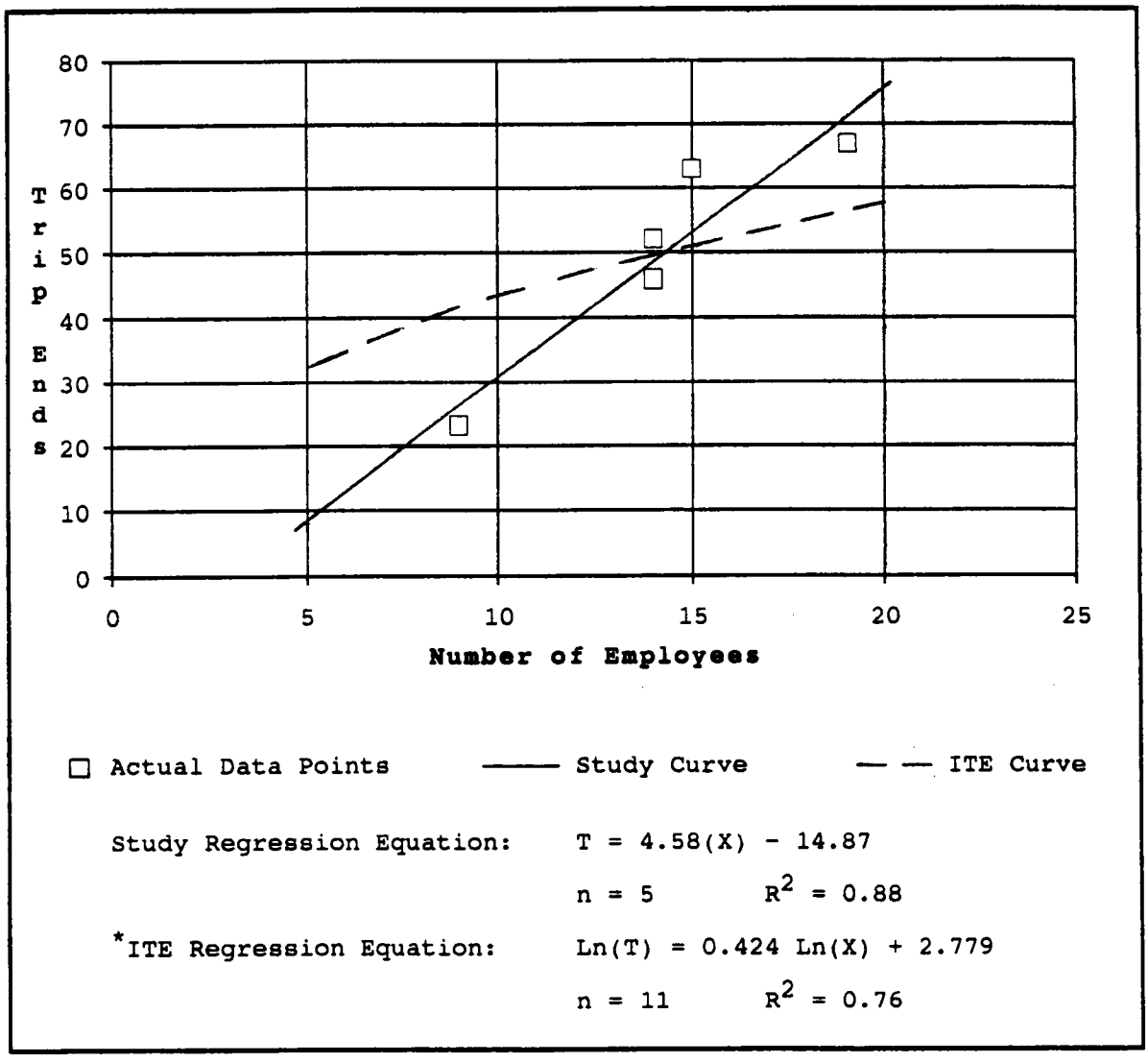

Figure 4.14. Plot of the number of trip ends for the Saturday peak hour of generator versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

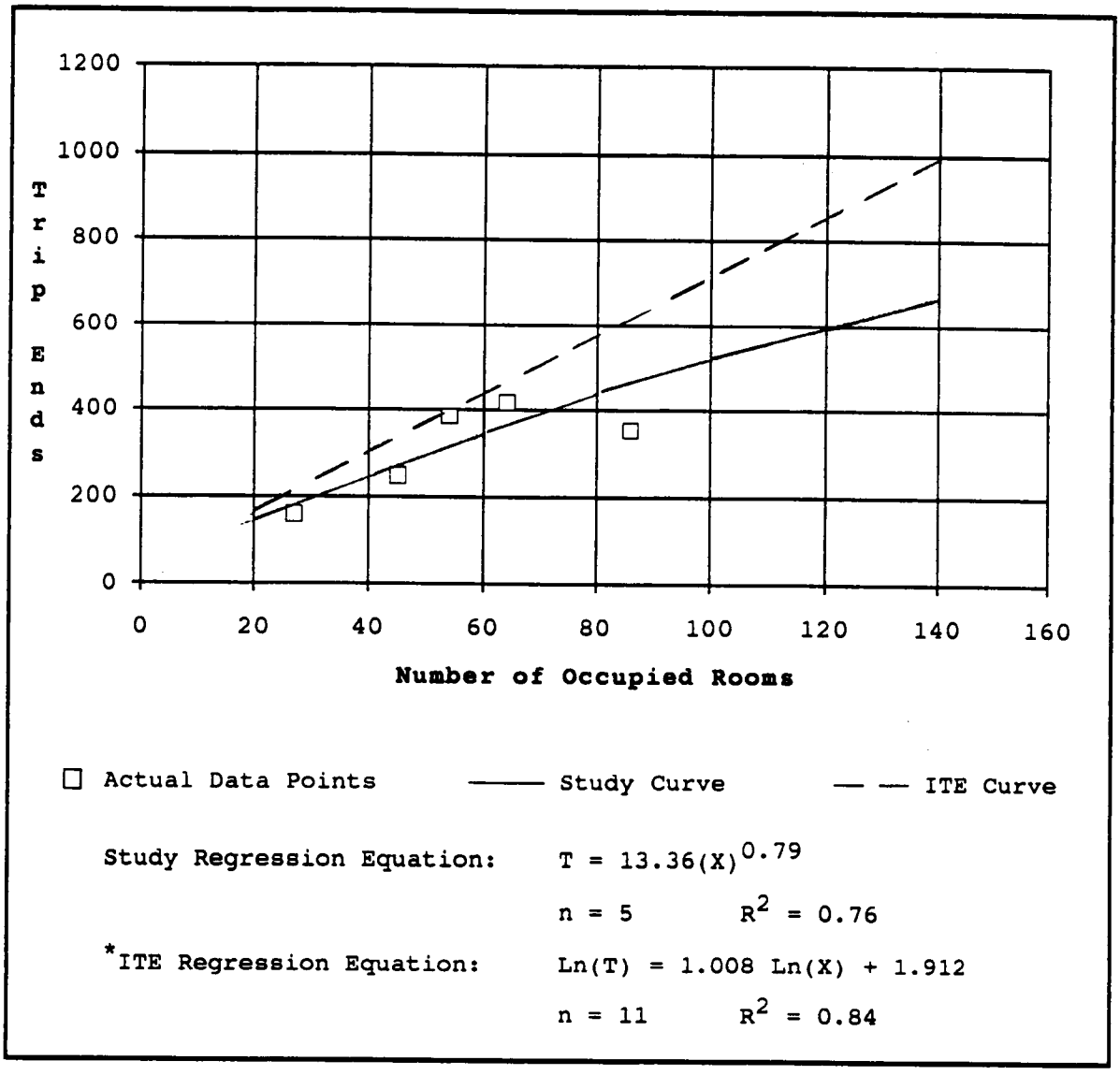

Figure 4.15. Plot of the number of trip ends for a Sunday versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

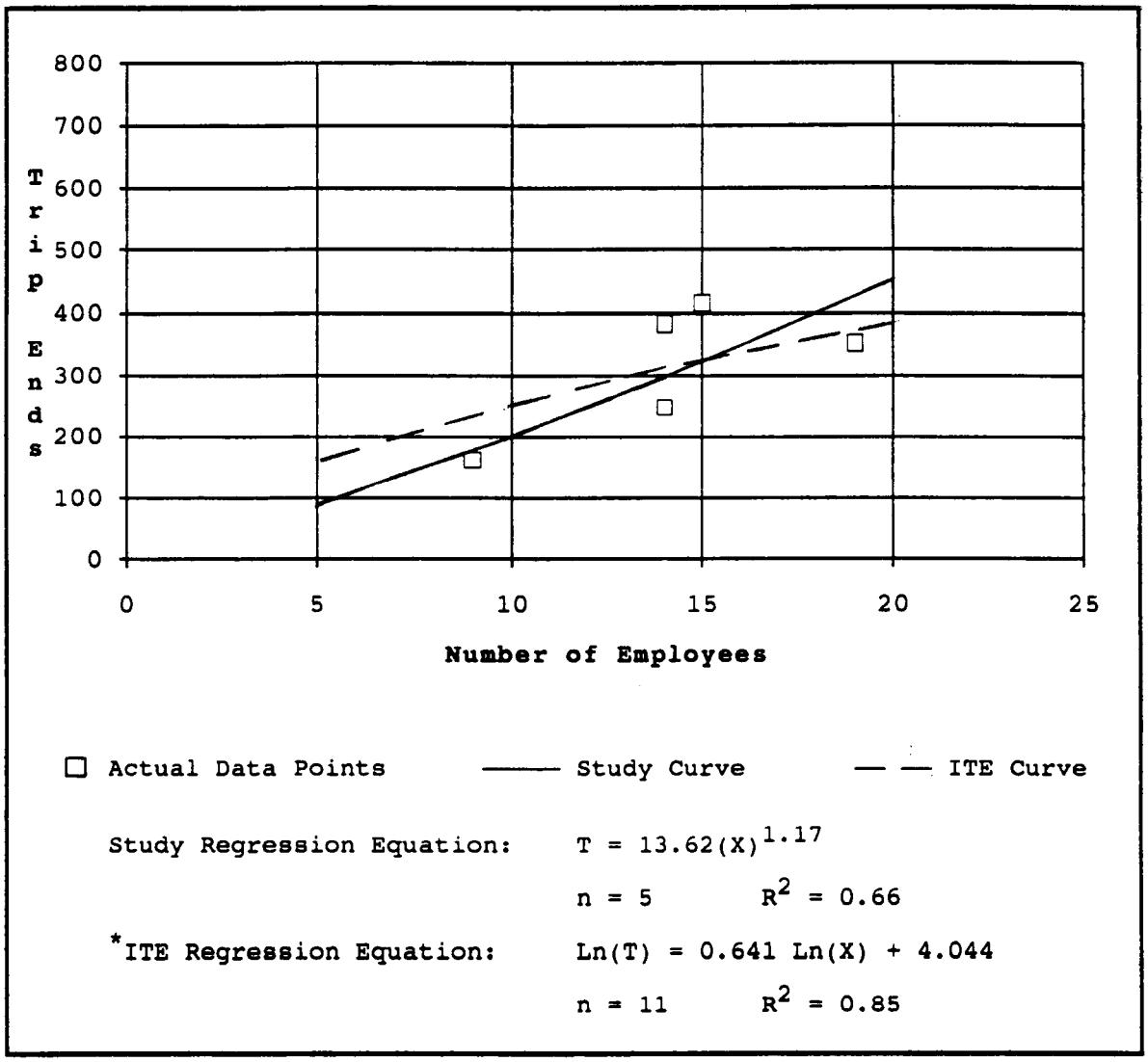

Figure 4.16. Plot of the number of trip ends on a Sunday versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

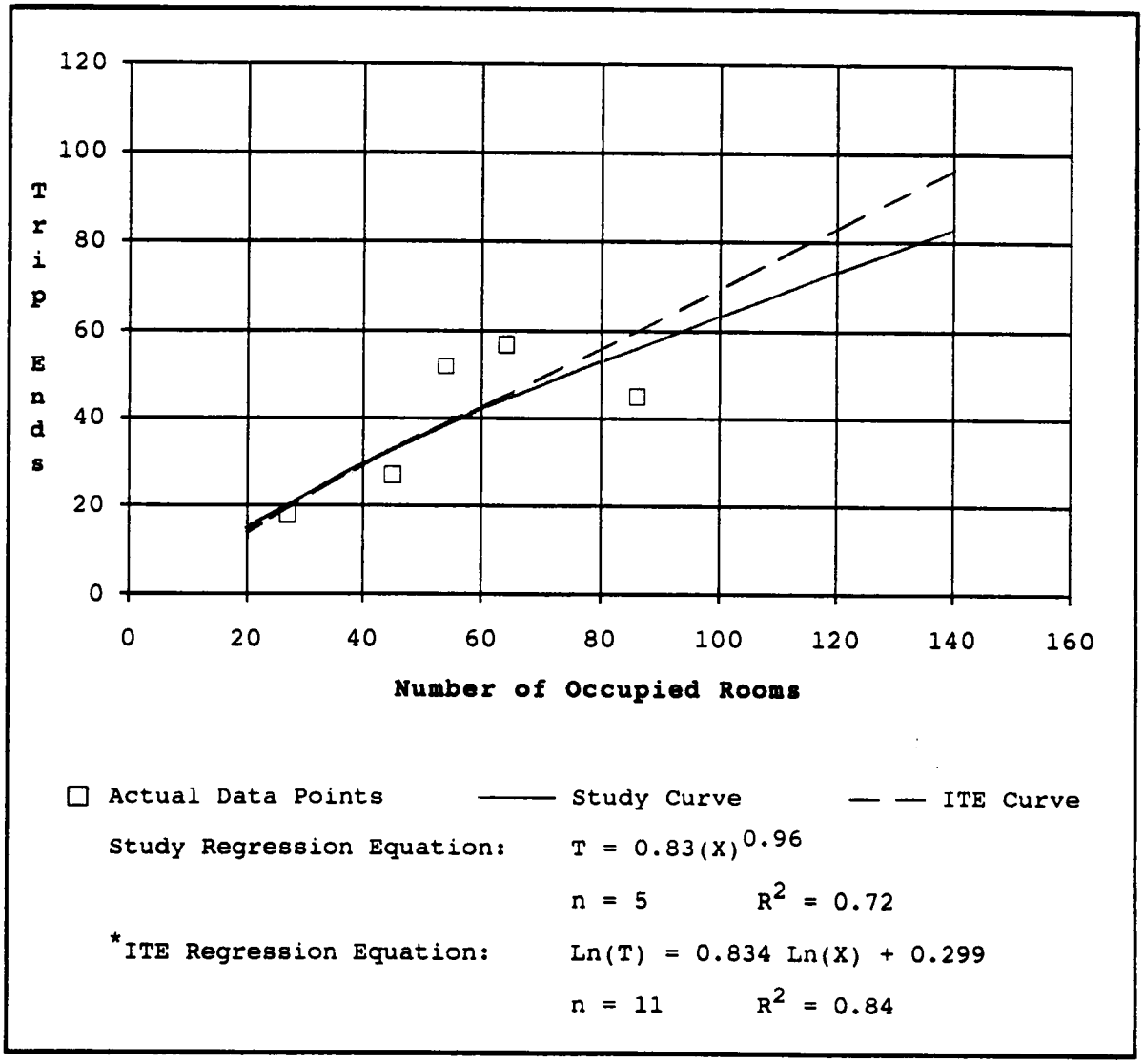

Figure 4.17. Plot of the number of trip ends for the Sunday peak hour of generator versus the number of occupied rooms.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

rooms. As shown in the graph there is a significant correlation between the two variables (R^2=0.72).

Figure 4.18 shows the relationship between the peak hour Sunday volumes and the number of employees. Regression analysis reveals a significant correlation (R^2=0.59).

Summary of Trip Generation Equations

Table 4.5 contains a summary of models representing regression equations between trip ends and the number of occupied rooms for each of the nine design time periods. Representative R^2 values, and the number of study sites (n) are also provided. The R^2 values from Table 4.5 indicate correlation varies according to each time period. Regression analyses show that a low correlation exists between the number of trips and occupied rooms for the a.m. peak hour of adjacent street traffic time period (R^2=0.38). However, significant correlation was found for the average weekday time period (R^2=0.85). Table 4.6 contains a summary of models representing regression equations between trip ends and number of employees. As noted in Table 4.6 regression analyses show that a low correlation exists between the number of trips and employees for the a.m. peak hour of adjacent street traffic (R^2=0.30) time periods. Maximum correlation exists for the peak hour of Saturday time period (R^2=0.88).

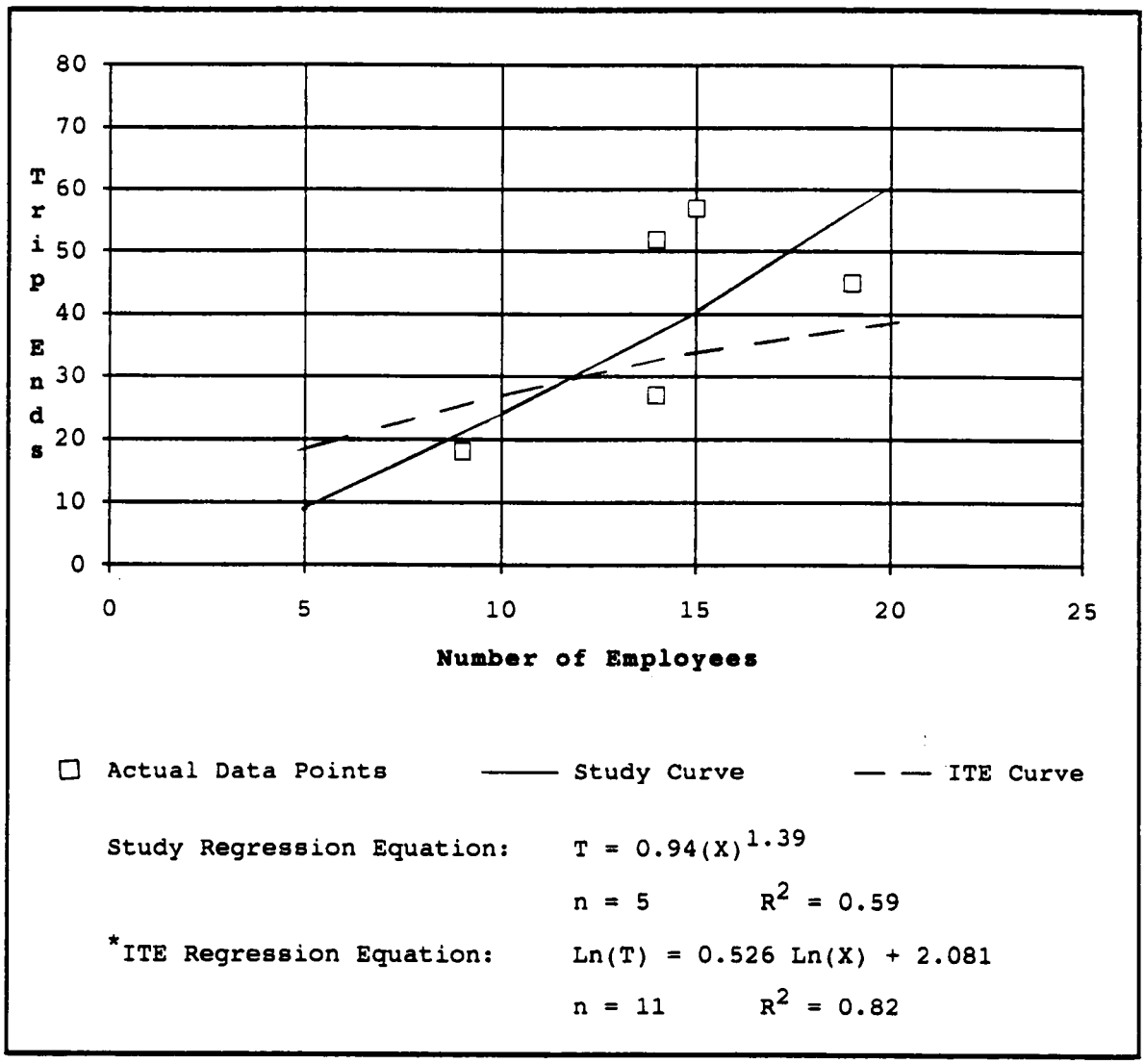

Figure 4.18. Plot of the number of trip ends for the Sunday peak hour of generator versus the number of employees.

*Source: *Trip Generation*. Fifth Edition, Institute of Transportation Engineers, 1991.

Table 4.5.

Summary of Trip Generation Regression Models: Relationship Between Trip Ends and Occupied Rooms

Time Period	Model Type	Equation	n	R^2
Weekday	Multiplicative	$T=13.46(OR)^{0.84}$	16	0.85
A.M. Peak Hour of Generator	Multiplicative	$T=2.34(OR)^{0.59}$	16	0.46
P.M. Peak Hour of Generator	Multiplicative	$T=2.52(OR)^{0.72}$	16	0.84
A.M. Peak Hour of Adjacent Street	Multiplicative	$T=1.60(OR)^{0.64}$	16	0.38
P.M. Peak Hour of Adjacent Street	Multiplicative	$T=2.29(OR)^{0.63}$	16	0.72
Saturday	Linear	$T=12.64(OR)+3.43$	5	0.66
Peak Hour of Generator	Linear	$T=13.40(OR)+0.48$	5	0.54
Sunday	Multiplicative	$T=13.36(OR)^{0.79}$	5	0.76
Peak Hour of Generator	Multiplicative	$T=0.83(OR)^{0.96}$	5	0.72

T= Trip Ends OR= Occupied Rooms

Table 4.6.

Summary of Trip Generation Regression Models: Relationship Between Trip Ends and Employees

Time Period	Model Type	Equation	n	R^2
Weekday	Linear	T=38.68(E)-82.29	16	0.84
A.M. Peak Hour of Generator	Linear	T=2.15(E)-0.04	16	0.44
P.M. Peak Hour of Generator	Linear	T=4.36(E)-7.95	16	0.80
A.M. Peak Hour of Adjacent Street	Linear	T=1.83(E)-0.06	16	0.30
P.M. Peak Hour of Adjacent Street	Linear	T=1.74(E)+7.69	16	0.43
Saturday	Linear	T=29.60(E)+57.10	5	0.87
Peak Hour of Generator	Linear	T=4.58(E)-14.87	5	0.88
Sunday	Multiplicative	$T=13.62(E)^{1.17}$	5	0.66
Peak Hour of Generator	Multiplicative	$T=0.94(E)^{0.96}$	5	0.59

T= Trip Ends E= Employees

The regression model analyses give evidence that both the number of occupied rooms and the number of employees can be used as indicators of trip-making potential of limited service/economy motels. However, caution should be used when interpreting regression models with weak correlation. Factors such as varied peak hours, low occupancy, and location might have caused the weak correlation. Caution should also be used when interpreting the significance of weekend trip generation models because these models were based on limited number of studies.

Summary of Results

Results of the trip generation analysis per occupied room for limited service/economy motels were compared with those given in the ITE *Trip Generation* manual for motels and Ms. Woods' publication on budget motels (Table 4.3). The observed trip generation rates per occupied room were lower than the ITE rates and somewhat more conservative than Ms. Woods' rates. ITE trip generation rates per occupied room near the minimum are more applicable than the average or maximum rates, for this type of motel. Ms. Woods' study on budget motels supports the results found in this study. This comparison of trip generation per occupied room results indicated that limited service/economy motels will generate fewer trips than motels defined in the ITE manual and subsequently will have lower traffic impacts. However, the

observed trip generation rates per employee were higher than the reported ITE rates (Table 4.4). The higher trip rates on employee basis appear to be the product of lower employment densities rather than increased business activity. Interpretation or use of the current ITE manual could result in errors when estimating site generated traffic for limited service/economy motels that could lead to unnecessary public concern and substantial development fees.

Regression analysis was conducted to determine the correlation between the number of trips and the independent variable. The regression models indicate that both occupied rooms and employees can be used as indicators of trip generating potential for limited service/economy motels. Some regression models such as the a.m. peak hour models provided weak correlation, while models such as the average weekday models provided significant correlation. Caution should be used when interpreting the significance of data with weak correlation and based on limited number of study sites.

CHAPTER V

QUESTIONNAIRE STUDY

An ideal trip generation model should explain why individual sites within a single existing land use experience trip variations. A questionnaire study was performed to evaluate trip rate variations for similar motel sites. The questionnaire study data would provide information on how such factors as guest characteristics and proximity to other land uses such as restaurants effect trip-making characteristics of motels. Trip generation rates can be better used in traffic impact studies if the trip characteristics of a proposed development are known. From the 16 motels previously studied eight motels were selected for this questionnaire study. The motels were selected based on cooperation from the management of these establishments. Table 5.1 shows a list of the motels selected for this study.

Methodology

Thirty questionnaires were provided for each of the eight motels. A total of 186 interviews was conducted. The survey was conducted during the week of September 21, 1992 through September 27, 1992. The surveyor was instructed to ask guests checking out of the motel if they would

Table 5.1.

List of Motels Selected for Questionnaire Study

Motel Number	Property
1	Econo Lodge, Cleveland TN
2	Days Inn, Cleveland TN
4	Econo Lodge, Chattanooga TN
11	Days Inn, Nashville TN
12	Econo Lodge, Knoxville TN
14	Comfort Inn, Knoxville TN
15	Days Inn, Knoxville TN
16	Hampton Inn, Knoxville TN

participate in the survey. Questions in the survey were designed to determine:

1. Whether or not commercial clients make more vehicular trips than tourist during their stay at the motel.
2. Whether or not guests arriving at their destinations make more vehicular trips than guests passing through to their destination during their stay at the motel.
3. The type of vehicular trips made by motel guests during their stay at the motel.

Three questions were asked of each person interviewed to determine the above criteria. A copy of the questionnaire used for this study is provided in Appendix B. The first question provides information on the type of guest; whether the guest is a tourist/pleasure traveler, business/ commercial traveler or other. The second question provides information on whether the guest has reached his or her destination or just passing through. From the first two questions the motel guests were categorized into the following motel guest types:

1. Tourist who has arrived at destination
2. Tourist who is passing through to destination
3. Business traveler who has arrived at destination

4. Business traveler who is passing through to destination
5. Other

The final question provides information on how many and what type of trips did the guest make during the time of stay at the motel. The guest was asked the number of times his or her vehicle made a round-trip during the time of his or her stay at the motel for the following purposes; restaurant, recreational; social; business; shopping; and other. It was important to make it clear to the guest that only one purpose must be listed for each round-trip made from the motel site. It should be noted that the "round-trips" defined in the questionnaire form were later converted to trip ends (trips) for uniform analysis purposes.

Results

The results of the questionnaire study show that business travelers who have reached their destination make more trips on average than the other motel guest types. The questionnaire data imply, as shown in Table 5.2, that business travelers who have reached their destination make an average of 5.13 trip ends per day while staying at the motel site. Tourists who have arrived at their destination make an average of 4.84 trip ends per day but account for only 10.2 percent of the guests interviewed. Business

Table 5.2.

Summary of Trip Characteristics of Motel Guest Types

Motel Guest Type Classif-ication	Actual Number Inter-viewed	Percentage of Total Inter-viewed (%)	Actual Number of Trip Ends Made	Percentage of Total Trip Ends Made (%)	Trip Ends Per Day
Tourist Arriving at Destination	19	10.2	92	16.1	4.84
Tourist Passing Through	96	51.6	240	42.0	2.50
Business Traveler Arriving at Destination	30	16.1	154	26.9	5.13
Business Traveler Passing Through	31	16.7	60	10.5	1.94
Other	10	5.4	26	4.5	2.60
Total	186	100.0	572	100.0	3.08

travelers and tourists who were passing through make only 2.50 and 1.94 trip ends per day, respectively, while staying at the motel. The data reveal, on average, business travelers make more vehicular trips than tourists and motel guests who have arrived at their destination make more vehicular trips than motel guests who are passing through. Full service motels tend to attract more business travelers and more destination travelers than limited service motels. While limited service/motels primarily attempt to attract the passing by traveler (Lattin 1989). The ITE motel land use category includes both full service and limited service/economy motels. This may be one of the reasons why limited service/economy motels generate less traffic than motels reported by the ITE manual.

Table 5.3 presents the distribution of trip types made by motel guest interviewees. The table shows that 55.6 percent of all trips made were restaurant trips. This indicates that proximity to other land uses such as restaurants can strongly affect the trip-making characteristics of motels. For example, motels with restaurants within walking distance should have less traffic impacts than motels with restaurants that are not.

Table 5.3.

Distribution of Trip Types Made by Motel Guests

Trip Type	Actual Number of Each Trip Type Made	Percentage of Total Trips Made (%)
Restaurant Trip	318	55.6
Recreational Trip	38	6.6
Social Trip	40	7.0
Business Trip	90	15.7
Shopping Trip	66	11.5
Other Trip	20	3.5
Total	572	100.0

Summary

As previously mentioned an ideal trip generation model should explain why individual sites within a single existing land use experience trip variations. An understanding of such factors as a motel's clientele characteristics and location with respect to other land uses such as restaurants will provide assistance in understanding trip rate variations and predicting trip rates for motels. Although a larger sample size and more detailed study is needed results of the questionnaire study indicated, on average, business travelers make more vehicular trips than tourists and motel guests who have arrived at their destination make more vehicular trips than motel guests who are passing through. The study also showed restaurant trips comprise a majority of the total trips made by guests during their stay at the motel.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

This research attempted to establish a data base on trip-generating characteristics of limited service/economy motels and compare the observed results with those given for motels in the 5th edition of the ITE *Trip Generation* manual. Currently, this specific land use is not explicitly presented in the ITE manual. The trip-generating characteristics of limited service/economy motels may vary substantially from the ITE land use category for motels. Interpretation or use of the current ITE rates could result in significant errors when estimating site generated traffic for this type of motel. With accelerating public concern about suburban congestion and development fees the validity of current trip generation rates has been questioned during the public review of proposed new developments (TRB 1990). Because of the risks involved developers, planners and engineers should not be obligated to use trip generation rates that are not sufficiently representative of the land use being considered. Representative trip generation models and other travel characteristics were determined to evaluate the traffic impact of such motels on the transportation system.

Conclusions

The principal conclusions of this study of trip-generating characteristics of limited service/economy motels are summarized as the following:

1. Trip generation rates per occupied room for limited service/economy motels developed in this study are considerably lower than those provided by the 5th edition of the ITE *Trip Generation* manual for the land use category of motels. Inappropriately using the ITE method on occupied room basis could result in a 48 percent overestimation of site generated traffic for limited service economy/motels which could lead to unnecessary public concern and increased development fees. These results indicate that limited service/economy motels will have lower traffic impacts than motels defined by the ITE manual and should be acknowledged by ITE and local governments. A documented study of trip generation for budget motels supports the results found in this study.
2. Trip generation rates per employee developed in this study for limited service/economy motels are considerably higher than those provided by the ITE manual for motels. This is primarily due to low employment densities of limited service/economy motels rather than amount of business activity.

Inappropriately using the ITE method on employee basis could result in a 61 percent underestimation of site generated traffic.

3. Trip generation regression models indicated that both the number of occupied rooms and the number of employees can be used as indicators of trip-making potential for limited service/economy motels.
4. Individual peak hour analysis of the study sites indicated that the a.m. and p.m. peak hours of generator (peak hours of motel traffic) are too varied to draw any conclusions. However, it is fair to assume from the composite temporal distribution analysis that the a.m. peak hour of traffic generated at limited service/economy motels coincides with the street network peak hour but the p.m. peak hour of motel traffic does not peak at the same time as the adjacent street traffic. The analysis indicated an appropriate p.m. peak hour of motel traffic between 6 p.m. and 9 p.m. for this type of motel.
5. Although a larger sample size and more detailed study is needed, the questionnaire data imply that such factors as guest characteristics and proximity to other land uses such as restaurants can strongly affect the trip-making characteristics of motels.

Recommendations for Further Research

This thesis intended to serve as a starting point for developing trip generation models and trip characteristics of limited service/economy motels. This study can be elaborated upon by the following recommendations for further research.

1. Further trip generation data should be collected for other limited service/economy motel sites nationally to compare with the data in this study and to develop a larger database.
2. It is standard practice to use the number of occupied rooms and the number of employees as indicators of trip-making potential of motels. Further research should be made to determine whether or not other independent variables can be used to estimate the amount of traffic generated at motels. Multiple independent variables, such as ADT, population, and competing facilities could also be considered in the trip generation equations.
3. Further research should be made with regard to the characteristics of trips made by motel guest types. Guest characteristics could be considered in estimating the number of trips generated by motels.
4. Location is an important factor in trip rate variations of motel sites. More complicated

situations, such as sites located on the corner of two roadways, sites located on or adjacent freeways, or sites located in tourist areas with significant fluctuations in traffic should be addressed.

5. Research should be made on the percentage of impulse, diverted, and new trips for motels.
6. And finally, the ITE *Trip Generation* manual and local governments should acknowledge specific land use categories such as limited service/economy motels for analyzing traffic impacts of these types of land uses on the highway system.

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APPENDICES

APPENDIX A

TRIP GENERATION RATES FOR INDIVIDUAL STUDY SITES

Table A.1.

Trip Generation Rates per Occupied Room for Weekday Time Periods for Individual Sites

	Trips per Occ. Room				
Motel Number	24-Hour Trip Rate	A.M. Peak Hour of Generator Trip Rate	P.M. Peak Hour of Generator Trip Rate	AM Peak Hour of Adjacent Street Trip Rate (7am-9am)	PM Peak Hour of Adjacent Street Trip Rate (4pm-6pm)
1	5.69	0.24	0.71	0.18	0.54
2	6.76	0.36	0.86	0.24	0.50
3	7.27	0.53	0.93	0.37	0.70
4	6.21	0.48	0.62	0.48	0.62
5	6.98	0.32	0.87	0.27	0.40
6	8.50	0.61	0.94	0.39	0.46
7	7.82	0.41	1.00	0.38	0.72
8	8.20	0.70	1.10	0.55	0.55
9	8.19	0.61	0.74	0.61	0.52
10	5.47	0.39	0.63	0.39	0.47
11	7.83	0.54	0.71	0.44	0.40
12	6.12	0.43	0.76	0.33	0.33
13	6.21	0.45	0.87	0.34	0.79
14	9.59	0.79	0.98	0.79	0.54
15	5.20	0.26	0.58	0.21	0.38
16	7.46	0.54	0.75	0.54	0.49
Average	6.88	0.45	0.78	0.38	0.49

Table A.2.

Trip Generation Rates per Occupied Room for Weekend Time Periods for Individual Sites

Time Period	Motel Number	24-Hour Trip Rate (trips/occ. room)	Peak Hour of Generator Trip Rate (trips/occ. room)
Saturday	1	5.08	0.62
	3	6.71	0.44
	14	7.03	0.75
	15	5.30	0.56
	16	8.03	0.93
	Average	6.20	0.65
Sunday	1	5.53	0.60
	3	6.00	0.67
	14	7.09	0.96
	15	4.09	0.52
	16	6.50	0.89
	Average	5.66	0.72

Table A.3.

Trip Generation Rates per Employee for Weekday Time Periods for Individual Sites

	Trips per Employee				
Motel Number	24-Hour Rate Trip Rate	A.M. Peak Hour of Generator Trip Rate	P.M. Peak Hour of Generator Trip Rate	AM Peak Hour of Adjacent Street Trip Rate (7am-9am)	PM Peak Hour of Adjacent Street Trip Rate (4pm-6pm)
1	34.14	1.43	4.29	1.07	3.21
2	28.17	1.50	3.58	1.00	2.08
3	24.22	1.78	3.11	1.22	2.33
4	29.15	2.23	2.92	2.23	2.92
5	38.13	1.73	4.73	1.47	2.20
6	35.31	2.54	3.92	1.62	1.92
7	27.73	1.45	3.55	1.36	2.55
8	18.22	1.56	2.44	1.22	1.22
9	36.83	2.75	3.33	2.75	2.33
10	31.00	2.22	3.56	2.22	2.67
11	39.14	2.71	3.57	2.21	2.00
12	32.76	2.29	4.06	1.76	1.76
13	33.71	2.43	4.71	1.86	4.29
14	41.79	3.43	4.29	3.43	2.36
15	32.84	1.63	3.68	1.32	2.37
16	33.80	2.47	3.40	2.47	2.20
Average	32.96	2.14	3.73	1.84	2.35

Table A.4.

Trip Generation Rates per Employee for Weekday Time Periods for Individual Sites

Time Period	Motel Number	24-Hour Trip Rate (trips/ employee)	Peak Hour of Generator Trips Rate (trips/ employee)
Saturday	1	30.50	3.71
	3	38.78	2.56
	14	30.64	3.29
	15	33.47	3.53
	16	36.40	4.20
	Average	33.62	3.54
Sunday	1	17.79	1.93
	3	18.00	2.00
	14	27.36	3.71
	15	18.53	2.37
	16	27.73	3.80
	Average	22.00	2.80

APPENDIX B

QUESTIONNAIRE FORM

QUESTIONNAIRE

Room No. _____

Time of check in _____ Date of check in _____

Time of check out _____ Date of check out _____

Dear Guest,

We would like to ask you to answer the following questions in order to gain a better understanding of your needs. This study will help serve you better in the future. Thank you for your cooperation. It is greatly appreciated.

Sincerely,

Management

1. How would you best describe yourself?
   a) Tourist/pleasure traveller
   b) Business/commercial traveller
   c) Other _____

2. How would you best describe the purpose of your stay?
   a) I have reached my destination
   b) I am passing through to my destination

3. Please list the number of times your vehicle exited and returned (round trip) to the motel for the following reasons during the time of your stay. For <u>each time</u> your vehicle exited and returned to the motel please list <u>only one</u> purpose.

   a) Restaurant (number) _____
   b) Recreational (number) _____
   c) Social (number) _____
   d) Business (number) _____
   e) Shopping (number) _____
   f) Other (number) _____

VITA

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