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Full Length Research Paper

An optimization solution by service science management and engineering (SSME) for using minibuses service as an alternative for private cars around Hentian Kajang in Malaysia

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There are lots of problems in Hentian Kajang: traffic congestion, unnecessary loss of fuel and global warming are only but a few of these problems. This study is an attempt to understand people's behaviour and modal choice and try to influence them, and public transport. A survey was conducted to develop the choice among private cars, minibuses and trains users, and a total of n=250 questionnaires were distributed. Legit models were developed for the alternative modes of private cars to minibuses. This study found that the most important variables found likely to encourage the use of public transport reduced travel time and subsidized fares. The data were processed by SPSS software to determine which factors encourage and discourage the use of private, public and minibuses transportation. According to the sensitivity analysis, travel time is 0.48, travel cost reduction is 0.567, frequency is 1.888, and the regularity of schedules is a key factor for change of the use of a minibus when the public viewed them in isolation from other factors that limit this option. As expected, the commuter switches to minibuses.

Key words: Service science management and engineering (SSME), MIS public transport policy, car reduction, logic model, mode choice.

INTRODUCTION

SSME is a term that frequently appears in the service management, service operations, services marketing, service design, and service engineering literatures (Ritter, 2002). Service involves both a provider and a client working together to create value. A doctor interviewed a patient, does some tests, and prescribes some medicine – the patient answers the questions, cooperates with the tests, and takes the medicine faithfully (Karni and Kaner, 2006). Perhaps technologies and other people are involved in the tests or in the assignment and filling of prescriptions. Together, doctor, patient, technologies and others co-create value in this case with patient health (Chase, 1981). These relationships and dependencies can be viewed as a system of interacting parts. In many cases, a service system is a kind of complex system – a

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Abbreviations: SSME, Service science management and engineering; **IBM,** international business management; **SS,** service science; **SM,** service management; **SE,** service engineering; **ESSM,** engineering social sciences and management; **P,** probability; **α,** variable 1; **TT,** Travel time for the minibus.

system in which the parts interact in a non-linear way (Cook et al., 1999). SSME can be said to be an approach to integrating a variety of disciplines including engineering, social sciences and management (ESSM) (Spohrer and Maglio, 2008), to focus on education and research on services.

The world economy is currently transitioning from a goods based economy to an economy in which value creation, employment and as such, a service system is not just the sum of its parts, but through complex interactions. The parts create a system whose behaviour was difficult to predict and model. In many cases, a main source of complexity in a service system is its people, whether those at the client, those at the provider, or those at other organizations (University of Chicago Press, 2003). Throughout human history the land was known by many changes in climate that scientists have been able to justify most of the natural causes, such as some volcanic eruptions or solar fluctua-tions. However, the dramatic increase in the temperature of last year, the earth's surface over the past two centuries (since the start of the industrial revolution) (Balsas, 2003), especially the twentieth scientists could not be subjected to the same natural causes; where was the human activity during this period? a significant impact must be taken into account to explain this steady rise in the Earth's surface temperature or the so-called global warming (Angela, 2007).

SSME are terms introduced to describe service science, an interdisciplinary approach to the study, design, and implementation of services systems – com-plex systems in which specific arrangements of people and technologies take actions that provide value for others. More precisely, SSME has been defined as the application of science, management, and engineering disciplines to tasks that one organization beneficially performs for or with another (Jorge et al. 2009).

Today, SSME is a call for academia, industry, and governments to focus on becoming more systematic about innovation in the service sector, which is the largest sector of the economy in most industrialized nations, and is fast becoming the largest sector in developing nations as well. SSME is also a proposed academic discipline and research area that would complement – rather than replace – the many disciplines that contributed to knowledge about service (Hefley and Murphy, 2008), The inferences that can be concluded from the statistics for net district domestic product, per capita income of the study area was presented (BBS, 2000).

Components of SSME

Service science, management and engineering (SSME) is a growing multi-disciplinary research and academic effort that integrated aspects of established fields like computer science, operations research, engineering, management sciences, business strategy, social and cognitive sciences, and legal sciences. Global markets are increasing service-based economies. Employment growth will be concentrated in the service-providing sectors of the global economy. Service innovation is needed to maintain profits (Lusch et al., 2006). Service design, development, marketing and delivery all require methods to make service businesses more efficient and scalable. Practitioners need depth and breadth in combinations of technology, business, and organizational studies, even at the undergraduate level. The goal of service science is to nourish productivity, quality, and learning and innovation rates across the service sector. We hope the resources on this site help to better understand and engage in the evolving discipline.

Traditionally overlooked as a ‘necessary evil’, service management is moving to the forefront as a business strategy. To maintain growth and customer loyalty in a competitive environment, leading companies had recognized the need to improve Service and Service Parts Management capabilities. SSME contains three parts based on the discipline; it is associated to: service science (SS), service management (SM) and service engineering (SE), respectively. These three parts often work together. The activities and tasks of these parts are integrated to produce and improve the service systems (Song et al., 2008)

The main drivers for a company to establish or optimize its service management practices vary. There are some benefits (Azmi and Ibrahim, 2001):

1. High service costs can be reduced, that is, by integrating the service and products supply chain.
2. Inventory levels of service parts can be reduced and therefore reduce total inventory costs.
3. Customer service or parts/service quality can be optimized.
4. Increasing service revenue.
5. Reduce obsolescence costs of service parts through improved forecasting.
6. Improve customer satisfaction levels.
7. Reduce expediting costs - with optimized service parts inventory, there is no need to rush orders to customers.
8. Minimize technician visits - if they have the right part in hand, they can fix the problem on the first visit.

The interaction of the above six areas namely; investi-gation data and information, science knowledge, analysis data, engineering knowledge, service management and result from the survey can be demonstrated through a diagram. Figure1 showed how science takes investi-gation data and information and science knowledge, analysis data, and engineering knowledge and turns it into knowledge while, engineering takes knowledge and makes things of result from it. Next, management examines the process of creating things of value and

Figure 1. Multidisciplinary way of creating value basic radial.

administers, manages, supplies, optimizes and makes profitable this process

These three components that is, Science, Engineering and Management are critical pillars of services activities. SSME is important as the world is becoming networked, dependent on information and information technology. Science will provide tools and methods to study services and develop solutions to problems that span multiple disciplines. The goal of SSME is to improve service systems and this is carried out through service innovation which is inherently multidisciplinary Figure 1.

In a nutshell, SSME can be said to be a term introduced by IBM and has thousands of technical researchers and business consultants around the world dedicated to services. This group has created a dynamic testing ground for SSME theories and practices. In addition, many IBM researchers are collaborating with academics that can help drive new programs and courses, and establish a new community around SSME. Potential IBM-SSME collaborations include:

1. Develop methods and skills to create reusable assets.
2. Sponsor centres, journals and conferences.
3. Service on curriculum and research advisory committees.
4. Offer joint programs with IBM research, IBM business consulting services and IBM Global Services

Key concepts

Service

In national economic statistics, the service sector is often defined as whatever is not agriculture or manufacturing service sector – Tertiary sector of the economy (Jorge et al., 2009). Intuitively, services are processes, performances, or experiences that one person or organization does for the benefit of another – such as custom tailoring suit, cooking a dinner to order, driving a limousine, mounting a legal defence, setting a broken bone, teaching a class, or running a business's information technology infrastructure and applications. In all cases, service involves deployment of knowledge, skills and competences that one person or organization has for the benefit of another (Vargo and Lusch, 2004), often done as a single customized job. And in all cases, service requires substantial input from the customer or client (Sampson, 2001) – how else could your steak be customized for you unless you tell your waiter how you want it prepared? In general, there are so-called front-stage and back-stage activities in any business transaction – front stage being the part that comes in contact with the customer and back stage being the part that does not. Service depends on having a high degree of front-stage activities to interact with the customer, whereas traditional manufacturing requires very little customer input to the production process and depend almost entirely on back-stage activities.

METHODS

A questionnaire study was carried out in selected urban environments of the Hentian Kajang area to determine reasons for travellers' mode choice of minibuses. The survey was carried out on a selected corridor in Hentian Kajang where there was high ownership of cars and the use of public transport and minibuses are available (Ahn and Cassidy, 2007). A total of 250 questionnaires

were collected over a period of 3 months from January to March, 2010. The questions addressing the users of private cars and minibuses were contained only in the revealed preference survey, pertaining to demographic, socioeconomic characteristics and mode attributes (Abdullah et al., 2007). The respondents were requested to report their current travel situation by answering a set of questions. These questions are categorized into (Balsas, 2003): Questions on respondent's current travel modes and associated attributes such as current travel mode available to the respondent in his/her current travel mode and associated travel time, cost, and access approach (Angela, 2007). The respondents were encouraged to report information on other travel mode attribute values. (Sun, 2009) Traveller's personal information relating to travel mode choice such as age, income, gender, occupation, education, total number of household members, and number of vehicle ownership in the household (Axler et al., 2006). The survey information included socio-economic characteristics of individuals, trip information of individuals, and attitudes and perceptions on travel and policy measures (Ahn and Cassidy, 2007). Socio-economic information included household income, individual's income, age, gender, vehicle ownership, and total number of members in household, occupation and education level. Trip information of individuals included the purpose of the trip, mode of travel, total travel time and travel cost, Improving the frequency ,suitable waiting time at the minibus Stops ,distance for the residential location etc. A logic model developed alternatives namely; bus, train and car, with the aim of comparing the utility of these travel modes and to identify the factors that would influence car users to move from travelling by car to choosing the public transport alternative (Angela, 2007). The explanatory variables were: age, gender, income, travel time, travel cost and car ownership.

Services sciences

The definition of services sciences is still under debate. According to the service management Interest Group at the Harvard Business School (Ritter, 2002), the main differences between services and manufacturing are in four perspectives:

1. Services are often marketed and performed by the same people.
2. Services can rarely be inventoried in conventional ways.
3. Services present special problems of quality control in a real-time delivery environment (Omerod, 2005).
4. Services benefit from creative human resource management.

The research division of IBM used the term "services sciences" to refer to service science management and engineering (SSME). This term includes both the service industry and service in the manufacturing industry. SSME has been defined as the application of science, management, and engineering disciplines to tasks that one organization beneficially performs for and with another. In a word, services sciences are about the adoption of scientific methods and tools in service sectors in order to serve the services. This has become the focus of a great deal of research as well as practice in recent years (Quinn and Paquette, 1990).

Service system

Flexibility and optimization at all levels are the ultimate goals in service systems design and management (Normann, 2004). In designing a supply chain, firms are often faced with the competing demands of improved customer service and reduced cost. Citric researcher Max has developed a model that incorporates supply chain-related costs while ensuring that certain service requirements are satisfied. His results suggested that significant service improvements can be achieved relatively to the minimum cost solution at a relatively incremental cost.

Businesses also need to take steps to deal with disruptions, which can happen to any supply chain, logistics system, or infrastructure network. Today's firms tend to assemble final products from increasingly complex components procured from suppliers rather than produced in-house. Colleagues are developing models to understand the interdependence of risks faced by a supply chain or a service system, and are working to design service systems that are robust and resilient (Quinn and Paquette, 1990).

The main drivers for a company to establish or optimize its service management practices vary (Vargo and Lusch, 2006):

1. High service costs can be reduced, that is, by integrating the service and products supply chain.
2. Inventory levels of service parts can be reduced and therefore reduce total inventory costs.
3. Customer service or parts/service quality can be optimized.
4. Increasing service revenue.
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7. Reduce expediting costs - with optimized service parts inventory, there is no need to rush orders to customers.
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Service management

Service management was integrated into supply chain management as the joint between the actual sales and the customer. The aim of high performance service management is to optimize the service-intensive supply chains, which are usually more complex than the typical finished-goods supply chain. Most service-intensive supply chains require larger inventories and tighter integration with field service and third parties. They also must accommodate inconsistent and uncertain demand by establishing more advanced information and product flows. Moreover, all processes must be coordinated across numerous service locations with large numbers of parts and multiple levels in the supply chain (Normann, 2004).

Among typical manufacturers, post-sale services (maintenance, repair and parts) comprise less than 20% of revenue. But among the most innovative companies in service, those same activities often generate more than 50% of the profits. Generally, service management comprise six different capabilities that companies should consider for optimization (Ross et al., 2006).

Impact on the environment

The problem with car-dependence on societies lies with its large impact on the environment, where the energy consumption and CO_2 emission of various modes of transportation are compared. Cars and taxis show high figures for both categories, emitting more than ten times the amount of CO_2 compared to trains, and over twice the amount of buses. In order to mitigate global warming, we must reduce the amount of environmental burden per unit transport Figures such as this make the importance of public transportation clear (CIT, 2001).

For future specific fuel consumption and specific CO_2 emissions of road vehicles, a 25% improvement was assumed for passenger cars and motorcycles and 20% for public buses in urban rail transit, the assumed improvement of final energy consumption from 2005 to 2020 is 20%. Besides, that CO_2 emission factor has been adjusted to the expected changes in the energy carrier split for electricity production in China analyses in (ICT, 2007). Hence,

Table 1. Improving the travel time for the minibus.

Valid (%)	Frequency	Percent	Valid percent	Cumulative percent
15	6	24.0	24.0	24.0
30	1	4.0	4.0	28.0
45	2	8.0	8.0	36.0
60	3	12.0	12.0	48.0
75	8	32.0	32.0	80.0
90	5	20.0	20.0	100.0
Total	25	100.0	100.0	

specific CO_2 emissions per passenger performance for a passenger car in Shanghai in 2020 will be about 3.5 times higher than that with public bus and 5.4 times higher than with urban rail transit. (ICT, 2007)

Financial implementation

The Malaysian government should provide financial infrastructure to public transport as well as provide the necessary tools for precautions to this sector. Also, the government should put some procedures and not to encroach upon the overall limits. Some of these measures are (Sustainable online 13 January, 2010):

1. Providing funds for public transport infrastructure.
2. Car parking charges.
3. Congestion charges.

In a study conducted, the impact of a transport model shift in a city: the case of Cape Town has set the following targets for achieving a transport modal shift:

1. 10% shift in commuters from private to public transport by 2020.
2. Energy savings.

If the city achieves its targets by 2024, 148 million gigajoules of energy would be saved. This is the energy equivalent of 4.7 billion litters of petrol saved.

Model structure

The logic model was used as a final model to investigate mode, choice and behaviour of travellers of modes of transport and to determine the tradeoffs travellers make when considering their mode of transport (Garvill et al, 2003; Krygsman and Dijst, 2001). The proposed model that contained all models was used to determine the dependent variables.

$$P = \frac{1}{1 + D e^{\alpha(\text{variable})}}$$

Investigating data and survey

Kajang is a town in the eastern part of Selangor Kajang, Malaysia (2.98° N and 101.77° E). It is located about 20 km south of the Malaysian capital, Kuala Lumpur (mykajang Hentian Kajang online 21 February, 2010).

Hentian Kajang is one of the fastest growing areas in the suburbs of the city, as it includes a major way station to transport passengers and the availability of public transport minibuses and buses as well as the region contains station (keretapi tanah melayu KTM train) that was transferred to the Kuala Lumpur capital. Large numbers of vehicle ownership and fixed mounting of the population make Hentian Kajang an excellent area for the study.

Data collected from the survey in the Hentian Kajang which was based on a questionnaire distributed in the area on the one that brought together different characteristics including age, race, and the number of family members and the level of education, which gives a clear understanding of the social and economic profiles of demographic. Other information collected includes: the level of knowledge (public transportation), and the travel time, travel costs, and the number of flights and preferred means of transport.

A total of 250 questionnaires were distributed and collected throughout the process of data collection. The data was collected by an interview with car, bus and train users. The process of conducting the interviews and distributing the questionnaire took about two months from February to April 2010.

RESULTS AND DISCUSSION

Improving the travel time for the minibus

Travel time is considered an important reason for mode choice. Using public minibus services is perceived as a waste of time by almost all private vehicle users. Tables 1 and 2 showed that a time reduction of thirty percent in current minibus transportation servicing attracted (28%) of people to board on the minibus while, a time reduction of seventy five percent attracted (82%) of people to use the public minibus service, This indicated the possibility of an increase in the use of minibuses service (Figures 3 and 4, Table 3).

The results in Appendix reflect the process of the imported calibration used to obtain the results described in Table 4.

From the Appendix, the model used to obtain the value of P equals to 0.001140754 which is somehow acceptable to be significant (significant value <0.05) for R^2 (0.94537) (Table 4).

Thus: LN D = 3.195843; α = -8.26948 and D = 24.4308.

$$P = \frac{1}{1 + 24.4308\ e^{-8.26948\ (\text{Travel time})}}$$

Table 2. An illustration of the cumulative percent.

Valid (%)	Cumulative percent	
15	24.0	100.0
30	28.0	76.0
45	36.0	72.0
60	48.0	64.0
75	80.0	52.0
90	100.0	20.0

Figure 2. Hentian Kajang map (source Google map).

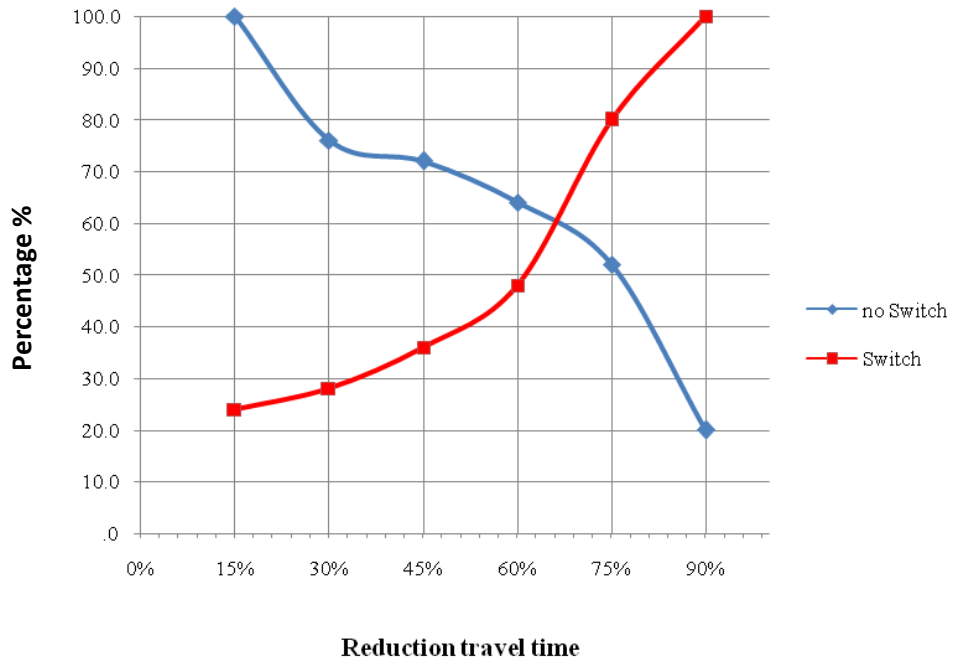

Figure 3. Switching to public transport if the travel time improves by reduction.

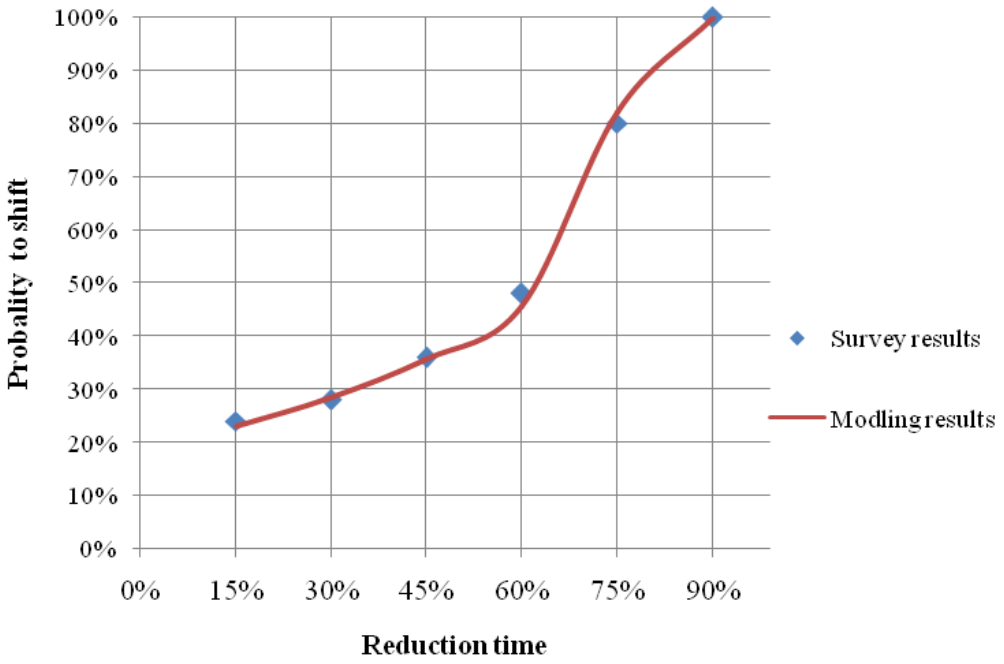

Figure 4. Improving travel time for the bus in order to encourage minibus users.

Table 3. An illustration of the survey results and data calibration for improved travel time.

Travelling time reduction (%)	Survey results (P)	(1-P)/P	Ln (1-P)/P
15	0.24	3.166667	1.15268
30	0.04	24	3.178054
45	0.08	11.5	2.442347
60	0.12	7.333333	1.99243
75	0.32	2.125	0.753772
90	0.2	4	1.386294

Table 4. An illustration of the survey results and logic model result.

Travelling time reduction (%)	Survey results (P)	Results from logic model
15	0.24	0.229495
30	0.28	0.283403
45	0.36	0.356892
60	0.48	0.456328
75	0.8	0.822283
90	1	0.998536

$$P = \frac{1}{1+De^{\propto(\text{Travel Time})}}$$

Improving the travel cost

Money is an important issue. Improving the travel cost for the minibus by its reduction will be a motive to encourage the use of minibus public transportation (Figure 5). Our survey result showed that 20% of the people will prefer using minibus if there is thirty percent reduction on the fare, while reduction of seventy-five percent on the fare will be enough to encourage 84% of the people which will prefer using public minibus for the cost pay of trips. Consequently, the fare will be enough to encourage

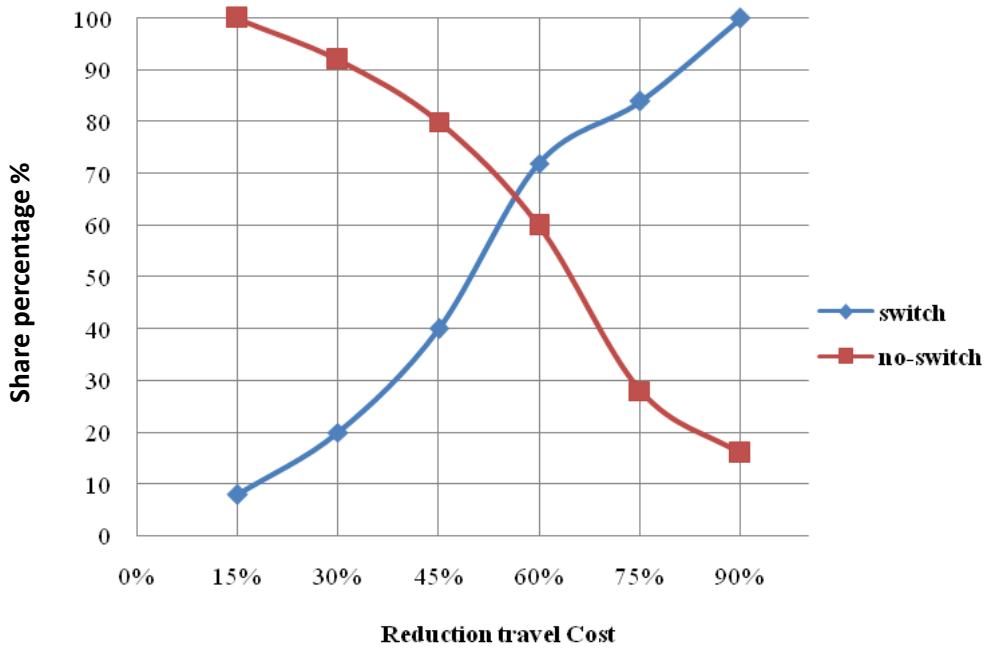

Figure 5. Switching to public transport if the travel cost improves by reduction.

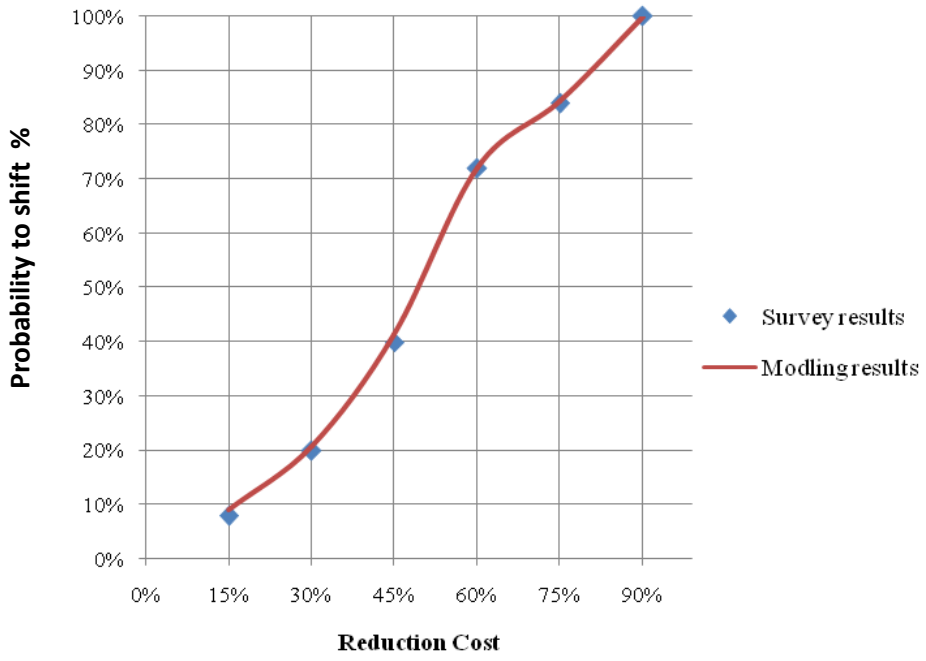

Figure 6. Improving the travel cost of the bus to encourage minibus users.

people to start using the public minibus (Figure 6).

Improving the frequency

It is generally acknowledged that minibus is cheaper than a private car but does not appear as a key factor for change in a small public bus when viewed in isolation from other factors that limit this option (Figure 7). Our survey result showed that 29% of the people will prefer using minibus if there is sixteen percent reduction on the regularity of schedules, while a reduction of thirty-six

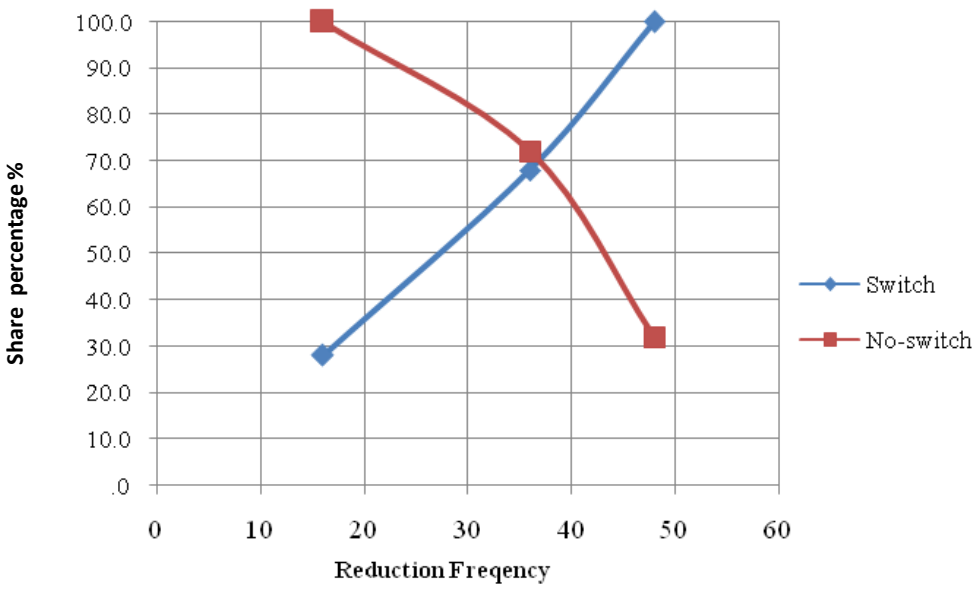

Figure 7. Switching to reduction frequency.

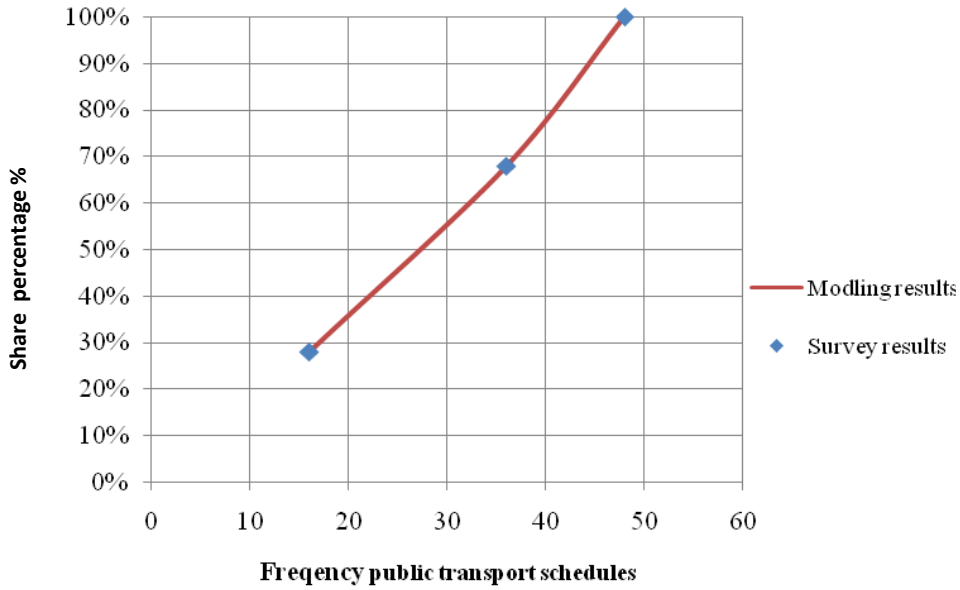

Figure 8. Improving the frequency of public transport schedules.

percent on the regularity of schedules will be enough to encourage 68% to prefer using public minibus (Figure 8).

Sensitivity analysis

Travel time reduction

The sensitivity of the modeling has been tested by taking the public transport services into a calibration. Therefore, a further 75% increment of time reduction for public transport travel will attract 36% of people to use the public minibus service; this indicated the possibility of an increase in the use of minibuses service. Then the sensitivity ratio is 0.48 (Table 5).

Travel cost reduction

Reduction of 60% on the fare will be enough to

Table 5. Sensitivity of the mode.

Changes in independent variable	Changes in dependent variable	Sensitivity ratio
75% travel time reduction	36% model shift	0.48
60% travel cost reduction	34% model shift	0.567
36% Frequency	68% model shift	1.888

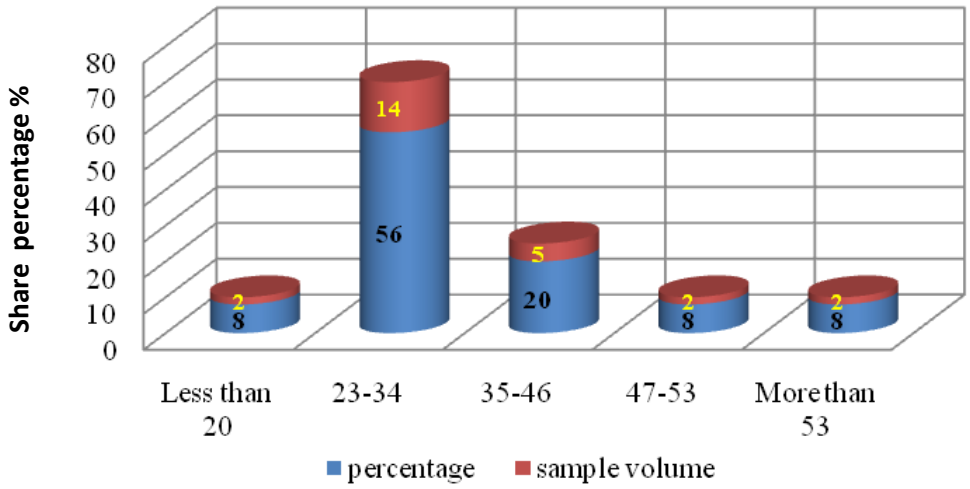

Figure 9. Car users according to their age.

encourage 34% of the people who will prefer using public minibus for the cost paid for the trip. The fare will be enough to encourage people to start using the public minibus. Then the sensitivity ratio is 0.567.

Findings of the survey

The section in which the main data were collected is within these streets: Jalan hentian 1, 2, 4, 6 – pangsapuri taman tenaga block A, block B, block C, block D-jalan tenaga 2 –jalan tenaga 3- jalan tenaga3a-jalan tenaga 5-jalan tenaga 6-jalan tenaga 9-jalan tenaga 10-jalan tenaga 20-jalan tenaga 21, jalan tenaga 22. The primary objective of the survey was to collect data to be used as user requirements to influence the use of minibuses and using different methods, urging them to include modeling the behaviour of transport users in closely minibus, find the best strategy to make policy effective by improving minibus services. It was observed that according to the age of car users, about 8% were younger, less than 20 (about 56%) were between 23 and 34 years of age, about 20% were aged between 35 and 46 years, and about 8% were aged between 47 to 53 and more than 53 years (Figure 9).

Illustration from our survey result showed that most of the private car users in Hentian Kajang are the Malays population with 36%, and Indian with 24%, while Chinese and international students who drove cars represent about 20% of the neighbourhood (Figure 10).

According to car users, the size of their household shows that the bigger the family, the more cars they will probably have; thus, it can be seen that households with the number of members between 1 to 3 persons represent about 44%, while families with 4 to 6 persons represent about 40% (Figure 11). Families with more than 6 persons represent about 16%.

Car ownership by the household is a major factor influencing the choice of transport. In this survey, the percentage of the number of vehicles each household owns is as follows: 36% had one car in their household, 40% had two cars and 24% had three cars (Figure 12). Although all the households had cars, it did not mean that car ownership was the sole or even main factor in the respondents' choice to drive. The household size, lack of public transport and low service frequency could have been more important factors in their choice.

Main survey questions

Results for the car users

Question 1: How many trips do you make to this station (Hentian Kajang) during the week?
1-5 to 7 trips { }; 2- 8 to 15 trips { }; 3- more than 15 trips { }
The bulk of the respondents that travel daily in private

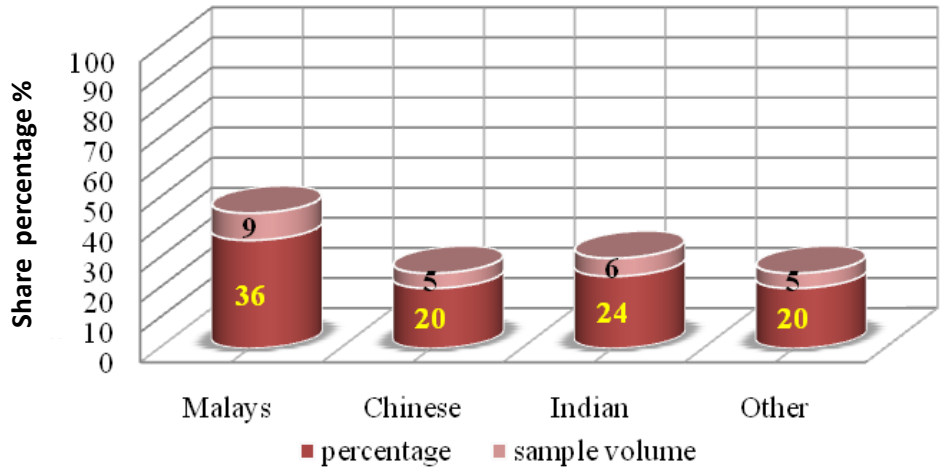

Figure 10. Car users according to their race.

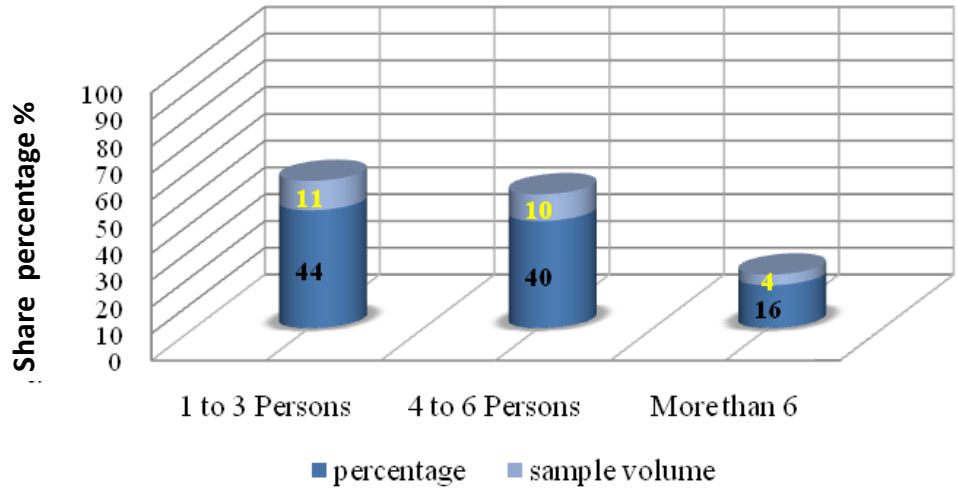

Figure 11. Car users according to the size of their household.

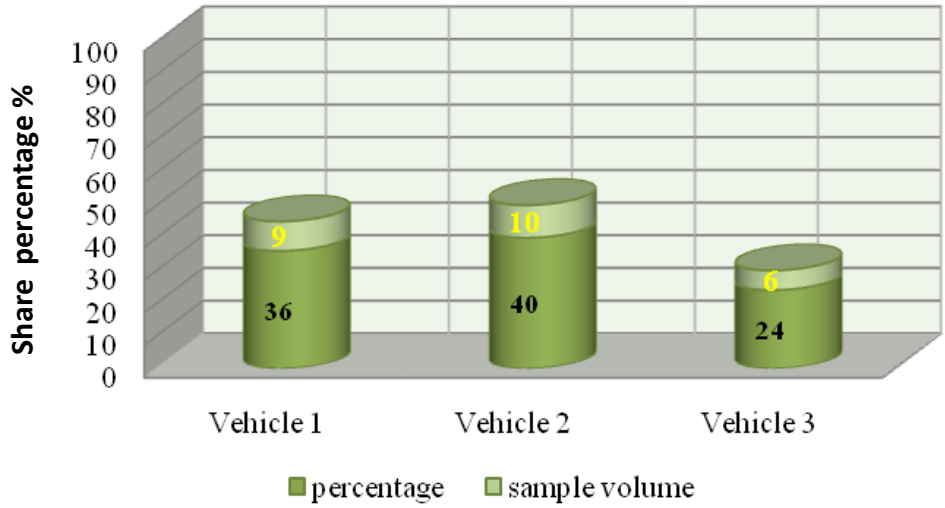

Figure 12. Car users' correspondence to their household car ownership.

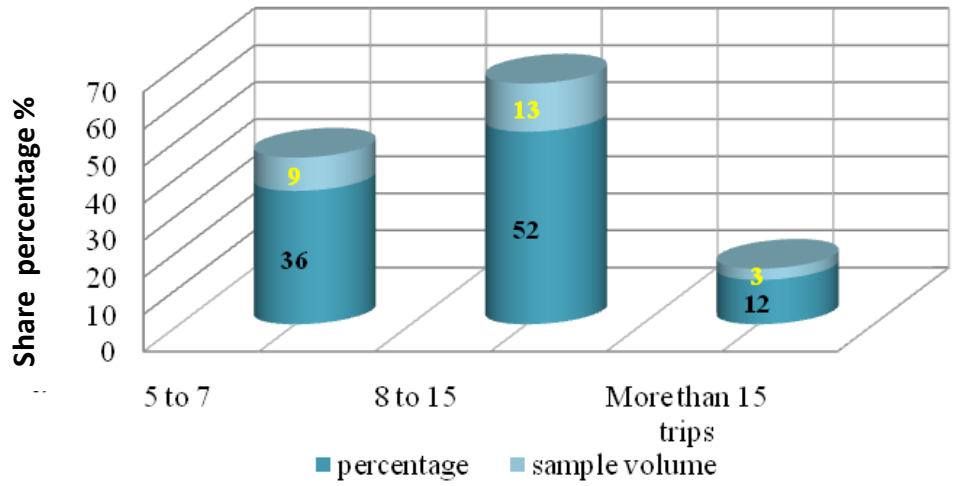

Figure 13. Car users according to the trip they make for a week.

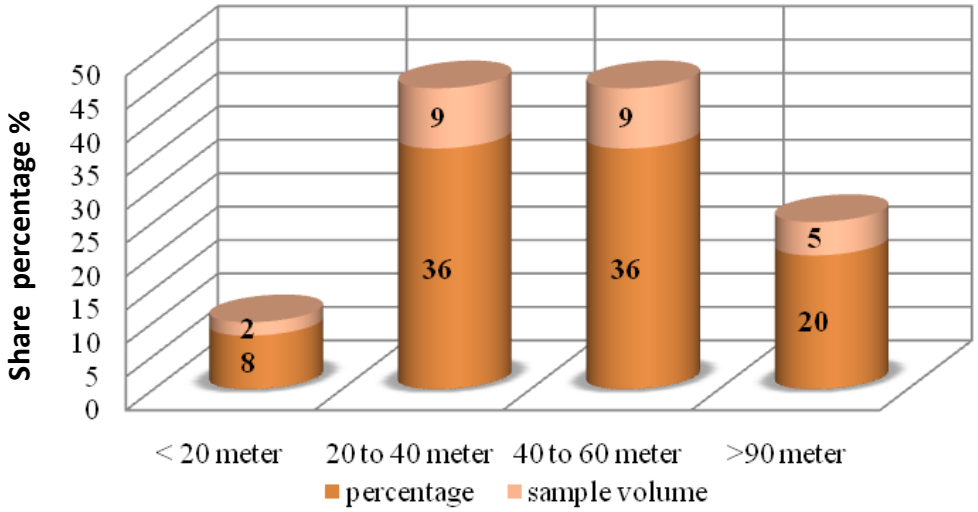

Figure 14. Residential location.

cars led to congestion in the region. Those that make 7 to 15 trips were 52%, those that make 5 to 7 trips were 36%, and those that make more than 15 trips were 12% (Figure 13).

Question 2: Where is your residence located?
< 30m { } 30 to 50 m { } 50 to 80 m { } >100 { }
Our survey showed that a large number of the residential area of respondents are located at a distance of 40 m (36%) and 60 m (36%), while a few number are located at a distance of >90 m (20%) (Figure 14).

Question 3: Do you have a driving license?
Yes { } no { }
80% of the users of private cars said they have a driver's license, while 20% do not (Figure 15).

Question 4: What is your occupation?
Full time employer { } part time employer { } student { } Housewife { } unemployed { }
More than 48% of the correspondents were full time employers, while the rest were students (32%), part time employers (12%), housewives and unemployed (4%) (Figure 16).

Question 5: What is your level of education?
Primary school { } secondary school { } college { }
Master { } PhD { }

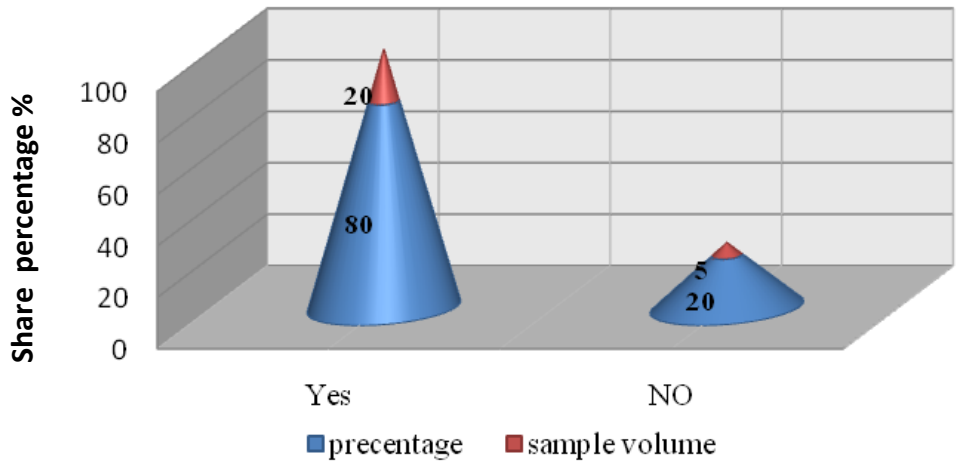

Figure 15. Driving license possessions.

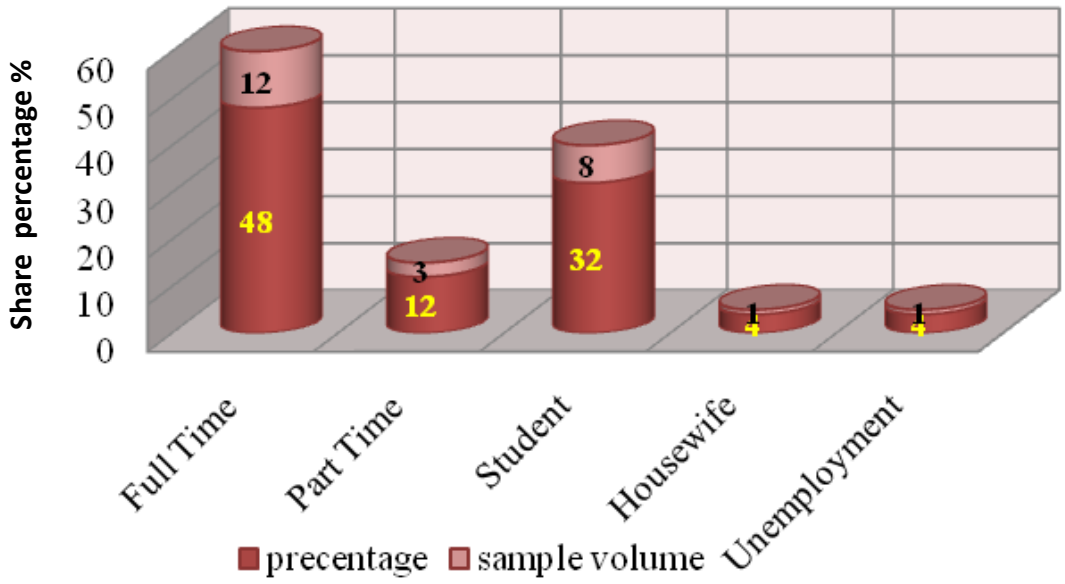

Figure 16. Occupation.

For educational background, 40% of car users were graduates, 32% attained masters, 12% had primary school, 8% had secondary school and 8% had PhD (Figure 17).

Results for public transport

Question 6: Would you say you know a lot, little or almost nothing at all about (Rotate) the public transportations' schedules in your areas?
A Lot { } little { } nothing { }
Knowledge about public transport indicated that the buses and minibuses were not regular in the right time. 16% answered a lot, 36% answered little, while 48% answered nothing (Figure 18).

Question 7: How many days a week do you usually work?
2 days { } 3 days { } 4 days { } 5 days { }
From our survey, people who go to work 4 days (40%) in a week are more committed to using private cars than those who go to work for 5 days (36%) and three days (16%), respectively. People who go to work or school 2 days a week have the least probability of owning a car with a staggering percentage of 8% (Figure 19).

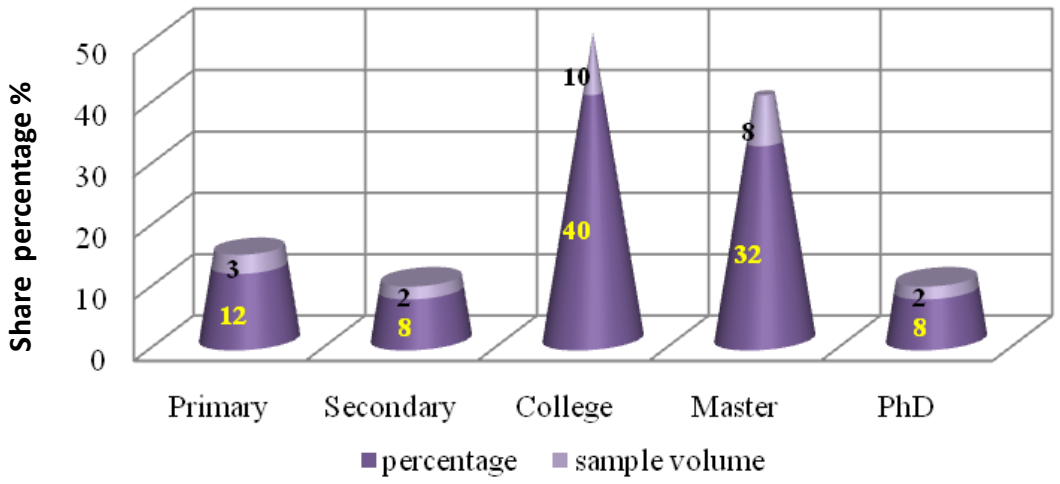

Figure 17. Car users according to their level of education.

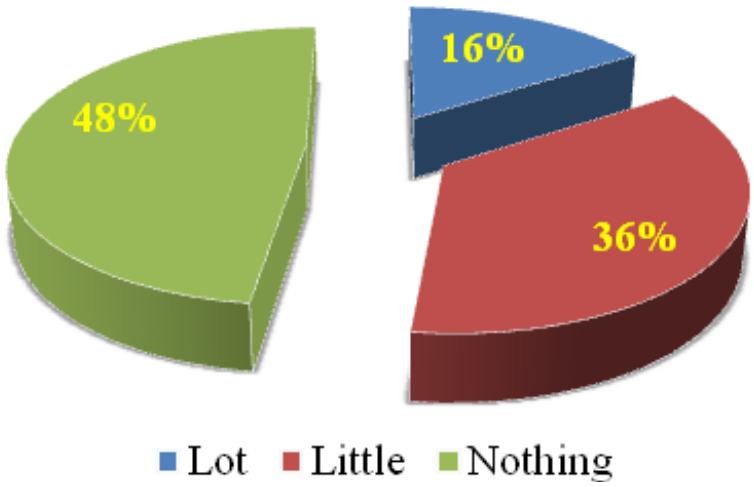

Figure 18. Car users' knowledge about schedules in the neighbourhood.

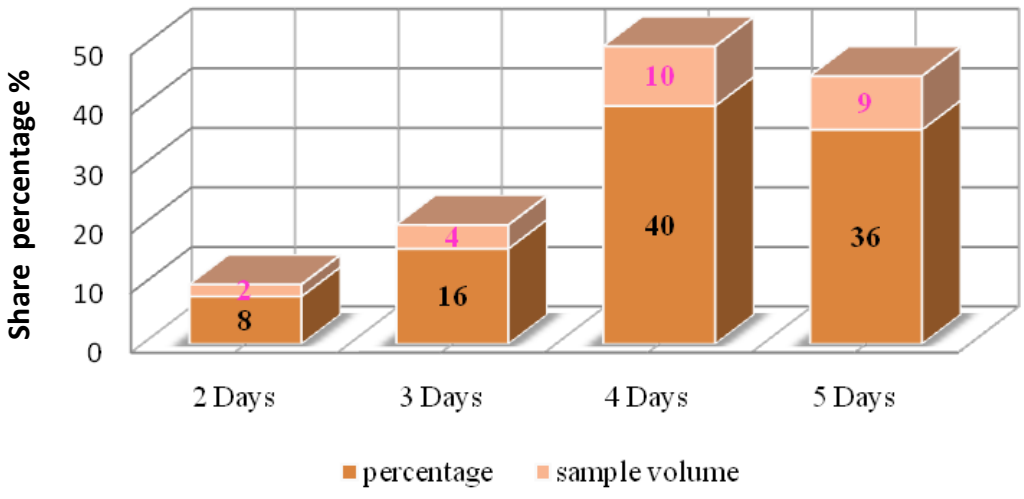

Figure 19. Car users' knowledge about working days per week.

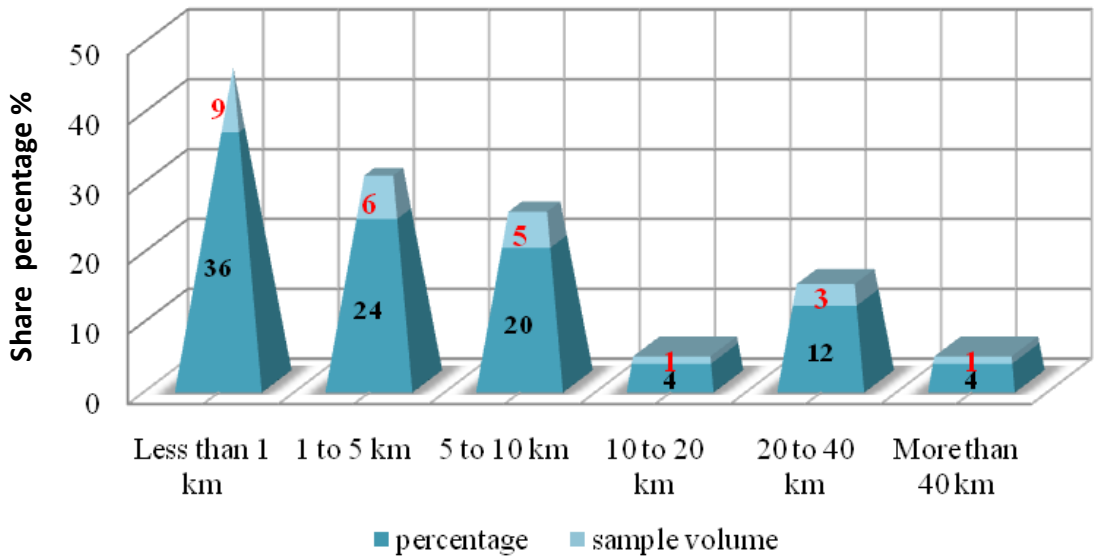

Figure 20. Car users according to working distance.

Results for minibus users

Question 8: Please estimate the distance between your place of work and where you live?
Less than 1 km { } 1 to 5 km { } 5 to 10 km { }
10 to 20 km { } 20 to 40 km { } more than 40 km { }.

Hentian Kajang as a vital location makes it a very popular place to live in where you can live away from the city in the suburb and still go to work regularly. We can see that people who have to travel less than 1 km have the largest percentage of car ownership (36%), and the other people who travel a distance of about 5 km occupy about 24% of total car ownership, while the other people who travel long distances of about 10 km occupy about 20%; thus, those that travel for long distances of about 40 km occupy 12% of total car ownership (Figure 20).

Question 9: What is your prime mode of transport to work?
Mode of transport to work shows that the use of private cars in a large proportion of 40% indicated that the train (24%) was the prime mode of transport to work, followed by the use of bus (20%), while the percentage of those that use minibuses was the lowest rate with a proportion of 16%, which indicated a failure to use minibuses due to use of several particulars because of the lack of minibuses and their facilities (Figure 21).

Observations

1. Different kinds of people were involved and this means that the foreigners were also involved with the parking problem.
2. Analysis of the responses indicated that 40% of the respondents have problem in finding the use of private cars. This indicates that there is a serious problem with the management of Hentian Kajang.
3. The three components: Science, Engineering and Management which are critical pillars of service activities are not integrated in the existing system. In fact there is an absence of any sort of management information system. The SSME principles are disregarded in the existing system.

Conclusion

The users of minibuses and of private cars should take strict measures to develop this sector. To be able to compete with cars, the minibus service must offer the quality desired by regular and potential users. It can be seen that potential users could be the ones who show positive attitudes to public transport. It is important to understand what these individuals want, the service attributes that are most important to them, and what would make them switch to using minibus services.

The sensitivity ratio (1.888) was very high. This ratio was possibly neglected, because there is need for modern travellers to use minibuses as a means of public transport. This process has positive consequences such as: it reduces travel time, cost prohibitive, as well as reduces environmental pollution by private cars, better service (more frequent flights and on time) and it reduces traffic congestion, especially in Hentian Kajang; whereas its negative consequence is less traffic on the roads which reduces pollution and increases safety.

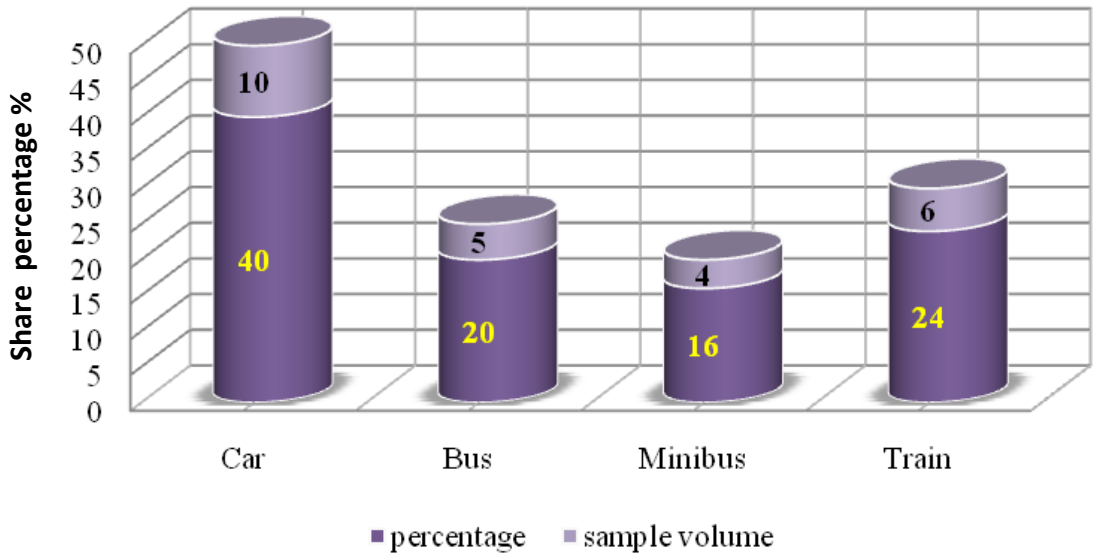

Figure 21. Mode of transport to work.

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Appendix. Summary output.

Regression statistics	
Multiple R	0.9723
R^2	0.945
Adjusted R^2	0.9317
Standard Error	0.2347
Observations	6

ANOVA					
	df	**SS**	**MS**	**F**	**Significance F**
Regression	1	3.81128	3.811284	69.20205	0.00114
Residual	4	0.2203	0.055075		
Total	5	4.03158			

	Coefficients	**Standard error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	3.196	0.19139	16.6984	7.5E-05	2.66447	3.727216	2.6645	3.7272
X Variable 1	-8.269	0.99407	-8.31878	0.00114	-11.0295	-5.50949	-11.029	-5.509