A STUDY ON THE SELECTION OF FAST FOOD RESTAURANT BY UTAR KAMPAR STUDENTS USING ANALYTIC HIERARCHY PROCESS (AHP)

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A STUDY ON THE SELECTION OF FAST FOOD RESTAURANT BY UTAR KAMPAR STUDENTS USING ANALYTIC HIERARCHY PROCESS (AHP)

By

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ABSTRACT

A STUDY ON THE SELECTION OF FAST FOOD RESTAURANT BY UTAR KAMPAR STUDENTS USING ANALYTIC HIERARCHY PROCESS (AHP)

Chen Jia Wai

Fast food is the food that can be prepared in a fast and standardize way as well as can be distributed quickly. The blooming of fast food restaurants have become the favorite choice among the undergraduates in Malaysia. They tend to choose fast food as alternatives besides traditional food in Malaysia due to the convenience. The objective of this project is to determine the priority of decision criteria in the selection of fast food restaurants among the undergraduates in Universiti Tunku Abdul Rahman (UTAR) Kampar Campus with Analytic Hierarchy Process (AHP) model. The decision criteria identified in this study are price, customer service, environment, flexibility, efficiency, location and cleanliness. Besides that, this project also aims to determine the most preferred fast food restaurant among McDonald's, Kentucky Fried Chicken (KFC), Pizza Hut, Domino's Pizza and Wing Zone with AHP model. The results of this study show that McDonald's is the most preferred fast food restaurant followed by KFC, Pizza Hut, Wing Zone and Domino's Pizza among the students. Price, customer service and cleanliness are ranked as the top three influential factors by the students in this study. The significant of this project is to determine the most preferred fast food restaurant as well as the most

influential decision criteria in the selection of fast food restaurants by the students in Kampar Campus with AHP model.

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Last but not least, none of this could happened without my course mates. We always motivate each other and keep track of each progress to make sure our progress is on time. Besides, their listening and consolation to my problems had relieved my stress all the time. Therefore, I would like to use this chances to thanks all of them for their supporting and understanding. I would also like to express my appreciation for their friendship in my university life.

DECLARATION

I hereby declare that the project report is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

_____

CHEN JIA WAI

APPROVAL SHEET

This project report entitled "**A STUDY ON THE SELECTION OF FAST FOOD RESTAURANT BY UTAR KAMPAR STUDENTS USING ANALYTIC HIERARCHY PROCESS (AHP)**" was prepared by CHEN JIA WAI and submitted as partial fulfilment of the requirements for the degree of Bachelor of Science (Hons) Statistical Computing and Operations Research at Universiti Tunku Abdul Rahman.

Approved by:

_____

(DR. LAM WENG SIEW) Date:…….

Supervisor

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Date: _____

PERMISSION SHEET

It is hereby certified that **CHEN JIA WAI** (ID No: **13ADB07227**) has completed this final year project entitled "A STUDY ON THE SELECTION OF FAST FOOD RESTAURANT BY UTAR KAMPAR STUDENTS USING ANALYTIC HIERARCHY PROCESS (AHP)" under the supervision of DR. LAM WENG SIEW from the Department of Physical and Mathematical Science, Faculty of Science.

I hereby give permission to the University to upload the softcopy of my final year project in pdf format into the UTAR Institutional Repository, which may be made accessible to the UTAR community and public.

Yours truly,

_____

(CHEN JIA WAI)

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

A	Pairwise comparison matrix
AHP	Analytic Hierarchy Process
CI	Consistency index
CR	Consistency ratio
c_{ij}	Degree of preference of element i to element j
FDW	Overall weight score for each decision alternative
$\lambda_{\max}$	Maximum eigenvalue
MCDM	Multi-Criteria Decision Making
n	Number of decision criteria or decision alternatives
Q	Weight score for decision alternatives with respect to each criteria
RI	Random index
w^T	Weight score for each decision criteria

CHAPTER 1

INTRODUCTION

1.1 Introduction

Fast food refers to sustenance that can be readied rapidly and effortlessly as well as sold in restaurants for fast meal or take away (Vogli, Kouvonen and Gimeno, 2014). In other words, fast food implies the food that can get ready and serve in the shortest time (Rashid, et al., 2014). Most of the fast food restaurants in Malaysia belong to franchise restaurant chain. It is built up with the walk up counter or even the drive-thru window. According to Statista (2016), McDonald's, Kentucky Fried Chicken (KFC), Pizza Hut and Domino's Pizza are listed as the ten most valuable fast food brands in worldwide. McDonald's with an estimated brand value of 88.65 billion U.S. dollars locates the first brands among the ten fast food brands while KFC, Pizza Hut and Domino's Pizza have the fourth, fifth and seventh places (Statista, 2016). Consuming fast food as breakfast, lunch, dinner or even supper has become a trend due to the human's changing lifestyle. It has evolved slowly into a needs for Malaysians (Samah, et al., 2015). Growing fast food culture is urged by the needs to spend time more efficiently when people's time spending outside nowadays is longer (Kecek and Gürdal, 2016). Evolution and marketing of fast food especially offer has influenced the young people consumption habit (Untaru and Ispas, 2014). The blooming of fast food restaurants in Kampar, Malaysia have become the favorite choice among the students in Universiti Tunku Abdul Rahman (UTAR) Kampar Campus. They tend to choose fast food as alternatives besides

traditional food due to the convenience. Therefore, factors such as price, customer service, environment, efficiency and so on will be studied in this research to investigate the students' selection of fast food restaurant.

1.2 History of Fast Food Restaurants

The first McDonald's Bar-B-Q restaurant was opened by two brothers who were Dick and Mac McDonald in San Bernardino, California. Their business are quite successful as their restaurant was a self-service drive-in restaurant with effective operation that served hamburger, soft drinks, potato chips and so on (Mcdonalds.com, n.d.). In 1954, a multi mixer salesman Ray Kroc discovered the opportunity of franchising this restaurant and one year later, his first McDonald's was opened in Des Plaines, Illinois (Aboutmcdonalds.com, n.d.). Until last year, McDonald's owns thirty six thousand five hundred and twenty five franchises in the worldwide (Statista, 2016).

The founder of Kentucky Fried Chicken (KFC) was Colonel Harland Sanders. He had originated a secret merge of eleven herbs and spices since 1952 (KFC®: Finger Lickin' Good®, n.d.). KFC was franchised in 1955 after the founder reached his retirement age (Kfc.ca, n.d.). In 1973, the first KFC restaurant in Malaysia was opened and there are over five hundred franchises across the nation (Kfc.com.my, n.d.).

The story of Pizza Hut began when the two brothers Dan and Frank Carney borrowed $600 from their mother to open their first restaurant in 1958 (Pizzahut.ru, n.d.). The restaurant was located in Wichita, Kansas. The founder

of Pizza Hut had brought the secondhand equipment for their starting business and free pizzas were given away to interested potential customers during the first night (Pizzahut.com.my, n.d.). Pizza Hut first entry in Malaysia was on 19th May 1982 at Yow Chuan Plaza, Kuala Lumpur (Saeed, Jain and See, 2001).

The original name for Domino's Pizza was DomiNick's. It was originated from two brothers who were Tom Monaghan and James who brought a pizza store in Ypsilanti, Mich in 1960 (Biz.dominos.com, n.d.). Later in 1965, Tom became the solo owner and the store was renamed to Domino's Pizza Inc. Within 13 years, there were two hundreds Domino's store and soon it was owned and franchised to over ten thousand stores in worldwide and become the leader of pizza delivery company. In 1997, the store was launched in Malaysia (Domino's Pizza Malaysia, n.d.).

Wing Zone is the youngest fast food restaurant among the other four restaurants. It was started by Matt Friedman and Adam Scott in 1991 with the idea of fulfilling the university's students living pattern which is studying late and searching for supper in the late night. The specialty of their food is the source and techniques to prepare the wings. Once their business become popular among the students, they opened their store in Gainesville and Wing Zone is globalized in 2009 (Wing Zone Malaysia, n.d.).

1.3 Problem Statement

There are multiple decision criteria or factors to be considered in choosing a fast food restaurant among the students. Therefore, the priority of decision criteria is very important in the selection of fast food restaurant. Selection of the most preferred fast food restaurant among the UTAR Kampar students is a Multi-Criteria Decision Making (MCDM) problem. Analytic Hierarchy Process (AHP) method will be used to study the preference of UTAR Kampar students in the selection of fast food restaurants. AHP model enables hard measurement to be scaled in human value. It can helps to decompose a complex structure into a basic one so that people can evaluate the problem easily through diversification.

1.4 Objectives

There are three objectives in this study which are shown as follows:

i) To determine the priority of decision criteria such as price, customer service, environment, flexibility, efficiency, location and cleanliness in the selection of fast food restaurant by using AHP model.

ii) To identify the ranking of fast food restaurant selection with respect to each decision criterion by using AHP model.

iii) To determine the most preferable fast food restaurant among McDonald's, Kentucky Fried Chicken (KFC), Pizza Hut, Domino's Pizza and Wing Zone based on UTAR Kampar students' preference by using AHP model.

1.5 Significance of the study

The significant of this project is to determine the most preferred fast food restaurant as well as the most influential decision criteria in the selection of fast food restaurants among UTAR Kampar students with AHP model. Furthermore, this study also helps other less favorable fast food restaurants to identify the potential improvements based on the most influential decision criteria.

1.6 Limitation

The target respondents in this research is limited to UTAR Kampar students only. Therefore, the results of this study indicate the preference of students in the selection of fast food restaurants in Kampar, Perak, Malaysia. It does not represent the preference of all consumers such as children and adults in Malaysia.

1.7 Outline of the Project Report

Chapter 1 has given an idea on the research topic and background of fast food restaurants in Malaysia. Problem statement, objectives, significance of the study as well as the limitation of this research have been presented also. The next chapter describes the literature review. Chapter 3 discusses about the data and methodology used in this study. Chapter 4 will presents the empirical results and discussion of this study while Chapter 5 concludes the project.

CHAPTER 2

LITERATURE REVIEW

Chapter 2 will discuss about the past researches that focus mainly on application of Analytic Hierarchy Process (AHP) model. Section 2.1 will explain the decision criteria that are selected from the researches related to fast food. Section 2.2 will describe the researches about application of AHP model in the selection of fast food restaurant in other country while the last section will demonstrate the application of AHP model in other field.

2.1 Review on Factors Affecting Fast Food Restaurant Selection

Fast food restaurants have been emerging in Malaysia for years. It is so happened that Malaysians' lifestyle are getting busier and due to the appearance of fast food restaurants also, it has change their eating pattern. Elements like educational developments, higher competition and time factor have enhance the fast growing of fast food consume habit (Kecek and Gürdal, 2016). Fast food restaurants such as McDonald's, Kentucky Fried Chicken (KFC), Pizza Hut, Subway, Wendy's, Burger King and so on are the common restaurant that can be easily found in Malaysia. There are various considerations before a purchase is made. Thus, seven criteria for preference of fast food restaurants are determined after the literature review.

2.1.1 Price

Price can be defined as the amount of money that a customer willing to pay for a certain item, food or services (Samah, et al., 2015). Consumers' purchase decision depends on their perception towards price. They are more preferred to a product that has a lower price. One of the factors that Samah, et al. (2015) examined in the research was the effect of price perception on customers' loyalty in fast food restaurant. The authors managed to prove that this factor showed a positive influence. Besides, Kavitha, Souji and Prabhu (2011) denoted that price sensitivity happens when a customer react to the change of price. The sensitivity vary from people as low income group are more sensitive towards the price. In the research of studying generation Y's food preference, Kavitha, Souji and Prabhu (2011) found out that this generation were moderately sensitive towards price. Since the respondents were students and they did not have stable income, price was ranked as the second top factor that would influence their food preference. In Romania, similar research was done by Untaru and Ispas (2014). The authors indicated also price was crucial factor that attract the youth who were not economically strong (Untaru and Ispas, 2014; Boo, 2012).

2.1.2 Customer service

A restaurant can offers various types of services. Customer service in this research refer to the services that are provided by the employees. It includes whether the employee serves the customers patiently, is their order accurate or do they answer customers' inquiry politely (Rashid, et al., 2014). Front line

employees play significant role in connecting consumers with the restaurant because consumer's feeling depends on their performance (Untaru and Ispas, 2013). Customers always concern about employee services. Their satisfaction is based on their expectation towards the services. In accordance with Min and Min (2013), improving services can helps to keep customers' loyalty in this competitive market. Employers should cater its services to adapt customers' changing needs and preference. For instance, the usage of computer system to order food and settle payment can helps to increase the accuracy of the order and payment. In addition, it can shorten the operation time as the system is faster and more efficiency. Service quality considered as one of the important factors also because the service provider's performance may affect customers' impression and judgement (Azila, et al., 2014).

2.1.3 Environment

Environment can be related to the atmospheric or physical environment of a restaurant such as area, signs, artifacts or condition surrounding (Untaru and Ispas, 2013). It is one of the factors that will affect customers' satisfaction because it will influence their emotions and expectations (Ryu and Jang, 2008; Jaini, Ahmad and Zaib, 2015; Azila, et al., 2014). Environment is the first thing that arise before customers receive any services from the restaurant. Hence, it acts as a pointer for customers' reaction (Jaini, Ahmad and Zaib, 2015). Moreover, young people nowadays prefer having meals outside at all times. Traditional family dinner is being replaced gradually (Jaworowska, et al., 2013). In Kampar, students studying or doing assignment in fast food restaurants or

café is a common phenomenon. Therefore, environment factor is considered in this study.

2.1.4 Flexibility

Operation hour of a fast food restaurant plays a significant role in affecting customers dine in intention. For instance, 24 hours operating restaurant will definitely attracts those consumers who prefer going out late at night. For the restaurants that operate only in the evening until night session, it is probably focus on the dinner dine in customers. Some of the fast food restaurants are operating in 24 hours like McDonald's but some are not. Min and Min (2013) set operation hours as one of the factors that the US and Korean consumers will considered during their selection of fast food restaurants. Opening hours belong to one of the factors that can helps to increase sales and demand (Untaru and Ispas, 2014). Since Kampar is a university town, the operation hour of fast food restaurants can be compared according to students' preference.

2.1.5 Efficiency

The speed of serving the customers when they walk into the restaurants until they are being served completely is defined as efficiency. In Romania, "Fast-food culture" has become the youth dining trend (Untaru and Ispas, 2014). This condition same goes with the Kampar students. Fast food is no longer consider as luxurious food. It suits people from all different levels. One of the causes that make fast food become common is its fast serving. Efficiency is essential in every sector. For food industry, fast serving can improve customers' satisfaction.

2.1.6 Location

Strategic location can enhance a restaurants to boost its sales. According to Min and Min (2013), locating establishments near to the competitor restaurants can earn locational advantage and get attention of potential customers. Consumers tends to have more selection and hence will increase the competition among restaurants. Due to the main consumers in Kampar belongs to students and their main transportation are bicycle, motorbike or cars, so location will be a consideration criteria because of the distance between the fast food restaurant and their accommodation. Meanwhile, Untaru and Ispas (2014) denoted location as one of the main features in their research.

2.1.7 Cleanliness

Lastly, hygiene is a very important criteria also as it will affect consumers' health. A restaurant cleanliness included facilities, toilet and the overall cleanliness (Untaru and Ispas, 2014). A dirty environment will affect consumers' appetite and yet reduce their number of visitation to the restaurant. From the findings of Min and Min (2013), they found out that cleanliness is the most valued factor by the Korean customers while it is ranked under top five factors by the US customers.

2.2 Application of AHP model in the Selection of Fast Food Restaurant

There are indeed numbers of fast food restaurants with different types of food provided at different price level. Consumers will always select their preference food and restaurant based on various considerations. AHP model has been used

in many studies in the fast food field to identify the significant factors that influence consumer's decision. Min and Min (2013) had conducted a cross cultural research on investigating the differences in the perceived service quality between USA and Korea fast food consumers by using AHP model. USA sample was collected from 262 customers who dine in at six different fast food restaurants in Southeastern and Midwestern US starting from January 2008 until November 2009. However, five different fast food restaurants in Seoul, South Korea were chosen together with two local fast food franchises to collect the sample starting from July of 2009 until December 2009. Among a total of 15 service attributes, top five attributes selected by US customers are taste of food, cleanliness of the restaurant, service response time, competitive price and quality of prior service. For Korean customers, cleanliness was valued as the most significant factor followed by taste of food, service response time, employee courtesy and quality of prior service. According to AHP results that are generated, McDonald's ranked as the top for overall service quality in US and Korea.

AHP model was used to evaluate fast food restaurants service quality by Chow and Luk (2005). Customers who exited and went in McDonald's at Bay Street, Toronto and Canada were requested to participate in the survey. Before participation, they were confirmed to patronize three fast food restaurants which were McDonald's, Burger King and Harvey. Data was collected over three week's period with 80 customers took part and eight questionnaires were excluded. Empathy had the highest mean importance, followed by tangibles,

assurance, reliability and responsiveness. Yet, Harvey had the top overall satisfaction scores compared to Burger King and McDonald's.

From the research studied by Kecek and Gürdal (2016), students' preference towards fast food restaurant was determined using AHP model also. The authors had chosen 169 students from Dumlupınar University Faculty of Economics and Administrative Sciences International Trade and Finance. Popeyes, Mr. Kumpir, Burger King, McDonald's, Pizza Pizza and Sbarro in Sera Kütahya shopping center were selected as the alternatives. Five criteria including price, taste and freshness, serving time, employee's attitudes and advertisement were ranked by the students. According to the studies, taste and freshness, price and employee's attitudes were the top three priority from the students' selection. Their favorite restaurants were Burger King and McDonald's with a weight of 0.27543 and 0.18429.

In Manado City, similar studies had been conducted by Wibowo and Tielung (2016). The researchers intended to determine the first priority fast food franchises among McDonald's, KFC and A&W. The influential criteria included price, atmosphere, location, cleanliness, efficiency and lastly taste. 50 respondents who had consume the food and had an experience in the three fast food restaurants were selected as the sample. According to AHP model, McDonald's was founded to be the top ranking restaurant followed by KFC and A&W. Meanwhile, price, cleanliness and atmosphere had the highest weight of 0.2432, 0.2152 and 0.1699.

2.3 Application of AHP model in other field

Since there are too much of concerns in every decision that people made, therefore a proper investigation is essential to reduce the error that cause loses to any party. AHP model is very powerful in solving Multi-Criteria Decision Making (MCDM) problem by decomposition of a complicated problem into a simplified version. This model can helps to determine the most suitable decision and highest weight criteria. Therefore, it is no wonder that AHP model has been used by many researchers in different field of studies.

Khan, Bharathi and Londhe (2015) had evaluated and ranked the elements that affect low income consumer's intention to purchase private health insurance. The low income group was specified to auto rickshaw drivers, cab drivers, panwalla or women home maids. Ten expert sales professionals from the insurance industry were selected to complete the survey by conducting face-to-face interview. As a result, premium amount, customer services and claim settlement history had the highest priority among nine criteria. At the end, the objectives of the study were accomplished because the key factors that affected buying intention were identified.

In Iran, AHP model was applied in pharmaceutical supply chain risk assessment with Simple Additive Weighting (SAW) methods (Jaberidoost, et al., 2015). Pharmaceutical companies played an important role because the medicines supply would definitely affect health system. Jaberidoost, et al. (2015) selected 16 experts who had at least five years of experience in that particular industry to conduct an interview for this study. Over the five supply chain function,

financial management had the highest ranking compared to supply, sales, operation and quality management. From the findings of SAW methods, financial and economic risks had the highest weight compared to other categories. Lastly, other than financial and supply risk, regulation issues was another top risk that were being identified.

Other than pharmaceutical risk assessment, AHP model was used in telehealth evaluation. Cancela, Fico and Waldmeyer (2015) used this model to determine the users' needs in a telehealth system. The telehealth system was designed to monitor and take care of Parkinson's Disease (PD) patients. Likewise, the authors wanted to compare the similarity of the opinion from clinicians and technicians. 16 experts from clinical and technical background were chosen. Based on the global weights of needs, increase wearability acceptance (user experience), increase self-management support (clinical practice) and ON/OFF fluctuations detection (performance) were the three most important user needs. For categorical weights, clinical practice was ranked as the first by both groups. Although some of the ranking of the categories were different, but the responses from this two group had no significant difference in overall. AHP model was proven once again as a useful tool to identify the user needs. It can helps the researchers and developers to assess a tool by referring to the validated framework of evaluation.

During the increasing demand for energy, biomass was another alternatives for limited fossil fuels. Hence, Yadav, Srivatava and Singh (2015) had conducted a research on selecting the most appropriate biomass energy in Indian using AHP

model. Total availability of biomass, conversion technology, process efficiency, cost of resources, capital cost and emission released were the main criteria for seven types of alternatives sources which are agriculture residue, animal excreta, energy crops, food and vegetable waste, sugar mill and brewery waste, sewage waste and tannery waste. Throughout the study, economic aspect were discovered as the most important factors that were being considered. At the end, they concluded that biomass energy can be used as another sources of alternative renewable energy. The significant criteria could be used as the consideration for investment by the energy planners.

In most countries, amount of e-waste management had been an issue to all stakeholder (Rimantho, Cahyadi and Dermawan, 2015). Rimantho, Cahyadi and Dermawan (2015) utilized AHP model to appraise and determined the ranking of waste electronic devices or products. They targeted to identify the proper management of these e-waste also. Five key informants from Surabaya city were picked. By conducting pairwise comparison, environment had the largest weight, followed by financial, technology, social and method. According to sensitivity analysis, all factors did not showed a significant effect on government, private and informal sectors. Next, financial sector was detected to affect the fluctuation of other factors. Lastly, the authors concluded that due to own characteristics of electronic waste management issues, each country had different factors and preferences in the management.

AHP model was implemented also in selecting the mobile network operators in Malaysia. Lam, Leong and Lam (2015) used AHP model to identify the most desirable network between Maxis, Digi, Celcom, U Mobile and others as well

as the factors affecting the selection. 300 respondents were selected to answer the questionnaires. The study found out that Maxis was the most popular network operator whereas monthly bill charges and commitment was the major factor among data services, influence, network coverage, after-sales services, rewards and value-added.

Job selection was one of the toughest decision among the fresh graduates. To deal with this problem, 93 students who were studying Statistical Computing and Operations Research in Universiti Tunku Abdul Rahman (UTAR) were surveyed to find out their preference job selection and the criteria that will affect their job selection. The generated result showed that business analyst had the top ranking for the job preference whereas income and benefit was the most considerable criteria among the students (Lam, Lee and Lam, 2015).

The following research was about supplier selection process using AHP model. Kambiz, et al. (2012) had considered six criteria in order to select the best supplier among supplier A, B, C and D. The criteria included reliability, transportation ease and cost, experience and lead time of the supplier as well as quality and price of the product. The researchers had chosen a group of decision maker who were the purchasing and supply chain managers to answer the surveys. By using Expert Choice generation of results, reliability of supplier and product quality dominated the other four criteria. The evaluation appeared to be consistent also because of the 0.07 consistency ratio.

Overall, AHP model has been widely used in various fields to make the best decision by solving MCDM problem. Based on the past studies, AHP model has been applied in the selection of fast food restaurants in different countries. However, AHP model has not been studied actively in Malaysia yet. Therefore, this research aims to fill the research gap by studying the selection of fast food restaurants among the students in UTAR Kampar, Malaysia with AHP model.

CHAPTER 3

METHODOLOGY

3.1 Project Design

This study examines the selection of fast food restaurants among Universiti Tunku Abdul Rahman (UTAR) Kampar students using Analytic Hierarchy Process (AHP) methodology. It aims to identify the ranking of the five selected fast food restaurants and the seven decision criteria based on the students' preference and past studies. Since the research is studying the student' preference, primary sources is obtained by giving out questionnaires to the students. There are seven faculties in UTAR Kampar. It includes Center for Foundation Studies (CFS), Faculty of Science (FSC), Faculty of Engineering and Green Technology (FEGT), Faculty of Business and Finance (FBF), Faculty of Information and Communication Technology (FICT), Faculty of Arts and Social Science (FAS) and Institute of Chinese Studies (ICS). All students from UTAR Kampar can participate in the survey as long as they fulfill the requirements. Since this research are planned to study the preference of UTAR Kampar students, so 20 students from each faculties are selected to balance the amount of target respondents. According to literature review and AHP methodology, the target respondents are the expert in the respective field. For this case, all selected target respondents are enquired to visit all five selected fast food restaurants and have an experience of having meals in the restaurants. In this study, 116 undergraduates from UTAR Kampar Campus are selected as the target respondents.

3.2 Model Development

AHP model is designed to solve Multi Criteria Decision Making (MCDM) problem by decomposition of a problem into a hierarchy. The hierarchy consists of three level which are top, middle and bottom. Top level is the main objective, middle level is the decision criteria whereas the last level contains decision alternatives. The hierarchy process is shown as below:

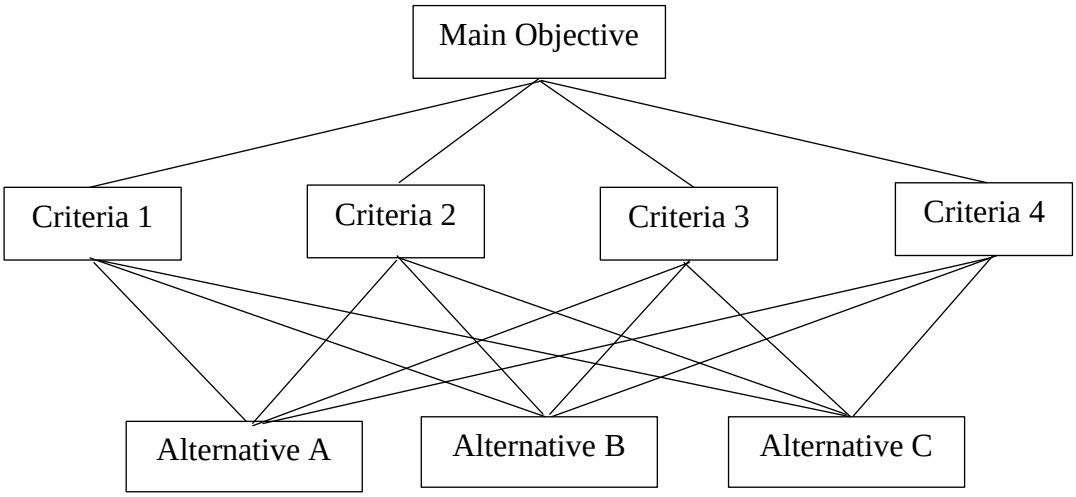

Figure 3.1: AHP hierarchy process

Table 3.1 will illustrates the hierarchy level in this study by stating the main objectives which is fast food selection, the seven decision criteria and the five decision alternatives.

Table 3.1: Hierarchy level for fast food selection

Top Level: Main Objective	Selection of Fast Food Restaurant
Middle Level: Decision Criteria	1. Price 2. Customer Service 3. Environment 4. Flexibility 5. Efficiency 6. Location 7. Cleanliness
Third Level: Decision Alternative	1. McDonald's 2. Kentucky Fried Chicken (KFC) 3. Pizza Hut 4. Domino's Pizza 5. Wing Zone

3.3 Data Analysis Procedures

AHP data analysis are performed in six steps.

Step 1: Identify the goal and distinguish the decision criteria as well as decision alternatives.

Step 2: Collect data based on the relative scale of importance introduced by Saaty (2008). Table 3.2 indicates the ratio scale that are used for comparison.

Table 3.2: Ratio scale used for pairwise comparison

Scale	Definition
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Absolute Importance
2,4,6,8	Intermediate Values

Step 3: Develop pairwise comparison matrix by using the data obtained. If there are n number of decision criteria or decision alternatives, then the number of pairwise comparisons will be formulated as:

$$(0.5)n(n-1) \tag{3.1}$$

If there are a numbers of decision criteria and b numbers of decision alternatives, then there should be one $(a \times a)$ matrix for the comparison of decision criteria and a numbers of $(b \times b)$ matrix for the comparison of decision alternatives in terms of the a decision criteria. The comparison matrix will be constructed as below:

$$A = \begin{bmatrix} c_{11} & c_{12} & \cdots & \cdots & c_{1a} \\ 1/c_{12} & c_{22} & & & c_{2a} \\ \vdots & & \ddots & & \vdots \\ \vdots & & & \ddots & \vdots \\ 1/c_{1a} & 1/c_{2a} & \cdots & \cdots & c_{aa} \end{bmatrix} \tag{3.2}$$

c_{ij} represents the degree of preference of element i to element j.

Step 4: Calculate the weights for each decision criteria and decision alternatives through Normalization Method. To perform this, sum for each column in the matrices are calculated and all elements in the column are divided by the column's total. The steps are repeated for all pairwise comparison matrices. For this study, eight new normalized matrices are formed. Next, average for each row in the newly formed matrices represent the priorities or weight for the decision criteria and decision alternative. Weight score for each decision criteria will be symbolized as w^T while the weight score for decision alternatives with respect to each criteria will be represented by Q.

Step 5: Overall weight score for each decision alternative (FDW) is computed by multiplying Q with w^T . The formula is as shown:

$$FDW = Q \times w^T \tag{3.3}$$

The FDW matrix will shows the priority of the decision alternatives. Elements with the largest weight indicates the highest or top ranking of the alternative.

Step 6: Check for consistency. Saaty (1980) had proposed consistency ratio (CR) in terms of consistency index (CI) and random index (RI) with the formula below:

$$CR = \frac{CI}{RI} \tag{3.4}$$

whereby CI is computed by

$$CI = \frac{\lambda_{\max} - n}{n-1} \tag{3.5}$$

where $\lambda_{\max}$ is the maximum eigenvalue and n is total number of criteria. $\lambda_{\max}$ is calculated by

$$\frac{1}{n}\sum_{i=1}^{i=n} \frac{\text{i}^{\text{th}} \text{ entry in A w}^{\text{T}}}{\text{i}^{\text{th}} \text{ entry in w}^{\text{T}}} \tag{3.6}$$

Saaty generated RI by calculating the average CI of randomly generated comparison matrices. Table 3.3 shows the random index.

Table 3.3: Random index

n	2	3	4	5	6	7	8	9	10
RI	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.51

$CR \leq 0.10$ is more preferred because it denotes that the degree of consistency is satisfactory and the result is reliable. If $CR > 0.10$, serious inconsistencies may occur and the model may not give a significant result.

CHAPTER 4

RESULT AND DISCUSSION

This chapter will highlights about the students' judgement towards the decision criteria together with the decision alternatives. Each criterion is ranked to determine its weightage same goes with the decision alternatives. All fast food restaurants are ranked with respect to each decision criteria. Finally, the overall weightage of each fast food restaurant is analyzed to identify the most favorable fast food restaurant by the students. Recommendation and contribution are underlined also at the last section of this chapter.

4.1 Pair-Wise Comparison Matrices

As mentioned in Chapter 3, students' selection in the questionnaires are averaged and constructed into a set of pairwise comparison matrices. Components in the higher level of the hierarchy act as the controlling element to the components in the lower level (Saaty, 2008). For instance, top level in the hierarchy for this study is selection of fast food restaurant and the middle level is the seven criteria. Thus, the first pairwise comparison matrix refers to the comparison among the seven criteria. The level below is the third level which is the five decision alternatives. Under the price factor, all five fast food restaurants are being compared with respect to this factor only. Same procedure is done to the other six criteria. Elements in the comparison matrices are within 1-9 scale as proposed by Saaty. The diagonals in the matrices are ranked as "1" because it indicates the criteria or alternative is compared to itself. The intensity

of the importance are listed in Table 3.2. Since there are seven criteria, there is a total of 21 comparisons for the first matrix. The following seven matrices have ten comparisons respectively as there are five restaurants to compare. Analysis for this research is conducted using Microsoft Excel while Expert Choice 11 software is exploited also to verify and determine the accuracy of the results.

4.1.1 Comparison among Decision Criteria

After reviewing past journals, the seven selected criteria are price, customer service, environment, flexibility, efficiency, location and cleanliness. Table 4.1 presents the first 7×7 matrix for judgement of the seven criteria.

Table 4.1: Pairwise comparison matrix for all decision criteria

Criteria	Price	Customer Service	Environment	Flexibility	Efficiency	Location	Cleanliness
Price	1.0000	2.1753	1.7676	2.3591	1.6052	2.1770	1.0455
Customer Service	0.4597	1.0000	2.7547	2.9678	2.3054	2.6211	1.1343
Environment	0.5658	0.3630	1.0000	2.5263	1.5254	1.7778	0.8946
Flexibility	0.4239	0.3369	0.3958	1.0000	0.9443	1.1950	0.6008
Efficiency	0.6230	0.4338	0.6556	1.0590	1.0000	2.2689	0.9227
Location	0.4593	0.3815	0.5625	0.8368	0.4407	1.0000	0.6995
Cleanliness	0.9565	0.8816	1.1178	1.6644	1.0837	1.4296	1.0000
TOTAL	4.4882	5.5722	8.2540	12.4134	8.9047	12.4695	6.2974

From the matrix above, the diagonal always remain to 1.0000 as the criterion is comparing to itself. By referring to the first row of the matrix, price is more important compared to the other six criteria. For instance, price is 2.1753 times

more favor than customer service, 1.7676 times more favor than environment and so on. For the value which is below 1.0000 such as 0.9443 under the comparison of flexibility and efficiency, it means that flexibility is less favor compare to efficiency. In other words, efficiency is 1.0590 more favor than flexibility.

The matrix in Table 4.1 is then normalized to obtain the weight score of each criteria and the newly formed normalized matrix is as shown below:

$$\begin{bmatrix} 0.2228 & 0.3904 & 0.2141 & 0.1900 & 0.1803 & 0.1746 & 0.1660 \\ 0.1024 & 0.1795 & 0.3337 & 0.2391 & 0.2589 & 0.2102 & 0.1801 \\ 0.1261 & 0.0651 & 0.1212 & 0.2035 & 0.1713 & 0.1426 & 0.1421 \\ 0.0944 & 0.0605 & 0.0480 & 0.0806 & 0.1060 & 0.0958 & 0.0954 \\ 0.1388 & 0.0778 & 0.0794 & 0.0853 & 0.1123 & 0.1820 & 0.1465 \\ 0.1023 & 0.0685 & 0.0681 & 0.0674 & 0.0495 & 0.0802 & 0.1111 \\ 0.2131 & 0.1582 & 0.1354 & 0.1341 & 0.1217 & 0.1147 & 0.1588 \end{bmatrix}$$

All normalized matrices will have a total of 1.000 under the summation of each elements in the same column. The average of each row is calculated to determine the priority of these criteria when students settle on their choices. Table 4.2 and Figure 4.1 shows the weight and ranking for seven criteria.

Table 4.2: Weight score and ranking of decision criteria

Criteria	Average	Rank
Price	0.2198	1
Customer Service	0.2148	2
Environment	0.1388	4
Flexibility	0.0830	6
Efficiency	0.1175	5
Location	0.0782	7
Cleanliness	0.1480	3

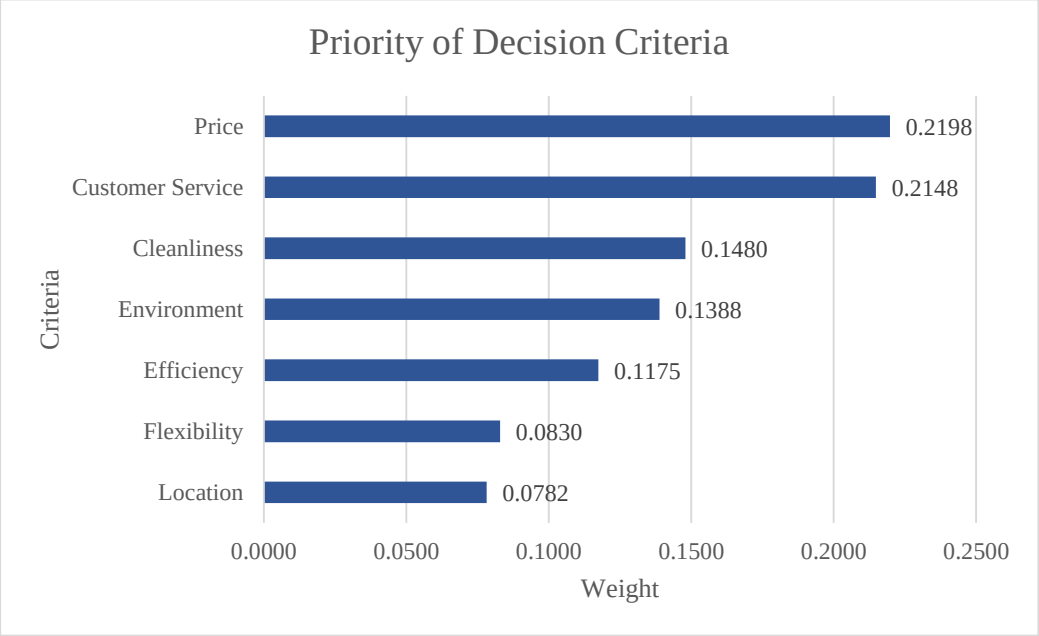

Figure 4.1: Weight of decision criteria

According to Table 4.2 and the graph above (Figure 4.1), price with the highest weight of 0.2198 is the first factor that students will consider when they select fast food restaurants. The second most preferred factor is customer service which is 0.0050 lower than price factor. The third and fourth factors fall into cleanliness and environment with a weight of 0.1480 and 0.1388. After all,

efficiency, flexibility and location are the least preferable factors that have the lowest ranking with weightages of 0.1175, 0.0830 and 0.0782.

In this research, price is proven as the first criterion that Universiti Tunku Abdul Rahman (UTAR) Kampar students will consider before they make a purchase. This is mainly due to the students are not income independently yet. Their money sources or living expenses mostly depend on the pocket money from their parents or the National Higher Education Fund Corporation (PTPTN). The amount of pocket money provided will reflects the financial status of the family (Saravanan and Devakinandini, 2014). As a result, students will tend to control their money usage based on their ability to buy. Moreover, perceived value might be one of the reason that attract students' purchase intention. Different people have different perspective, thus the perceived value varies among the people.

Customer service is the second top criterion. Many researches had proved that customer service will affect customer satisfaction which has implication on customer retention (Ahmad, 2015). Customer satisfaction is believed to be an essential factors because it acts as a legitimate and trustworthy evaluation about a business (Sabir, et al., 2014). Hence, it is not surprise that students will select customer service as the second because of these reasons.

Next, cleanliness and environment are ranked as third and fourth. These two criteria are interrelated because the cleanliness of a restaurants will influence the customers' impression towards the environment. First of all, hygiene food

and environment is the basic needs to prevent any diseases. Next, Kampar is a university town. Most of the business income come from the students. Fast food restaurants are one of options for them to relax, enjoy or even a place for them to discussion or revision other than hostel and campus. Although environment might not be the main concern in a fast food restaurant, but it will bring discomfort to the customers.

The last three criteria are efficiency, flexibility and location. Efficiency is the highest among these three. The reason to explain the fifth ranking might because of fast food restaurants always serve in a fast and systematic way. Hence, the speed of serving a customer will not affect the students to make an order. Flexibility and location are the least considerable criteria. Both of it has a slightly difference of 0.0048. Students select this two as the last because the operating hour is not an issue for them. Meanwhile, they have their own transport such as bicycle, motorcycle or car. Therefore, no doubt that location is the last considerable criterion.

4.1.2 Pairwise Comparison Matrix with Respect to Price

Table 4.3 presents the comparison matrix among the five fast food restaurants under the price criterion. It represents also students' preference restaurants when come to the price factor.

Table 4.3: Pairwise comparison matrix with respect to price

Alternatives	McDonald's	KFC	Pizza Hut	Domino's Pizza	Wing Zone
McDonald's	1.0000	3.6811	4.0375	3.6109	3.6521
KFC	0.2717	1.0000	3.0907	2.8232	2.9872
Pizza Hut	0.2477	0.3235	1.0000	1.6359	1.9878
Domino's Pizza	0.2769	0.3542	0.6113	1.0000	2.2758
Wing Zone	0.2738	0.3348	0.5031	0.4394	1.0000
TOTAL	2.0701	5.6936	9.2426	9.5095	11.9029

As comparing McDonald's to KFC, Pizza Hut, Domino's Pizza and Wing Zone, the values of 3.6811, 4.0375, 3.6109 and 3.6521 show that McDonald's is more preferred to the other four fast food restaurants when price is set as the determinant factor. KFC also has a higher value when it is compared to Pizza Hut, Domino's Pizza and Wing Zone.

The normalized matrix is as below:

$$\begin{bmatrix} 0.4831 & 0.6465 & 0.4368 & 0.3797 & 0.3068 \\ 0.1312 & 0.1756 & 0.3344 & 0.2969 & 0.2510 \\ 0.1196 & 0.0568 & 0.1082 & 0.1720 & 0.1670 \\ 0.1338 & 0.0622 & 0.0661 & 0.1052 & 0.1912 \\ 0.1323 & 0.0588 & 0.0544 & 0.0462 & 0.0840 \end{bmatrix}$$

Table 4.4: Ranking and weight of fast food restaurants under price

Restaurant	Average	Rank
McDonald's	0.4506	1
KFC	0.2378	2
Pizza Hut	0.1247	3
Domino’s Pizza	0.1117	4
Wing Zone	0.0751	5

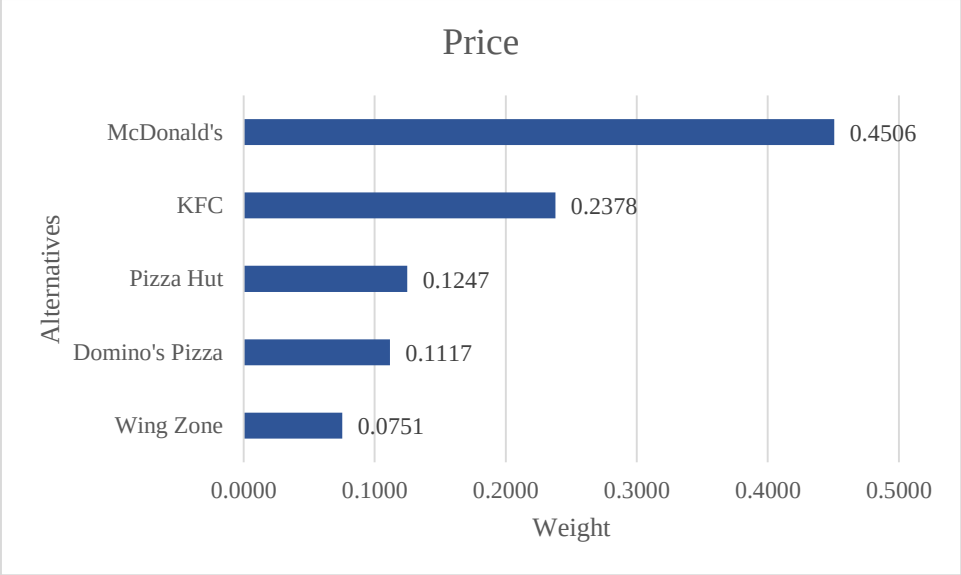

Figure 4.2: Results on price factor

From Figure 4.2, the weight of McDonald’s (0.4506) is much higher than the other four fast food restaurants. KFC (0.2378) is the second favorable fast food restaurants followed by Pizza Hut (0.1247), Domino’s Pizza (0.1117) and lastly Wing Zone (0.0751).

4.1.3 Pairwise Comparison Matrix with Respect to Customer Service

The following table (Table 4.5) denotes the matrix under customer service factor.

Table 4.5: Pairwise comparison matrix with respect to customer service

Alternatives	McDonald's	KFC	Pizza Hut	Domino's Pizza	Wing Zone
McDonald's	1.0000	3.3320	2.6626	2.4311	1.7771
KFC	0.3001	1.0000	1.6663	1.4699	1.1945
Pizza Hut	0.3756	0.6001	1.0000	1.6467	1.5441
Domino's Pizza	0.4113	0.6803	0.6073	1.0000	1.4472
Wing Zone	0.5627	0.8371	0.6476	0.6910	1.0000
TOTAL	2.6497	6.4496	6.5838	7.2386	6.9630

Matrix in Table 4.5 shows the same phenomenon with matrix in Table 4.3 which is the upper triangular part of matrix shows values of greater than 1.0000. McDonald's is once again more preferable compared to the other four fast food restaurants.

The normalized matrix for customer service criterion is as below:

$$\begin{bmatrix} 0.3774 & 0.5166 & 0.4044 & 0.3358 & 0.2552 \\ 0.1133 & 0.1550 & 0.2531 & 0.2031 & 0.1716 \\ 0.1417 & 0.0930 & 0.1519 & 0.2275 & 0.2218 \\ 0.1552 & 0.1055 & 0.0922 & 0.1381 & 0.2078 \\ 0.2124 & 0.1298 & 0.0984 & 0.0955 & 0.1436 \end{bmatrix}$$

Table 4.6: Ranking and weight of fast food restaurants under customer service

Restaurant	Average	Rank
McDonald's	0.3779	1
KFC	0.1792	2
Pizza Hut	0.1672	3
Domino’s Pizza	0.1398	4
Wing Zone	0.1359	5

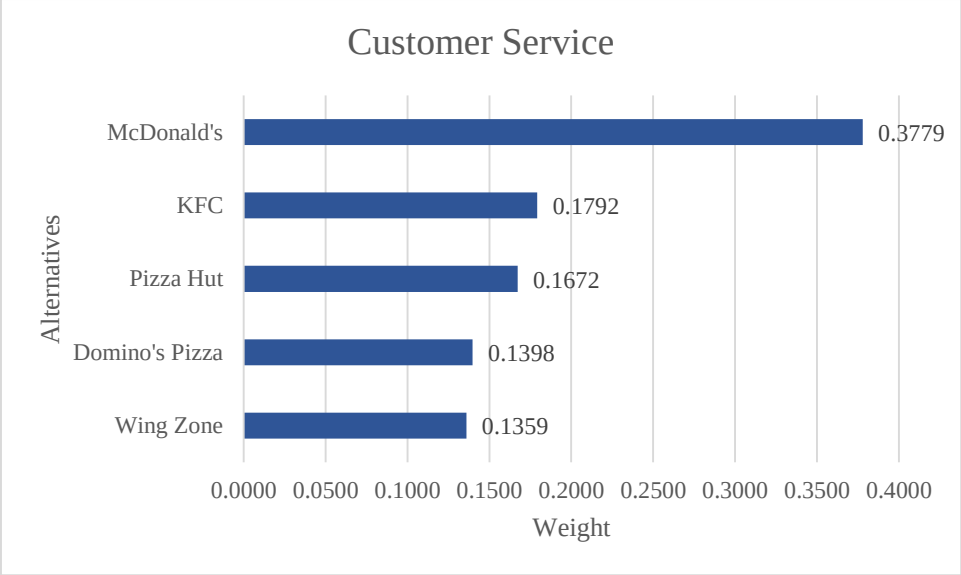

Figure 4.3: Results on customer service factor

McDonald’s has the highest ranking with a weight of 0.3779. Other four fast food restaurants do not show an obvious difference on their weight. KFC is still the second ranking with weightage of 0.1792 and Pizza Hut shows 0.1672. There is only 0.0039 differences between Domino’s Pizza and Wing Zone. In short, students prefer the services offered by McDonald’s.

4.1.4 Pairwise Comparison Matrix with Respect to Environment

Table 4.7 illustrates how the students rank the priority of the environment in each of the fast food restaurants.

Table 4.7: Pairwise comparison matrix with respect to environment

Alternatives	McDonald's	KFC	Pizza Hut	Domino's Pizza	Wing Zone
McDonald's	1.0000	3.0637	2.1208	2.8415	1.2033
KFC	0.3264	1.0000	1.4365	1.6470	0.8784
Pizza Hut	0.4715	0.6961	1.0000	2.0868	1.1711
Domino's Pizza	0.3519	0.6072	0.4792	1.0000	1.0107
Wing Zone	0.8310	1.1385	0.8539	0.9895	1.0000
TOTAL	2.9809	6.5054	5.8905	8.5647	5.2634

Environment in McDonald's is more preferable compared to the other fast food restaurants. KFC is less favorable compared to McDonald's and Wing Zone. Pizza Hut manage to beat Domino's Pizza and Wing Zone only.

Normalized matrix with respect to environment:

$$\begin{bmatrix} 0.3355 & 0.4709 & 0.3600 & 0.3318 & 0.2286 \\ 0.1095 & 0.1537 & 0.2439 & 0.1923 & 0.1669 \\ 0.1582 & 0.1070 & 0.1698 & 0.2437 & 0.2225 \\ 0.1181 & 0.0933 & 0.0814 & 0.1168 & 0.1920 \\ 0.2788 & 0.1750 & 0.1450 & 0.1155 & 0.1900 \end{bmatrix}$$

Table 4.8: Ranking and weight of fast food restaurants under environment

Restaurant	Average	Rank
McDonald's	0.3454	1
KFC	0.1733	4
Pizza Hut	0.1802	3
Domino’s Pizza	0.1203	5
Wing Zone	0.1809	2

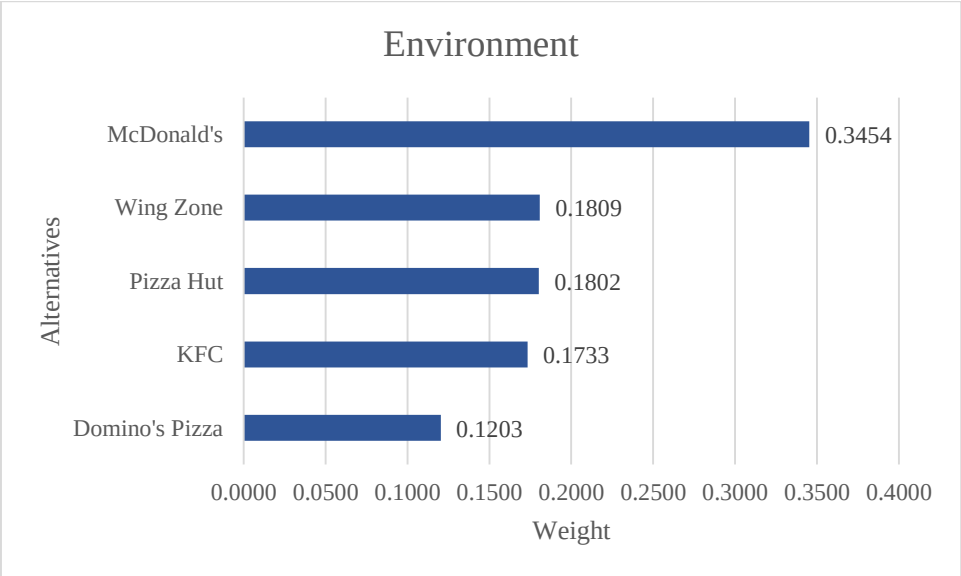

Figure 4.4: Results on environment factor

From Figure 4.4, no doubt that McDonald’s (0.3454) dominates this criterion also. However, Wing Zone (0.1809) appears to be the second priority followed by Pizza Hut (0.1802). KFC is ranked the fourth under this criterion whereas Domino’s Pizza is the last.

4.1.5 Pairwise Comparison Matrix with Respect to Flexibility

Table 4.9 shows the comparison of flexibility of each fast food restaurants.

Table 4.9: Pairwise comparison matrix with respect to flexibility

Alternatives	McDonald's	KFC	Pizza Hut	Domino's Pizza	Wing Zone
McDonald's	1.0000	5.3578	4.9344	4.9341	4.6150
KFC	0.1866	1.0000	2.0228	1.8565	1.4926
Pizza Hut	0.2027	0.4944	1.0000	1.6399	1.2705
Domino's Pizza	0.2027	0.5387	0.6098	1.0000	1.2394
Wing Zone	0.2167	0.6700	0.7871	0.8069	1.0000
TOTAL	1.8087	8.0608	9.3541	10.2373	9.6174

It is same goes with Table 4.3 and 4.5 with upper triangular part's values greater than 1.0000. The values obtained for McDonald's have a stronger importance compared to others.

Normalized matrix under flexibility criterion:

$$\begin{bmatrix} 0.5529 & 0.6647 & 0.5275 & 0.4820 & 0.4799 \\ 0.1032 & 0.1241 & 0.2162 & 0.1813 & 0.1552 \\ 0.1120 & 0.0613 & 0.1069 & 0.1602 & 0.1321 \\ 0.1121 & 0.0668 & 0.0652 & 0.0977 & 0.1289 \\ 0.1198 & 0.0831 & 0.0841 & 0.0788 & 0.1040 \end{bmatrix}$$

Table 4.10: Ranking and weight of fast food restaurants under flexibility

Restaurant	Average	Rank
McDonald's	0.5414	1
KFC	0.1560	2
Pizza Hut	0.1145	3
Domino's Pizza	0.0941	4
Wing Zone	0.0940	5

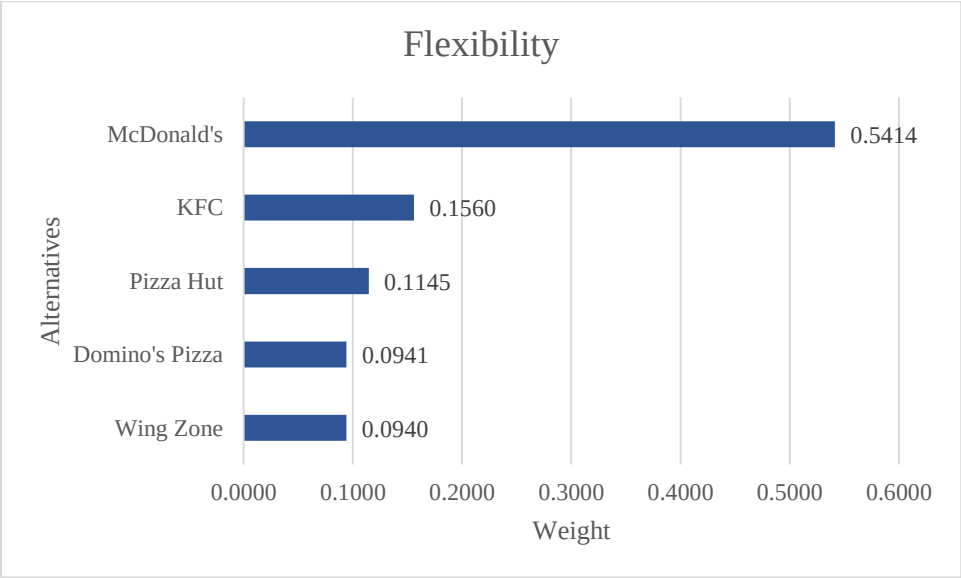

Figure 4.5: Results on flexibility factor

The ranking for each fast food restaurants under flexibility criterion is same with price and customer service criteria. McDonald's is the first, followed by KFC, Pizza Hut, Domino's Pizza and Wing Zone. In this case, Domino's Pizza and Wing Zone has a very little difference of 0.0001 in their weight. This means their flexibility do not differ much.

4.1.6 Pairwise Comparison Matrix with Respect to Efficiency

Efficiency of a fast food restaurant is a comparable issue for the students also.

Table 4.11: Pairwise comparison matrix with respect to efficiency

Alternatives	McDonald's	KFC	Pizza Hut	Domino's Pizza	Wing Zone
McDonald's	1.0000	3.5879	3.4855	2.9906	2.5222
KFC	0.2787	1.0000	2.4416	2.1496	1.8772
Pizza Hut	0.2869	0.4096	1.0000	1.5714	1.3671
Domino's Pizza	0.3344	0.4652	0.6364	1.0000	1.1788
Wing Zone	0.3965	0.5327	0.7315	0.8484	1.0000
TOTAL	2.2965	5.9953	8.2949	8.5600	7.9453

McDonald's has higher efficient compare to all. KFC is less efficient compared to McDonald's only while Pizza Hut is less efficient compared to McDonald's and KFC only. Domino Pizza manage to beat Wing Zone efficiency only.

Normalized matrix for efficiency criterion:

$$\begin{bmatrix} 0.4355 & 0.5984 & 0.4202 & 0.3494 & 0.3174 \\ 0.1214 & 0.1668 & 0.2943 & 0.2511 & 0.2363 \\ 0.1249 & 0.0683 & 0.1206 & 0.1836 & 0.1721 \\ 0.1456 & 0.0776 & 0.0767 & 0.1168 & 0.1484 \\ 0.1726 & 0.0889 & 0.0882 & 0.0991 & 0.1259 \end{bmatrix}$$

Table 4.12: Ranking and weight of fast food restaurants under efficiency

Restaurant	Average	Rank
McDonald's	0.4242	1
KFC	0.2140	2
Pizza Hut	0.1339	3
Domino’s Pizza	0.1130	5
Wing Zone	0.1149	4

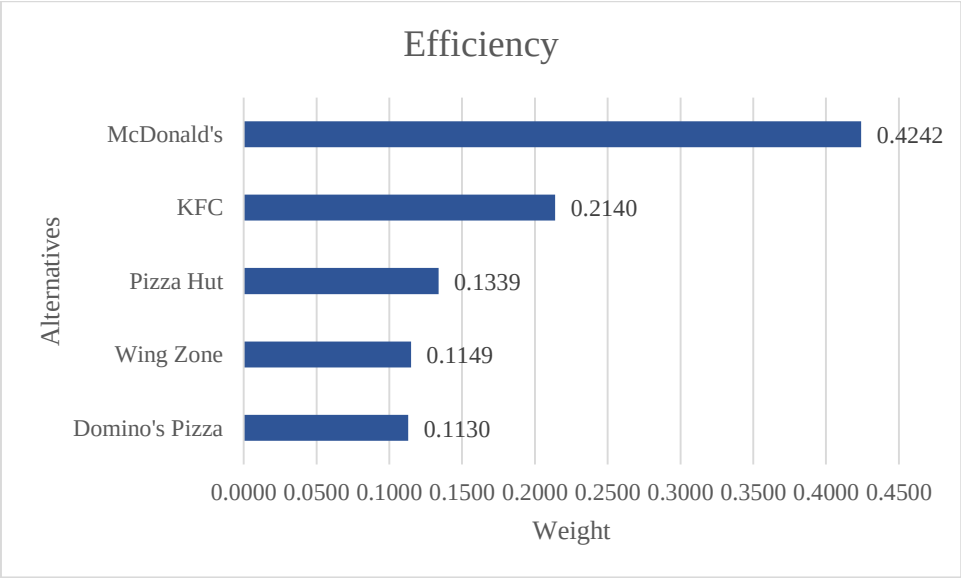

Figure 4.6: Results on efficiency factor

From Figure 4.6, McDonald’s (0.4242), KFC (0.2140) and Pizza Hut (0.1339) are the three highest ranking for efficiency. Domino’s Pizza (0.1130) and Wing Zone (0.1149) ranked as the last two also.

4.1.7 Pairwise Comparison Matrix with Respect to Location

Location of each fast food restaurant is judged also by the students.

Table 4.13: Pairwise comparison matrix with respect to location

Alternatives	McDonald's	KFC	Pizza Hut	Domino's Pizza	Wing Zone
McDonald's	1.0000	5.0426	5.2372	3.0787	2.3324
KFC	0.1983	1.0000	2.3943	1.0369	1.0466
Pizza Hut	0.1909	0.4177	1.0000	0.7742	0.7494
Domino's Pizza	0.3248	0.9645	1.2916	1.0000	1.1927
Wing Zone	0.4287	0.9555	1.3345	0.8385	1.0000
TOTAL	2.1428	8.3802	11.2576	6.7282	6.3211

From the figures in Table 4.13, McDonald's has the most preferred location when it is compared to other fast food restaurants. KFC also has a better location compared to Pizza Hut, Domino's Pizza and Wing Zone. Yet, Pizza Hut's location is less preferable compared to all.

Normalized matrix for location criterion:

$$\begin{bmatrix} 0.4667 & 0.6017 & 0.4652 & 0.4576 & 0.3690 \\ 0.0925 & 0.1193 & 0.2127 & 0.1541 & 0.1656 \\ 0.0891 & 0.0498 & 0.0888 & 0.1151 & 0.1185 \\ 0.1516 & 0.1151 & 0.1147 & 0.1486 & 0.1887 \\ 0.2001 & 0.1140 & 0.1185 & 0.1246 & 0.1582 \end{bmatrix}$$

Table 4.14: Ranking and weight of fast food restaurants under location

Restaurant	Average	Rank
McDonald's	0.4720	1
KFC	0.1488	2
Pizza Hut	0.0923	5
Domino’s Pizza	0.1437	3
Wing Zone	0.1431	4

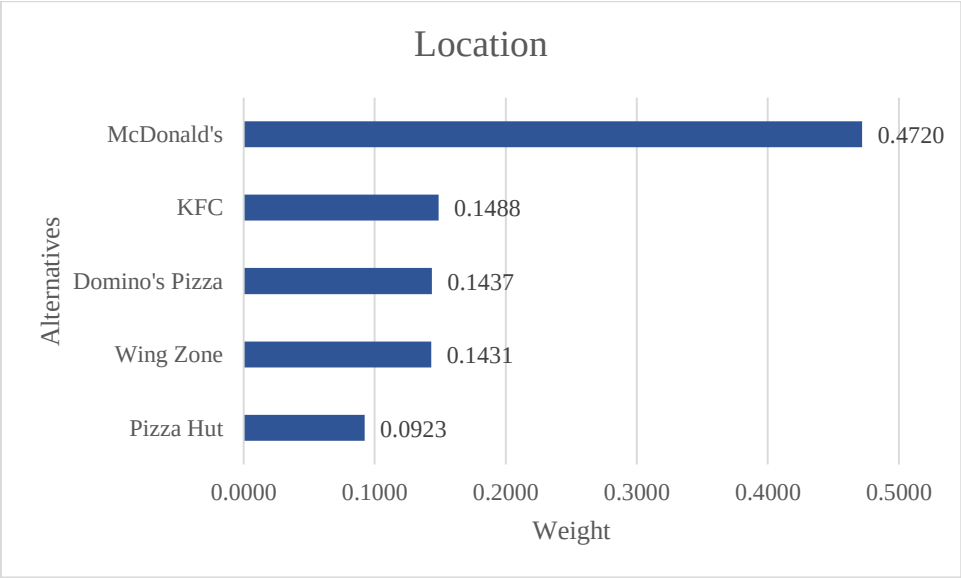

Figure 4.7: Results on location factor

KFC (0.1488), Domino’s Pizza (0.1437) and Wing Zone (0.1431) have almost the same weight when come to evaluate their location. Pizza Hut (0.0923) shows the least desirable location because it is located the furthest from most of the students’ hostel.

4.1.8 Pairwise Comparison Matrix with Respect to Cleanliness

Lastly, students are requested to compare the cleanliness of each fast food restaurant. Table 4.15 shows the result of the comparison.

Table 4.15: Pairwise comparison matrix with respect to cleanliness

Alternatives	McDonald's	KFC	Pizza Hut	Domino's Pizza	Wing Zone
McDonald's	1.0000	3.1599	2.0701	1.6400	1.2337
KFC	0.3165	1.0000	1.1054	1.0567	0.9088
Pizza Hut	0.4831	0.9047	1.0000	1.5803	1.0370
Domino's Pizza	0.6098	0.9463	0.6328	1.0000	1.0515
Wing Zone	0.8106	1.1003	0.9643	0.9511	1.0000
TOTAL	3.2199	7.1112	5.7726	6.2281	5.2310

The same interpretation is done for the findings in Table 4.15 to perform analyzing to the matrix.

Normalized matrix for cleanliness criterion:

$$\begin{bmatrix} 0.3106 & 0.4444 & 0.3586 & 0.2633 & 0.2358 \\ 0.0983 & 0.1406 & 0.1915 & 0.1697 & 0.1737 \\ 0.1500 & 0.1272 & 0.1732 & 0.2537 & 0.1982 \\ 0.1894 & 0.1331 & 0.1096 & 0.1606 & 0.2010 \\ 0.2517 & 0.1547 & 0.1670 & 0.1527 & 0.1912 \end{bmatrix}$$

Table 4.16: Ranking and weight of fast food restaurants under cleanliness

Restaurant	Average	Rank
McDonald's	0.3225	1
KFC	0.1548	5
Pizza Hut	0.1805	3
Domino’s Pizza	0.1587	4
Wing Zone	0.1835	2

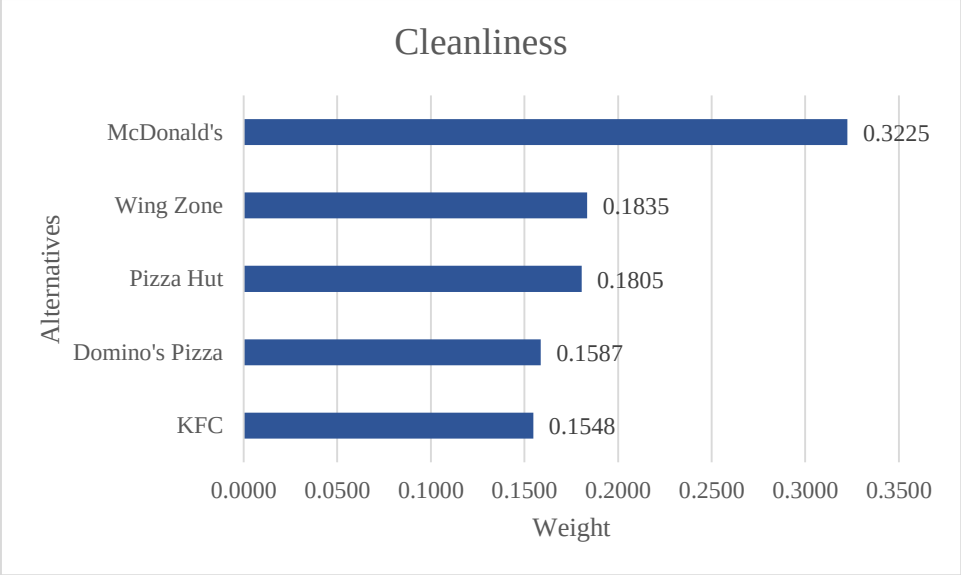

Figure 4.8: Results on cleanliness factor

The ranking for cleanliness criterion is a bit unusual compared to the previous criteria. This is because Wing Zone has the second priority under this criterion which means students prefer the cleanliness of Wing Zone compared to KFC, Pizza Hut and Domino’s Pizza. Nevertheless, KFC has the lowest ranking among all.

4.2 Result Analysis

This section will analyses the priority of each fast food restaurant when comes to the comparison under one factor. Table 4.17 and Figure 4.9 below indicate the result and position of the restaurants. It is obviously that McDonald's has become the leader in all seven criteria. It has the top ranking among all. It denotes that most of the students in UTAR Kampar prefer the services offer by McDonald's. Other than that, five fast food restaurants have found out to have the same ranking under price, customer service and flexibility. As mention in previous sentence, McDonald's has the top priority, followed by KFC, Pizza Hut, Domino Pizza and Wing Zone. For efficiency factor, the top three restaurants are the same as previous factors but Wing Zone has a higher efficiency than Domino Pizza. Meanwhile, Wing Zone is ranked as the second restaurant that has a satisfactory environment compared to the third favorable restaurants which are Pizza Hut and followed by KFC with Domino Pizza. McDonald's, KFC and Domino Pizza have a more strategic location compared to other fast food restaurants. Last but not least, Wing Zone and Pizza Hut are ranked again as the second and third restaurant that emphasizes cleanliness in their restaurants. Domino Pizza and KFC are the last two restaurants under this criteria.

Table 4.17: Ranking of fast food restaurants under each factor

Alternative	Criteria						
	Price	Service	Customer	Environment	Flexibility	Efficiency	Location	Cleanliness
McDonald's	1	1	1	1	1	1	1
KFC	2	2	4	2	2	2	5
Pizza Hut	3	3	3	3	3	5	3
Domino's Pizza	4	4	5	4	5	3	4
Wing Zone	5	5	2	5	4	4	2

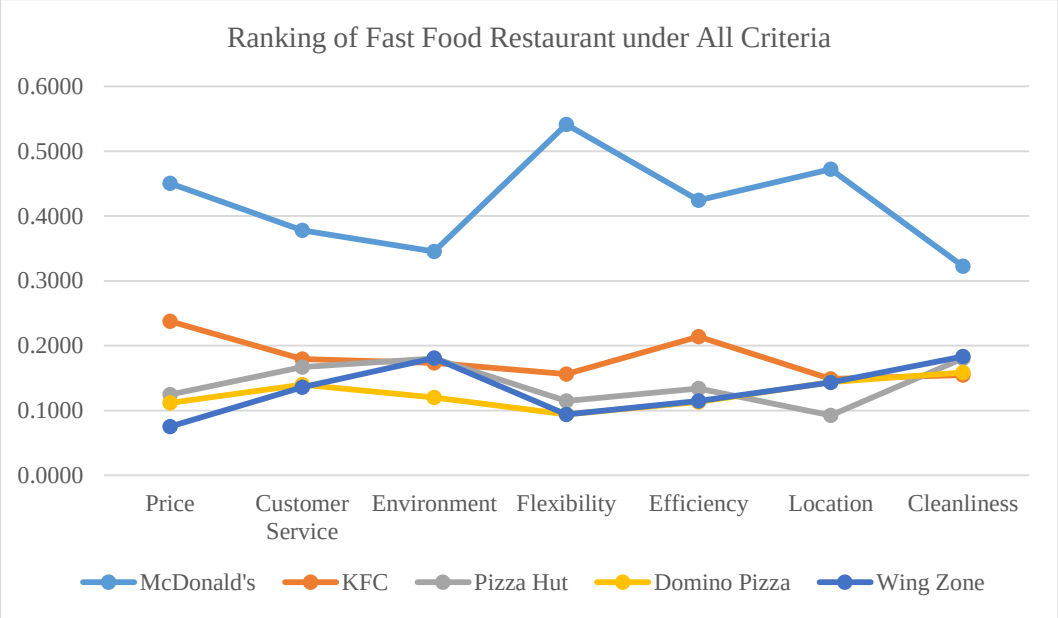

Figure 4.9: Combination of restaurants' weightage for all criteria

The overall weight score (FDW) for five fast food restaurants is computed by multiplying weight score of fast food restaurants under each criteria with weight score for all criteria.

$$FDW = \begin{bmatrix} 0.4506 & 0.3779 & 0.3454 & 0.5414 & 0.4242 & 0.4720 & 0.3225 \\ 0.2378 & 0.1792 & 0.1733 & 0.1560 & 0.2140 & 0.1488 & 0.1548 \\ 0.1247 & 0.1672 & 0.1802 & 0.1145 & 0.1339 & 0.0923 & 0.1805 \\ 0.1117 & 0.1398 & 0.1203 & 0.0941 & 0.1130 & 0.1437 & 0.1587 \\ 0.0751 & 0.1359 & 0.1809 & 0.0940 & 0.1149 & 0.1431 & 0.1835 \end{bmatrix} \times \begin{bmatrix} 0.2198 \\ 0.2148 \\ 0.1388 \\ 0.0830 \\ 0.1175 \\ 0.0782 \\ 0.1480 \end{bmatrix}$$

$$= \begin{bmatrix} 0.4075 \\ 0.1874 \\ 0.1475 \\ 0.1271 \\ 0.1305 \end{bmatrix}$$

Since McDonald's has the highest ranking in all criteria, to be sure that it is still the top in overall. Most of the time KFC is ranked as second except the environment and cleanliness factors. Thus, KFC appears to be second favorable choice for the students. Pizza Hut has the same case also because it has the third ranking in all criteria but it obtains the last rank in location factor. So, Pizza Hut still remain the third in overall ranking. Wing Zone has been once chosen as the second for environment and cleanliness factors. However, it gets the last ranking in price, customer service and flexibility. Therefore, Wing Zone has acquired as the fourth in this study. The least favorable restaurant falls onto Domino Pizza. The highest rank that obtained by this restaurant is the third place in location factor. It obtains the fourth in price, customer service, flexibility and cleanliness yet the last in environment and efficiency. To conclude, McDonald's (0.4075) is the most preferred fast food restaurant by the students followed by KFC (0.1874), Pizza Hut (0.1475), Wing Zone (0.1305) and Domino Pizza (0.1271). The results are shown in Figure 4.10.

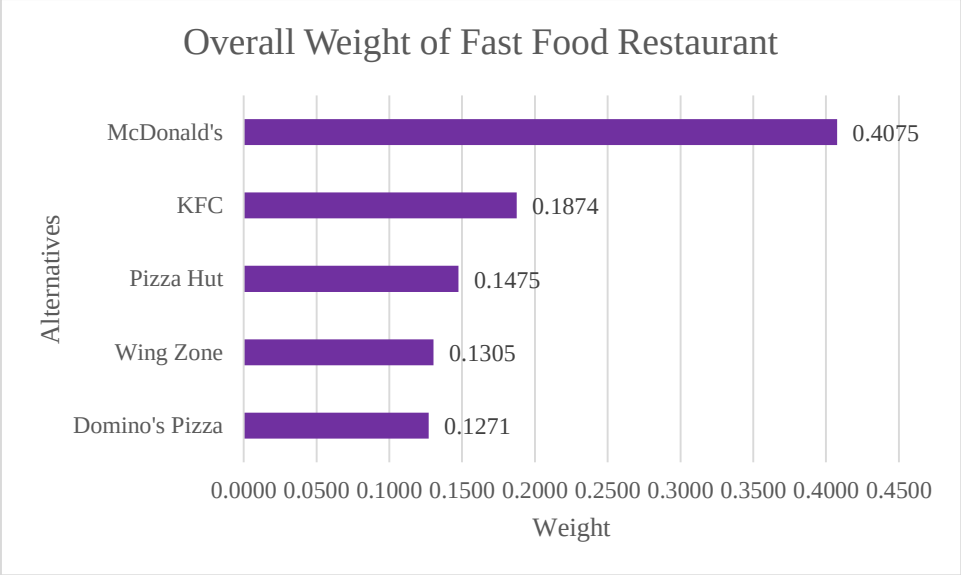

Figure 4.10: Ranking of fast food restaurant

4.3 Consistency Ratio

According to Saaty (1990), pairwise comparison matrix is consistent if the eigenvalue, $\lambda_{\max} \geq n$ where n denotes the number of decision criteria. To calculate $\lambda_{\max}$, pairwise comparison matrix (A) in Table 4.1 is used to multiply with weight score (w^T) in Table 4.2. $\lambda_{\max}$ that obtained is 7.2760 which is greater than 7. Consistency index (CI) is computed as

$$CI = \frac{7.2760 - 7}{7 - 1}$$
$$= 0.0460$$

Since there are seven criteria in this study, $n = 7$ and $RI = 1.32$ in the random index table (Table 3.3) is selected to calculate the consistency ratio (CR).

$$CR = \frac{0.0460}{1.32}$$
$$= 0.0348$$

Overall consistency ratio is 0.0348 which is less than 0.10. This claims that the pairwise comparison does not showed serious inconsistencies. Therefore, the

result for this study using Analytic Hierarchy Process (AHP) model is acceptable.

4.4 Recommendations

Even though McDonald's is the most preferred fast food restaurants among UTAR Kampar students, but it has to keep going on emphasizing any criteria that can retain its customers because there are chances for other fast food restaurants to improve and intimidate its first position. Although KFC has the second priority, but its cleanliness and environment have a lower ranking. It should consider to urge its employees on keeping the hygiene of restaurants more often so that customers can feel more comfort and relieve when they dine in. Pizza Hut has all third ranking in all criteria but the last rank about its location. In order to cope with the competitor, it can try to improve on its delivery system or promote more single set meals as the proportion of a pizza is too much for a person but sometimes it is not enough for a group of people. Wing Zone should offer an affordable prices to the students. Apart from it, it needs to improve its employees' courtesy and adjusts its operation hour so that the opening hour is more students friendly. Finally, Domino Pizza need to improve on all dimensions in an effort to attract more customers and enhance its sales and prestige.

4.5 Contribution of the Research Project

The study on the selection of fast food restaurant has been done by the past researchers but yet quite limited numbers of studies done in Malaysia especially using AHP model. The findings in this study help to identify the most favorable fast food restaurants by the UTAR Kampar students together with the students' judgement on the criteria. The research findings can be taken as a guidance for the existing fast food restaurants to comprehend the students' need and to enhance their services.

CHAPTER 5

CONCLUSION

5.1 Research Summary

The objectives of this research is to identify the priority of decision criteria in the selection of fast food restaurants among the UTAR Kampar's students. The decision criteria identified in this study are price, customer service, environment, flexibility, efficiency, location and cleanliness. This research found out that students appraise price, customer service and cleanliness as the top three consideration. The priority of the decision criteria in the selection of fast food restaurants are followed by environment, efficiency, flexibility and location. Besides that, this project also aims to determine the most preferred fast food restaurant among McDonald's, KFC, Pizza Hut, Domino's Pizza and Wing Zone with AHP model. McDonald's has dominated the fast food market in Kampar because it is most welcomed by the students. The following fast food restaurants after McDonald's are KFC, Pizza Hut, Wing Zone and Domino's Pizza. The significance of this project is to determine the most preferred fast food restaurant as well as the most influential decision criteria in the selection of fast food restaurants using Analytic Hierarchy Process (AHP) model. Furthermore, this study also helps other less favorable fast food restaurants to identify their weaknesses and the potential improvements based on the most influential decision criteria. In conclusion, AHP model assists the decision makers to select the most appropriate choice under a complicated problem. Although AHP model had been invented by Thomas L. Saaty in 1970's, this

model is very powerful and popular because it is still a famous research topic nowadays. It can helps the researchers to identify the highest weightage of decision criteria and identify the most precise decision based on the selected decision alternatives.

5.2 Recommendations for Future Research

Enlarging the scope of respondents to different age levels in the society is recommended to improve for the current study. This study focuses on the students' perspective only, so perspective from the people in different levels will make the research more reliable because consumers of fast food restaurants come from different varieties. Besides, more franchises can be listed in the decision alternatives to investigate the competition power of each fast food restaurant in Malaysia.

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APPENDICES

Appendix A - Questionnaire

UDPS3286 RESEARCH PROJECT
A STUDY ON THE SELECTION OF FAST FOOD RESTAURANT BY UTAR KAMPAR STUDENTS

Gender : M / F
Race : _____
Course : _____
Faculty : _____
Year/Trimester : _____

How frequent do you have a fast food meals?

- Once a week
- Twice a week
- More than twice a week
- Less than two times per month

Have you been trying the food provided by the fast food restaurants in Kampar?
(McDonald, KFC (inside Tesco), Wing Zone, Domino Pizza, Pizza Hut)

- Yes
- No

Here are the **example** on the scaling of the factors and decision:

Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer Service

"Price is 9 times more important than customer service."

Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Custome r Service

"Price and Customer Service has the equal importance."

Scale	Definition
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Absolute Importance
2, 4, 6, 8	Intermediate Values

This questionnaire will be separated into Part A and Part B.
Part A - comparing each criteria/factors during fast food selection.
Part B - comparing which fast food restaurant is more preferred with respect to each criteria/factors.

Part A

Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer Service
Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environment
Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Flexibility
Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Efficiency
Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Location
Price	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Cleanliness

Customer Service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Environment
Customer Service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Flexibility
Customer Service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Efficiency
Customer Service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Location
Customer Service	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Cleanliness

Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Flexibility
Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Efficiency
Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Location
Environment	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Cleanliness

Flexibility	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Efficiency
Flexibility	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Location
Flexibility	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Cleanliness

Efficiency	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Location
Efficiency	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Cleanliness

Location	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Cleanliness

Part B

a) Price

McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	KFC
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Domino Pizza	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

b) Customer Service

McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	KFC
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Domino Pizza	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

c) Environment

McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	KFC
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Domino Pizza	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

d) Flexibility (eg: operating hours)

McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	KFC
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Domino Pizza	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

e) Efficiency

McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	KFC
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Domino Pizza	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

f) Location

McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	KFC
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Domino Pizza	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

g) Cleanliness

McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	KFC
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
McDonald	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Pizza Hut
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
KFC	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Domino Pizza
Pizza Hut	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Domino Pizza	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Wing Zone

Other recommendations: _____
(Any other factors that are significant in selecting fast food restaurant)

Appendix B - Publication

Lam, W.S., Chen, J.W. and Lam, W.H., 2016. An empirical study on the selection of fast food restaurants among the undergraduates with AHP model. *American Journal of Information Science and Computer Engineering*, 2(3), pp. 15-21.

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An Empirical Study on the Selection of Fast Food Restaurants Among the Undergraduates with AHP Model

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Abstract

Fast food is the food that can be prepared in a fast and standardize way as well as can be distributed quickly. The blooming of fast food restaurants have become the favourite choice among the undergraduates in Malaysia. They tend to choose fast food as alternatives besides traditional food in Malaysia due to the convenience. The objective of this paper is to determine the priority of decision criteria in the selection of fast food restaurants among the undergraduates in Universiti Tunku Abdul Rahman, Malaysia with Analytic Hierarchy Process (AHP) Model. The decision criteria identified in this study are price, customer service, environment, flexibility, efficiency, location and cleanliness. Besides that, this paper also aims to determine the most preferred fast food restaurant among McDonald, Kentucky Fried Chicken (KFC), Pizza Hut, Domino Pizza and Wing Zone with AHP Model. The results of this study show that McDonald is the most preferred fast food restaurant followed by KFC, Pizza Hut, Wing Zone and Domino Pizza among the undergraduates. Price, customer service and cleanliness are ranked as the top three influential factors by the undergraduates in this study. The significant of this paper is to determine the most preferred fast food restaurantas well as the most influential decision criteria in the selection of fast food restaurants by the undergraduates in Malaysia with AHP model.

Keywords

Fast Food Restaurants, Multi-Criteria Decision Making, Analytic Hierarchy Process, Priority, Undergraduates

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1. Introduction

A fast food restaurant is defined as a restaurant that can supply the food rapidly and requires minimum services. Normally this type of restaurant is the franchise restaurant chain. It was built up with the walk up counter or even the drive-thru window. Fast food implies that the food which can be served in the shortest time [1]. The fast food franchises have grown rapidly in Malaysia such as Kentucky Fried Chicken (KFC), McDonald, Pizza Hut, Domino Pizza and so on. The blooming of fast food restaurants have become the favourite choice among the undergraduates in Malaysia. They tend to choose fast food as alternatives besides traditional food in Malaysia due to the convenience. Since there are variety of fast food restaurants available, they have to set preference on the selection of fast food restaurants based on multiple criteria or factors. The evolution and marketing of fast food have influenced the young people consumption habit [2]. Besides that, other factors such as price, customer service, environment and efficiency have been identified as the decision criteria or factors in the selection of fast food restaurant.

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In order to make decision scientifically, Analytic Hierarchy Process (AHP) model is one of the preferable methods to solve this multi-criteria decision making (MCDM) problem. AHP was first introduced by Saaty[3]. It is designed to solve MCDM problem based on the priority ranked to the decision criteria and alternatives. The objective of this paper is to determine the priority of decision criteria in the selection of fast food restaurant among the undergraduates in Universiti Tunku Abdul Rahman, Malaysia with Analytic Hierarchy Process (AHP) Model. The decision criteria identified in this study are price, customer service, environment, flexibility, efficiency, location and cleanliness. Besides that, this paper also aims to determine the most preferred fast food restaurant among McDonald, Kentucky Fried Chicken (KFC), Pizza Hut, Domino Pizza and Wing Zone with AHP Model. The rest of the paper is organized as follows. The next section describes the literature review. Section 3 discusses about the materials and methods used in this study. Section 4 presents the empirical results of this study and section 5 concludes the paper.

2. Literature Review

Min and Min [4] investigated the differences in the perceived service quality between USA and Korea. They collected the data from six different fast food restaurants in Southeastern and Midwestern US and five different fast food restaurants in Seoul, South Korea. The results show that cleanliness and employee courtesy are the top two factors in the selection of fast food restaurants for Korean customers. However, price and location are the top two factors in the selection of fast food restaurants for US customers.

Chow and Luk [5] studied the service quality of fast food restaurant with Analytic Hierarchy Process (AHP) model. A survey was conducted over a three week periods and seventy two respondents were selected. Empathy, tangibles and assurance were ranked as the top three service quality in their study. Untaru and Ispas [6] conducted a study on assessing preference of young people between the local fast food restaurants and international fast food restaurants. Price, cleanliness and service are part of the decision criteria that considered by the young people in the selection of fast food restaurants.

Kavitha *et al.* [7] concluded that intrinsic factors like health, sensory appeal and price play a significant role in affecting food preference among generation *Y*. Intan Maizura *et al.* [8] has done a research on investigating the impact of service quality and food quality towards customer satisfaction. Intan Maizura *et al.* [8] identified that customers' loyalty is affected by service quality and customer satisfaction. According to Irza *et al.* [9], price perception and physical environment affect the customers' loyalty in the selection of fast food restaurant.

AHP model has been widely used in other fields as well. Rimantho *et al.* [10] appraised the ranking of waste electronic products and determined proper management for these waste with AHP model. Lam *et al.* [11] studied the job selection among the undergraduates by using AHP model. Jaberidoost *et al.* [12] used AHP model to assess the risk in pharmaceutical supply chain in Iran. Khan *et al.* [13] applied AHP model also to rank the buying factors of private health insurance from the low income group. Lam *et al*. [14] studied the preference in the selection of mobile network operators in Malaysia based on multiple criteria using AHP model. In Indian, AHP is applied to determine the ranking of most appropriate biomass energy sources to produce renewable energy [15]. Lastly, Cancela *et al.* [16] studied the significant factors for designing and assessing a telehealth system for Parkinson's disease. AHP model has been used to solve multi-criteria decision making problem in various fields.

Based on the past studies, AHP model has been applied in the selection of fast food restaurants in different countries. However, AHP model has not been studied actively in Malaysia yet. Therefore, this paper aims to fill the research gap by studying the selection of fast food restaurants among the undergraduates in Malaysia with AHP model.

3. Materials and Methods

3.1. Data

In this study, McDonald, Kentucky Fried Chicken (KFC), Pizza Hut, Domino Pizza and Wing Zone are selected as the decision alternatives. The decision criteria include price, customer service, environment, flexibility, efficiency, location and cleanliness. AHP model is used to determine the priorities of decision alternatives and criteria among the undergraduates. In this study, 140 undergraduates from Universiti Tunku Abdul Rahman, Kampar Campus in Malaysia are selected as the target respondents.

3.2. Analytic Hierarchy Process

AHP model is designed to solve multi-criteria decision making problem by decomposition of the problem into a hierarchy. The hierarchy consists of three levels which are top, middle and bottom level. Top level is the main objective, middle level is the decision criteria whereas the bottom level contains decision alternatives. Figure 1 presents the general hierarchy structure in AHP model.

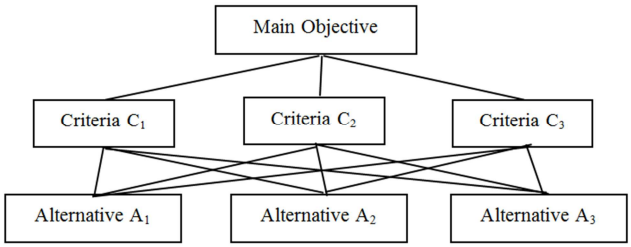

Figure 1. General Hierarchy Structure in AHP model.

Data analysis in AHP model can be divided into five steps as shown below [17].

Step 1: Identify the objective, decision criteria and decision alternatives in building the hierarchy structure.

Table 1 shows the three levels of hierarchy in this research which consists of the main objective, decision criteria and decision alternatives for the selection of fast food restaurants.

Table 1. Hierarchy Structure for the Selection of Fast Food Restaurants.

Top Level	Selection of Fast Food Restaurant
(Main Objective)	
Middle Level	1. Price (C_1)
(Decision Criteria)	2. Customer Service (C_2)
	3. Environment (C_3)
	4. Flexibility (C_4)
	5. Efficiency (C_5)
	6. Location (C_6)
	7. Cleanliness (C_7)
Bottom Level	1. McDonald (A_1)
(Decision	2. KFC (A_2)
Alternative)	3. Pizza Hut (A_3)
	4. Domino Pizza (A_4)
	5. Wing Zone (A_5)

Step 2: Each element in the second and third level of the hierarchy structure is compared in pairwise to obtain its relative importance to the problem. Saaty [3] has introduced a ratio scale for pairwise comparison as shown in Table 2.

Table 2. Ratio Scale used for pairwise comparison.

Scale	Definition
1	A and B are of equal importance
3	A has a slightly higher importance than B
5	A has a strong importance than B
7	A has a very strong importance than B
9	A has a absolute importance than B
2,4,6,8	Intermediate values

If there are n decision criteria or decision alternatives, then the number of pairwise comparisons will be formulated as below.

$$(0.5)n(n-1) \tag{1}$$

A pairwise comparison matrix **C** for n decision criteria is shown below.

$$\mathrm{C} = \begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \\ \dots \\ C_n \end{array} \begin{array}{c} \begin{array}{ccccc} C_1 & C_2 & C_3 & \dots & C_n \end{array} \\ \begin{bmatrix} 1 & a_{12} & a_{13} & \dots & a_{1n} \\ 1/a_{12} & 1 & a_{23} & \dots & a_{2n} \\ 1/a_{13} & 1/a_{23} & 1 & \dots & a_{3n} \\ \dots & \dots & \dots & \dots & \dots \\ 1/a_{1n} & 1/a_{2n} & 1/a_{3n} & \dots & 1 \end{bmatrix} \end{array} \tag{2}$$

A pairwise comparison matrix B for m decision alternatives, compared in terms of one decision criterion is shown below.

$$\mathrm{B} = \begin{array}{c} \\ A_1 \\ A_2 \\ A_3 \\ \dots \\ A_m \end{array} \begin{array}{c} \begin{array}{ccccc} A_1 & A_2 & A_3 & \dots & A_m \end{array} \\ \begin{bmatrix} 1 & b_{12} & b_{13} & \dots & b_{1m} \\ 1/b_{12} & 1 & b_{23} & \dots & b_{2m} \\ 1/b_{13} & 1/b_{23} & 1 & \dots & b_{3m} \\ \dots & \dots & \dots & \dots & \dots \\ 1/b_{1m} & 1/b_{2m} & 1/b_{3m} & \dots & 1 \end{bmatrix} \end{array} \tag{3}$$

In this study, the pairwise comparison matrix C obtained for seven decision criteria is shown below.

$$\mathrm{C} = \begin{bmatrix} 1.00 & 2.18 & 1.77 & 2.36 & 1.61 & 2.18 & 1.05 \\ 0.46 & 1.00 & 2.75 & 2.97 & 2.31 & 2.62 & 1.13 \\ 0.57 & 0.36 & 1.00 & 2.53 & 1.53 & 1.78 & 0.89 \\ 0.42 & 0.34 & 0.40 & 1.00 & 0.94 & 1.19 & 0.60 \\ 0.62 & 0.43 & 0.66 & 1.06 & 1.00 & 2.27 & 0.92 \\ 0.46 & 0.38 & 0.56 & 0.84 & 0.44 & 1.00 & 0.70 \\ 0.96 & 0.88 & 1.12 & 1.66 & 1.08 & 1.43 & 1.00 \end{bmatrix} \tag{4}$$

The pairwise comparison matrix $\mathrm{B_{Ci}}$ (i=1,2,3,..7) for five decision alternatives, compared in terms of each decision criterion is shown as follows.

Price (C_1):

$$\mathrm{B_{C1}} = \begin{bmatrix} 1.00 & 3.68 & 4.04 & 3.61 & 3.65 \\ 0.27 & 1.00 & 3.09 & 2.82 & 2.99 \\ 0.25 & 0.32 & 1.00 & 1.64 & 1.99 \\ 0.28 & 0.35 & 0.61 & 1.00 & 2.28 \\ 0.27 & 0.33 & 0.50 & 0.44 & 1.00 \end{bmatrix} \tag{5}$$

Customer Service (C_2):

$$\mathrm{B_{C2}} = \begin{bmatrix} 1.00 & 3.33 & 2.66 & 2.43 & 1.78 \\ 0.30 & 1.00 & 1.67 & 1.47 & 1.19 \\ 0.38 & 0.60 & 1.00 & 1.65 & 1.54 \\ 0.41 & 0.68 & 0.61 & 1.00 & 1.45 \\ 0.56 & 0.84 & 0.65 & 0.69 & 1.00 \end{bmatrix} \tag{6}$$

Environment (C_3):

$$B_{C3} = \begin{bmatrix} 1.00 & 3.06 & 2.12 & 2.84 & 1.20 \\ 0.33 & 1.00 & 1.44 & 1.65 & 0.88 \\ 0.47 & 0.70 & 1.00 & 2.09 & 1.17 \\ 0.35 & 0.61 & 0.48 & 1.00 & 1.01 \\ 0.83 & 1.14 & 0.85 & 0.99 & 1.00 \end{bmatrix} \quad (7)$$

Flexibility (C_4):

$$B_{C4} = \begin{bmatrix} 1.00 & 5.36 & 4.93 & 4.93 & 4.61 \\ 0.19 & 1.00 & 2.02 & 1.86 & 1.49 \\ 0.20 & 0.49 & 1.00 & 1.64 & 1.27 \\ 0.20 & 0.54 & 0.61 & 1.00 & 1.24 \\ 0.22 & 0.67 & 0.79 & 0.81 & 1.00 \end{bmatrix} \quad (8)$$

Efficiency (C_5):

$$B_{C5} = \begin{bmatrix} 1.00 & 3.59 & 3.49 & 2.99 & 2.52 \\ 0.28 & 1.00 & 2.44 & 2.15 & 1.88 \\ 0.29 & 0.41 & 1.00 & 1.57 & 1.37 \\ 0.33 & 0.47 & 0.64 & 1.00 & 1.18 \\ 0.40 & 0.53 & 0.73 & 0.85 & 1.00 \end{bmatrix} \quad (9)$$

Location (C_6):

$$B_{C6} = \begin{bmatrix} 1.00 & 5.04 & 5.24 & 3.08 & 2.33 \\ 0.20 & 1.00 & 2.39 & 1.04 & 1.05 \\ 0.19 & 0.42 & 1.00 & 0.77 & 0.75 \\ 0.32 & 0.96 & 1.29 & 1.00 & 1.19 \\ 0.43 & 0.96 & 1.33 & 0.84 & 1.00 \end{bmatrix} \quad (10)$$

Cleanliness (C_7):

$$B_{C7} = \begin{bmatrix} 1.00 & 3.16 & 2.07 & 1.64 & 1.23 \\ 0.32 & 1.00 & 1.11 & 1.06 & 0.91 \\ 0.48 & 0.90 & 1.00 & 1.58 & 1.04 \\ 0.61 & 0.95 & 0.63 & 1.00 & 1.05 \\ 0.81 & 1.10 & 0.96 & 0.95 & 1.00 \end{bmatrix} \quad (11)$$

Step 3: Weights for each decision criterion and decision alternatives are obtained through the normalization method. First of all, sum for each column in the matrices is calculated and all elements in a column are divided by the column's sum. Eight new normalized matrix are formed. The average for each row in the newly formed matrices represents the priorities or weight for the decision criteria and decision alternative respectively.

Step 4: The overall weights for the decision alternatives in matrix **F** is computed as below.

$$\mathbf{F} = \mathbf{Q} \times \mathbf{w}^{\mathbf{T}} \quad (12)$$

Highest weight in matrix **F** indicates that the particular decision alternative gives the highest ranking.

Step 5: In order to check for consistency in pairwise comparison matrix, Saaty [3] has introduced the consistency ratio (*CR*) which is defined in terms of consistency index (*CI*) and random index (*RI*) with the formula as shown below.

$$CR = \frac{CI}{RI} \quad (13)$$

CI is defined as below.

$$CI = \frac{\lambda_{\max} - n}{n-1} \quad (14)$$

λ_{max} is the maximum eigenvalue,

n is total number of decision criteria.

Table 3 shows the random index (*RI*) with respect to the number of decision criteria.

Table 3. Values of Random Index.

n	RI
2	0.00
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.51

If $CR \leq 0.10$, the level of inconsistency in the pairwise comparison matrix is satisfactory and therefore, the result is acceptable.

4. Empirical Results

Figure 2 shows the weights or priority of all decision criteria in the selection of fast food restaurants among the undergraduates based on matrix **C** in (4).

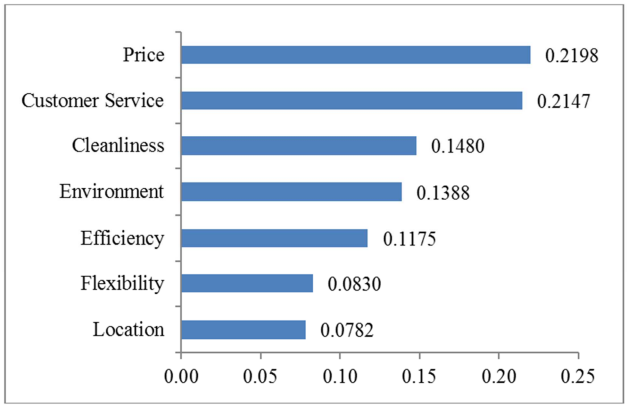

Figure 2. Priority of Decision Criteria in the Selection of Fast Food Restaurants.

As shown in Figure 2, the priority of decision criteria in the selection of fast food restaurants is the price (0.2198) followed by customer service (0.2147), cleanliness (0.1480), environment (0.1388), efficiency (0.1175), flexibility (0.0830) and finally location (0.0782). Price and customer service are the most influential criteria in the selection of fast food restaurants among the undergraduates.

Figure 3 to Figure 9 display the preference of fast food restaurants based on each decision criterion from (5) to (11).

Price (C_1):

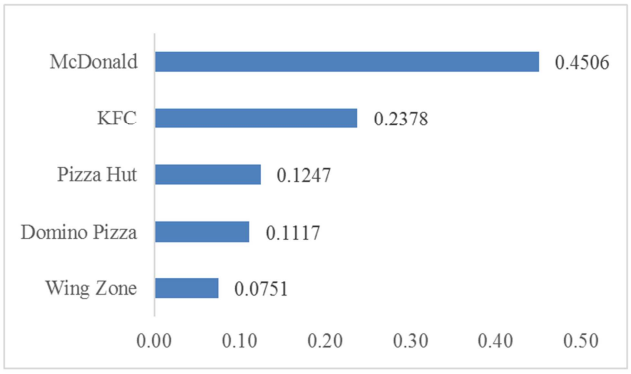

Figure 3. Preference of Fast Food Restaurants Based on Price.

Customer Service (C_2):

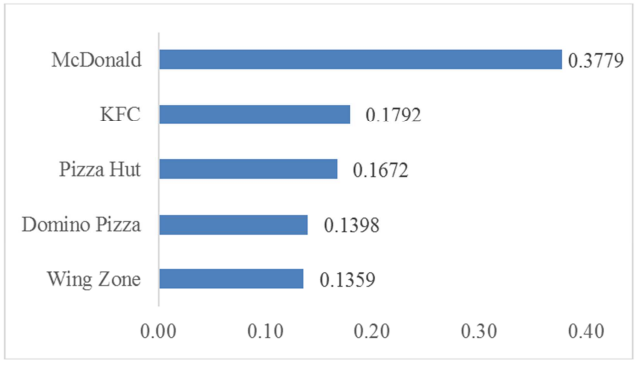

Figure 4. Preference of Fast Food Restaurants Based on Customer Service.

Environment (C_3):

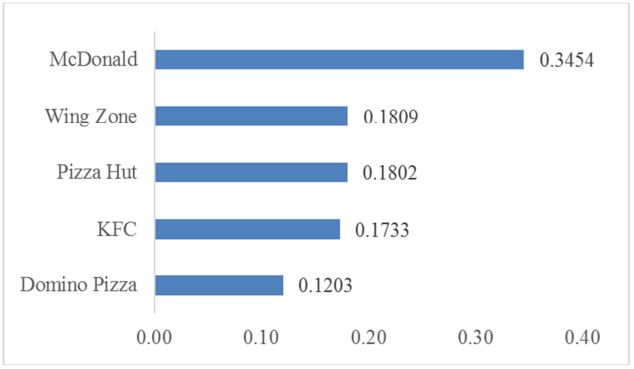

Figure 5. Preference of Fast Food Restaurants Based on Environment.

Flexibility (C_4):

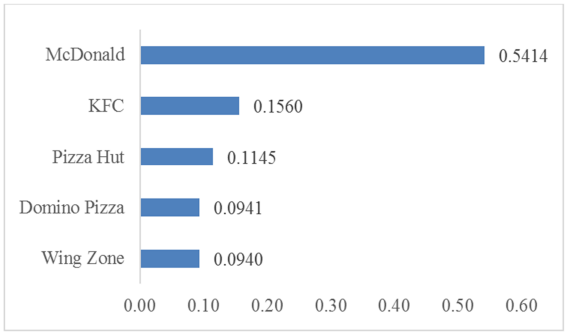

Figure 6. Preference of Fast Food Restaurants Based on Flexibility.

Efficiency (C_5):

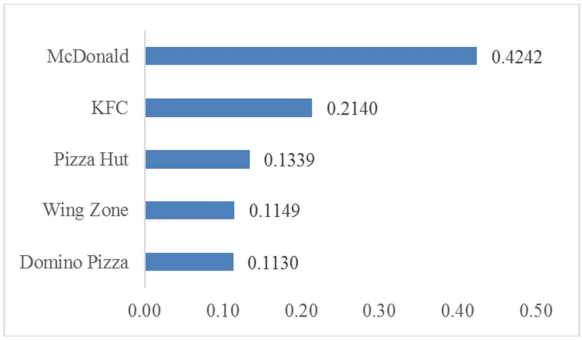

Figure 7. Preference of Fast Food Restaurants Based on Efficiency.

Location (C_6):

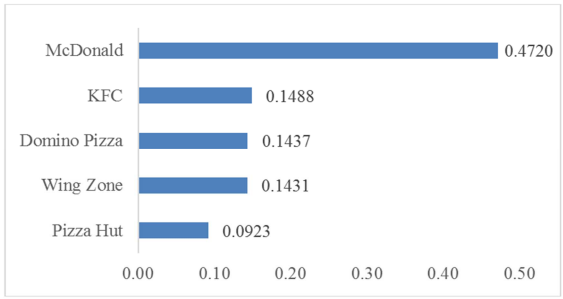

Figure 8. Preference of Fast Food Restaurants Based on Location.

Cleanliness (C_7):

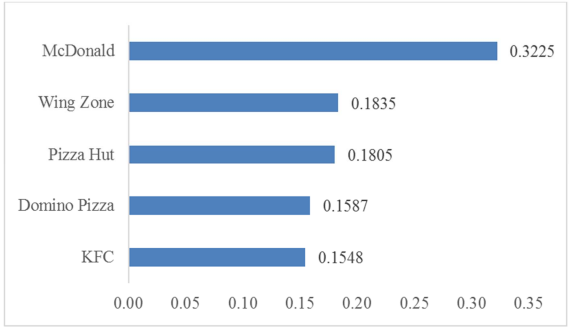

Figure 9. Preference of Fast Food Restaurants Based on Cleanliness.

As shown from Figure 3 to Figure 9, McDonald has the top ranking for all decision criteria. This implies that McDonald is the most preferred fast food restaurant among the undergraduates in UTAR Kampar, Malaysia in terms of price, customer service, environment, flexibility, efficiency, location as well as cleanliness. After McDonald, KFC excels other fast food restaurants in terms of all decision criteria except environment and cleanliness. Wing Zone and Domino Pizza are ranked at the lowest for most of the decision criteria. Wing Zone is ranked at the lowest in terms of price, customer service and flexibility. Domino Pizza is ranked at the lowest in terms of environment and efficiency.

Figure 10 presents the overall weights or priority in the selection of fast food restaurants in this study.

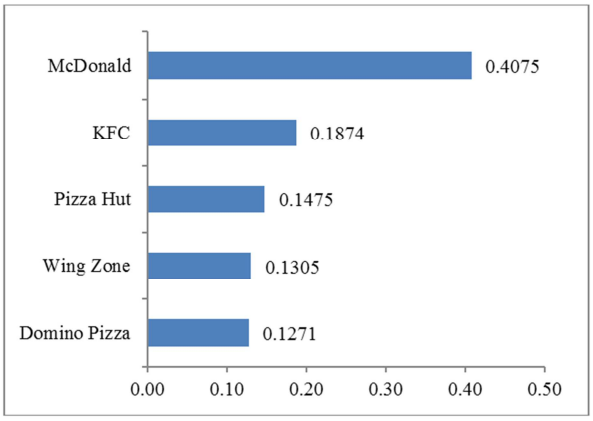

Figure 10. Overall Weights in the Selection of Fast Food Restaurants.

Based on Figure 10, the results show that McDonald (0.4075) is the most preferred fast food restaurant among the undergraduates with respect to all decision criteria which are price, customer service, environment, flexibility, efficiency, location and cleanliness. The preference of the fast food restaurants is followed by KFC (0.1874), Pizza Hut (0.1475), Wing Zone (0.1305) and finally Domino Pizza (0.1271). In this study, the overall consistency ratio is 0.0348 which is well below 0.10. This implies that the pairwise comparison matrix does not show any inconsistencies problem. Therefore, the results obtained in this study with AHP model are acceptable and reliable.

5. Conclusion

This paper aims to determine the priority of decision criteria in the selection of fast food restaurants among the undergraduates in Malaysia with AHP Model. The decision criteria identified in this study are price, customer service, environment, flexibility, efficiency, location and cleanliness. Besides that, this paper also aims to determine the most preferred fast food restaurant among McDonald, KFC, Pizza Hut, Domino Pizza and Wing Zone with AHP Model. The results of this study show that McDonald is the most preferred restaurant followed by KFC, Pizza Hut, Wing Zone and Domino Pizza among the undergraduates. Price, customer service and cleanliness are ranked as the top three influential decision criteria by the undergraduates in this study. The significance of this paper is to determine the most preferred fast food restaurantas well as the most influential decision criteria in the selection of fast food restaurants by the undergraduates in Malaysia with AHP model. Furthermore, this study also helps other less favourable fast food restaurants such as Wing Zone and Domino Pizza to identify the potential improvements based on the most influential decision criteria.

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