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The Delphi method to identify attributes for a valuation approach for residential property exposed to flood risk

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Abstract

Purpose – This study is aimed to identify the attributes for a valuation approach of flood risk exposure, in particular for residential property. With frequent flood events in Malaysia, there is a need for valuation methods to evolve and represent the increased risk of natural disasters.

Design/methodology/approach – This study employed the Delphi method which is a systematic and interactive research technique in obtaining variables for a valuation approach for residential property exposed to flood risk.

Findings – Results from the Delphi method revealed four categories of attributes, namely environmental, locational, structural and economical.

Originality/value – The findings from this research will transform the valuation approach in Malaysia to identify the value of residential property exposed to flood risk. The determination of variables will represent the current risk in valuations, especially for residential property in flood-prone areas.

Keywords Delphi, Flood, Risk, Malaysia, Valuation

Paper type Research paper

1. Introduction

The increased number of properties, development in marginal areas, and changes in water collection and flows has led to a situation where worldwide, commercial and residential property markets are becoming more exposed to the consequences of a flood natural disaster (Eves and Wilkinson, 2014). As a result of the increased number of properties, growth in marginal areas, and improvements in water collection and flows, commercial and residential property markets around the world are becoming more vulnerable to the effects of a flood natural disaster. A number of studies have been published that examine the long-term effects of flooding on property markets, including property prices and values (Lamon and Proverbs, 2006).

Subsequent heavy rainfall and floods, caused not only by climate change and environmental impacts but also local issues that have more impact on residential property development and prices (Lamond *et al.*, 2007), and the ability for homeowners to obtain both finance and insurance for their property (Daniel *et al.*, 2009), are all serious issues.

Floods have serious consequences such as displacement of people, loss of lives, damage to property, as well as the impact on the environment (Mishra and Sinha, 2020; Tsakiris, 2014). Damage arising from flood events can attribute to several factors that may also affect property values (Bhattacharya *et al.*, 2013). Furthermore, residents have become more aware of the impact from floods to the value of property. A report by McAlpine and Porter (2018)

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mentioned that despite the fact that basic flood inundation risk indicators were not available to the general public, a lot of buyers were becoming aware of the risk by other means. The process by which flooding risk has suppressed house prices is one of the other sources of information that residents have become aware of.

An appropriate valuation assessment also helps assess the damage value of a property after a disaster. This is especially important for the purpose of insurance. Nevertheless, for long-term purposes, determining risk value to a property was also assessed. This is due to the characteristics of property being heterogeneous. In other words, a property has its own characteristics, which makes it difficult to identify the value. Therefore, the risk element of a flood-prone area was taken into account when determining the value of a property. The risk value comes from the results of flood depth distribution, bearing body forms, flood depth-damage curves and economic losses. These are obtained through hazard analysis, bearing body exposure assessment, vulnerability analysis and loss of quantification in flood areas with the highest disaster level (Wang *et al.*, 2021). According to several researchers such as de Koning *et al.* (2017), Ooi *et al.* (2014) and Bunten and Kahn (2017), the risk that is associated with house prices was taken into account in determining the value. In addition, there was a significant difference in house prices located inside and outside a flood risk zone (Harrison *et al.*, 2001). According to a study by the Committee of Climate Change (2015), floods will result in the loss of lives, damage to property or the environment as well as affecting the daily activities of local communities.

Furthermore, understanding the link between flood risk, insurance, flood mitigation and property value is important in the maintenance of property value (Lamond *et al.*, 2019). Savills (2016) in the technical report also mentioned that the risk exposed to a flood threatens the national investment portfolio. The real estate sector will also be directly affected by flooding if flood-proofing measures are not incorporated (Shahid *et al.*, 2017).

The issue for a professional valuer is how to correctly identify the impact of a flood and include these into their valuation report (Cradduck, 2016). The literature indicates the difficulties in assessing flood damages because of the lack of knowledge amongst valuers (Lamond *et al.*, 2007). In Malaysia, valuers practically do not take into account the factors of a natural disaster (flood) in determining the value of real estate. The use of traditional valuations, especially the comparison method, has widely been adopted by most valuers. Earlier studies by Newell *et al.* (2010), Yahya *et al.* (2012), Sunderajoo (2017), Ismail *et al.* (2019a, b), and Zulkarnain *et al.* (2020) revealed most valuers in Malaysia rely heavily on traditional methods for valuations. The use of advanced methods such as automated valuation model (AVM) and artificial neural network (ANN) have been rarely used or rejected by most of the local valuers. Although this research has not employed the advanced methods, this study will nevertheless improvise the methodology in determining values, especially property with high-risk exposure to flood events. With these reasons, there is high motivation to implement this study which sets the variables that represent the risk exposure of residential property in flood-prone areas. Flood risks are locally variable, depending on flood risk zones and flood return periods (Curtis *et al.*, 2017). Furthermore, this study attempts to identify the variables by using the involvement of an expert panel in the field of real estate. Expert groups engaged in this research include specialists in real estate, such as valuers, estate agents, academicians, government officers and other specialists involved in real estate.

2. Literature review

The impact of a flood on residential property damage can be divided into two types, namely flood and property characteristic. According to Soetanto and Proverbs (2006), the damage caused by a flood is considered by many to be an easy problem to solve, but it is a complex phenomenon to valuers and property owners. The real estate sector, specifically the housing

industry, has seen rapid development and constitutes as a major industry in the real estate sector. Due to rapid development of residential areas, property players and governments need to have a mechanism, not just in terms of planning, but also a valuation mechanism of residential projects in flood-prone areas.

Flood hazard is considered a common natural disaster that occurs in Malaysia. Based on the history of floods since the 1970s until present, the monsoonal floods that took place from December 2014 to January 2015 were considered one of the more severe floods to hit Malaysia in recent decades. These floods saw more than 100,000 residents evacuated from their homes, causing damage to buildings and infrastructure (Akasah and Doraisamy, 2015). Therefore, it can be concluded that some areas of residential property in Malaysia is at risk of high exposure to flood events.

The impacts left by flood events have caused tremendous damage from the physical contact of floodwaters with buildings and infrastructure declining physically. Indirect impacts from a disaster are more difficult to deal with, where it involves the surrounding community affected by the flooding events. Usually, the main effect of floods on the residents will involve health, social and economy aspects.

Property valuation exercises, even without dealing with disasters, are challenging due to small, inefficient markets, lack of market data and inadequate or missing property records (Mitchell *et al.*, 2015). Many attributes will affect residential property value. In valuation practises that are commonly used nowadays, most of the valuers consider the factor of locational, structural and neighbourhood in determining residential property value (Abidoye and Chan, 2016; Candas *et al.*, 2015). Climate change and the risk of natural disaster that have been exposed in most countries in the world (United Nation, 2015) need to be considered as factors that will affect property value in Malaysia. The damages from a natural disaster (floods) have a significant impact on property value, development and investment decisions for stakeholders and property players in the real estate industry and practices (Cradduck, 2016). Previous research has found evidence that floods have an impact and cause damage to properties including residential and industrial areas (Albano *et al.*, 2017; Van Ootegem *et al.*, 2015).

Residential properties are unique products that need to meet the requirements of purchasers to own or buy a house for investment. The complexity of a residential development nowadays is more challenging for developers to produce more comprehensive residential areas, with conducive living environments and excellent amenities for the residents. Many factors are involved in determining the market value of a home, not just the factors of demand and the supply of real estate as the main determinants of property prices (Candas *et al.*, 2015).

Several researchers have studied the determinants of residential property value in the real estate industry. Among the factors that have been identified are location, neighbourhood characteristics, property state of repair, size of the property, availability of neighbourhood security and age of the property are the most highly significant variables that are influential on property value in the Lagos Metropolis area in Nigeria (Abidoye and Chan, 2016). These attributes have been widely used by professionals in real estate in determining value for residential property. Furthermore, this method has taken into account the factor of natural disasters, in particular flood events. Several studies have shown that any changes to property characteristics can change the value of the property. The previous literature has revealed several studies related to the factors affecting residential property values, focussing on different situations. For instance Samarasinghe and Sharp (2010) and Zhang (2016) highlighted several factors that significantly contributed to the residential property value, such as neighbourhood structure, community, environment and house features, size of land and built-up area of the property. In the latest research by Yang *et al.* (2019), the researcher developed empirical tools in determining residential property prices including several major variables, such as structural features, accessibility levels and neighbourhood amenities. Kenney *et al.* (2006) found significant results that revealed given scenarios of a 0.5% or 1% flood-risk, the valuer will make adjustments

to the yield on the valuation of investments within the range of 0.5%–1.5% on the base yield of 10%, which will result in a reduction in the capital value of about 5%–15%. Therefore, the increased risk of floods driven by climate change can have a significant impact on residential properties, especially in affected areas. The practitioners in these areas, such as valuers and estate agents, need to take into account the factor of risk exposure of residential property in flood-prone areas. This is achieved by using weighted and synthesised measures in a set of cardinal directives. From earlier research within the same area, there were several factors that could contribute to the value of residential property in flood-prone areas such as: lot size, building size, type of construction, building age, deterioration conditions, the number of bedrooms, built-in wardrobes, standard kitchen, garage, swimming pool, proximity to shops, transportation, schools and work, exposure to air or vehicle noise, local supply and demand, and mortgage interest rates (Grahn and Nyberg, 2017; Yeo *et al.*, 2003). Another research that revealed the impact from floods to property value was by Kheir and Portnov (2016) where their findings demonstrated environmental factors tended to lower the property values.

Ismail *et al.* (2016) found that the variables of flood duration in urban and rural areas were negative and statistically significant. The research revealed that as the flood duration increased by an hour; the land value in urban and rural areas decreased by 0.042 and 0.047%. It showed that the land value in urban and rural areas with prolonged periods of flooding tended to decrease the property market value. Prolonged periods of flooding continuously caused damage to property.

The findings from literature reviews from various countries such as the USA, England, Canada, Australia, Hungary, New Zealand, South Korea, Japan and Malaysia particularly have different disclosure opinions in their research scenarios of flood impact on residential property values in their respective countries. A summary based on the research conducted from previous studies showed that floods had a significant impact on residential property value.

In relation to this study, several variables that have significant impacts on values have been selected as important scenarios in the economic attributes to identify property values impacted by flood events. The highly significant attributes will be used in the formation of economic valuation model development in determining the residential property value considering the flood impact, based on the literature review survey. The economic attributes can be divided into four categories: (1) structural (2) locational (3) environmental and (4) macroeconomics. The detailed explanations are as follows:

2.1 Structural attributes

Structural attributes refer to the building design (internal and external), ownership, space and material that are used for the residential property. The building specification for the residential property record contains detailed information on the property's structural components, consisting of several bathrooms, bedrooms, parking space, living area, swimming pool, age of the house and building size (Bin and Polasky, 2004; McKenzie and Levendis, 2010). These features affect the performance of buildings at various levels, depending on their usage (Wyatt, 2013).

Some titles of properties have a positive impact while others have a negative impact on property value. For instance, in land tenure (Mitchell *et al.*, 2015) itself, the freehold property carries a positive impact on property value compared to a leasehold property. The age of the house also has a negative impact on property value (Clapp and Giaccotto, 1998). Numerous studies reveal that the specification of a residential house, including the number of bedrooms, bathrooms and floor area is positively related to the sale price of the house. Most house buyers are willing to purchase a house and pay more for space, especially functional space (Aluko, 2011).

Since structural attributes are the main factors in determining property value, the model development has considered the most significant attributes such as age, building size, land size and property condition in this research.

2.2 Locational attributes

In valuations, the locational attributes refer to the distance of each of the facilities and amenities in the neighbourhood area to residential property (Gallimore *et al.*, 1996). The attributes consist of the quality of the neighbourhood amenities provided by the government to the residential area, such as schools, hospitals, light rapid transit (LRT)/mass rapid transit (MRT), mosques and recreational areas. All amenities provided in the neighbourhood area have a positive impact on property value. The development of an industrial area close to a residential area will have a negative impact on property value (Ismail *et al.*, 2016).

For activities involving the sale of real estate, it is usually the sellers who often find location-specific information related to low-cost homes, based on their lives there. This information is also more likely to attract homeowners because of its close location (Pope, 2008). As a summary, this research considered the factors of distance to highways and convenience stores as main significant factors in contributing to the model development.

To analyse the impact of real estate location on hedonic models, the region in the analysis is usually divided into homogeneous regions, namely neighbourhoods, which can be defined in various ways. The most common way to create a neighbourhood is to use the boundaries of an administrative city or county. When urban development grows and becomes a metropolitan area with a natural extension of the urban fabric, these municipal boundaries do not necessarily represent a bright neighbourhood. On the other hand, when urban development is underway with a great planning project, the boundaries are more specific and tend to create a clearer community (Melanda *et al.*, 2016). Findings by Chung *et al.* (2018) revealed that the advantages of urbanisation affect every city. Although the case study was more concerned with the properties of urban facilities and the density of communities and programs due to unmanaged urbanisation, it was more related to housing features, since most apartment projects are under city-state-supported urban infrastructure developments.

Therefore, it can be summarised that the location is considered a factor that significantly influences the value of a residential property and is viewed from a variety of aspects. Location refers to the position of the property either located in the city or rural area. In addition, the location is visible from the distance of the residential property with facilities provided in the surrounding area. A strategic location with many basic amenities is considered a good and profitable property option for investment purposes.

2.3 Environmental attributes

The environmental attributes refer to the externality factors such as crime rate, disaster-prone area (flood and earthquake) and greenery area (Netusil, 2015). The environmental attributes that are more often evaluated and are believed to have a considerable impact on a natural disaster (flood) and real estate values are related to flood-prone areas. The environmental attributes and residential areas located at the highest crime rate will also have a negative impact on property value (Sasaki and Yamamoto, 2018).

Flood attributes generally refer to the level of flood that will have an impact (Lamond *et al.*, 2010) on the structure of the building or area. Numerous studies have indicated the level of flood is based on the frequency, depth and duration of flood events. Flood events will have a negative impact on property value (Aliyu *et al.*, 2016), and the flood itself will inflict damage to the building and flood-affected area (Osti and Nakasu, 2016). Based on a study by Elmer *et al.* (2010), a significant positive correlation was found between recurrence interval and level loss. This relationship cannot be fully explained by different water levels. The loss of buildings increases with the probability of a reduction in the occurrence of floods at the location of a residential project.

Kenney *et al.* (2006) in their research suggested that despite recent flood events affecting property values, the impact was marginal where the features had no effect, even though they were considered risky, while Lamond *et al.* (2005) reviewed fifteen case studies which found

that floods had a significant impact on residential property value in the USA between 3% and 12%. The interesting findings from the research are that the attributes involved were dominant for a particular case and differed from one situation to another.

The most important reason for the diversity of research outcomes, and related to the inability to exclude other influences on property values, is a site-specific feature of much of the work. Depth and frequency of flood experience (or flood risk) vary from site to site. But what was discussed in the literature was the implications of the nature of the flood-liability disclosure, which varies by the details of the exposure, the time of exposure, the level of publicity of the exposure, the duration of the exposure (permanent and temporary), and the nature and scope of any regulations attached to the disclosure (Yeo *et al.*, 2003).

2.4 Macroeconomic attributes

The macroeconomic nature of the influence on the value of property received is huge and varied. Some of these influences are related to changes in gross domestic product (GDP), population, inflation rates, construction costs, interest rates and Real property gain tax (RPGT), and household incomes are important in determining the level of common value at a given time, and, therefore, useful in predicting change over time (Gallimore *et al.*, 1996). According to Wyatt (2013), the key macroeconomic variables that affect all property investment returns are a supply of floor space in the relevant sector, inflation, exchange rates and interest rates. Based on the research conducted by Mariadas *et al.* (2016) which empirically examined whether rising trends in Malaysian house prices were associated with macroeconomic attributes such as changes in population, construction costs, housing speculation and inflation rates, the findings revealed the correlation between housing speculation and construction costs, and inflation rates were low. At the same time, inflation had a very low correlation with house and population. This study showed that inflation rates do not affect housing prices. The results were in contrast to Ong (2013), who argued that inflation would include real payments on long-term fixed-rate mortgages; an increased supply of money led to inflation and reduced monetary value which led to rising housing prices. This was supported by Anari (2002) who mentioned that inflation has a relationship between house prices, rent and even consumer price index. Nevertheless, an important implication of these findings was that house prices were a stable inflation hedge over time. As a summary in developing the economic model of property valuation impact from a flood, a detailed review of past research has been carried out to identify the attributes used in property valuations. The identified attributes are divided into four categories as follows:

(1) structural;

(2) locational;

(3) environmental;

(4) macroeconomics;

Based on research conducted by Mariadas *et al.* (2016), which empirically examined whether rising trends in Malaysian house prices were associated with macroeconomic attributes such as changes in population, construction costs, housing speculation and inflation rates; the findings revealed the correlation between housing speculation, construction costs and inflation rates was low.

The macroeconomic nature of the influence on the value of the property received is huge and varied. Some of these influences are related to changes in GDP, population, inflation rate, construction cost, interest rate, RPGT, and household incomes are important in determining the level of common value at a given time, and, therefore, useful in predicting changes over time. According to Wyatt (2013), the key macroeconomic variables that will affect all property

investment returns will affect all property investment returns. Those variables are the supply of floor space in the relevant sectors, inflation, exchange rates and interest rates.

The dynamic literature reviews on macroeconomic factors that could contribute to house price values that are influenced by flood events allow for endogenous house price determinations in this paper. The macroeconomic variables are used to investigate the effects of adjustments in fundamentals such as GDP, population, inflation rates, construction costs, interest rates, RPGT and household incomes on housing market equilibrium. It is impossible to tell if observed changes in the relationship between house prices and flood events represent shifting fundamentals or an increase in house prices without first knowing this theoretical relationship. Furthermore, since the control group experiences some or all of the contemporaneous influences that affect property values, the macroeconomic factors enable the model that will be developed during the post-Delphi process to isolate the effect attributable to the flood from other concurrent variables; such as macroeconomic changes in the housing market as well as changes in the local housing market. Therefore, the model will be able to isolate the effect attributable to a flood from other contemporaneous variables, such as macroeconomic changes in the housing market.

3. Methodology

In order to identify the details and attributes of the valuation model for residential property with exposure to flood events, this study has employed the Delphi Method. The Delphi Method is a systematic and interactive research technique for obtaining the judgement of a panel of independent experts on a specific topic. Contrary to traditional surveys, which will use random samples to estimate the views held by separate individuals within the target population, the Delphi method uses interaction by an expert panel with relevant expertise to reach a consensus group's response to complicated queries. Methods such as focus group discussions (FGDs) are used to collect information to better understand how experts make decisions. Therefore, an FGD with subject matter experts (SMEs) was used to determine variables in valuation methods to assess residential property with exposure to flood events. The domains' established variables were validated through an FGD with SMEs led by a panel of experts. In determining the economic attributes from the impact of floods on residential property value, a consensus from the expert panel was needed. The Delphi method is beneficial as a tool to garner the opinion from experts using a questionnaire and to analyse and validate the results (Nawawi, 2008).

The Delphi method procedure involved several processes (Figure 1). In the early stages there was a need to identify the research question and then identify potential respondents for the research conducted. The selection of experts was based on predefined criteria in terms of field expertise, academic qualifications, work experience, and active involvement with professional bodies, both local and international. After the selection of the respondents was

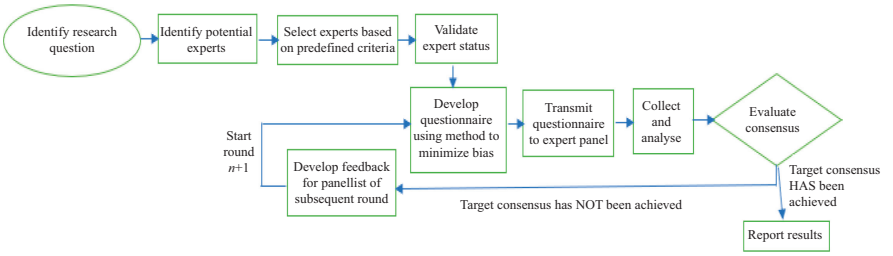

Figure 1.
Delphi method procedurea

Source(s): Hallowell and Gambatese, 2010, p. 102

created, then the validation process to identify the suitable respondents for this research was obtained. The next level was to develop a questionnaire using a method to minimise bias and transmit surveys to experts. After obtaining a complete response from the survey, the process of collecting and analysing the responses of any respondent involved, was conducted. The results of the analysis were used to evaluate a consensus and finally report the results of the investigation made if the consensus targets were obtained.

An appropriate elicitation approach had to be identified for this analysis in order to obtain a synthesis of expert opinions while minimising biases. An expert survey was used to elicit information from experts for the purpose of standardising flood effect data collection on housing. For this reason, a variety of theoretically appropriate questioning methods were considered. This study compared two interviewing techniques: FGDs and (single) expert interviews, as well as the Delphi process, which employed a more standardised questioning approach. All panel members were informed of their anonymous counterpart's opinions, known as the feedback process. Respondents were given the opportunity to update their answers after receiving the results of previous questionnaires. At this stage, the experts had already reached a consensus on the issue of the methodological approach in identifying the value of housing affected by flood events. Delphi was widely regarded as a very impartial and logical process in this research as members of the panel experts were not able to exert undue control onto other members. In addition, Delphi was very useful for experts who live far away and getting them together for a committee meeting was impractical. As a result, panel selection was a critical aspect of implementing the Delphi technique.

In order to identify and verify the appropriate attributes to be used in this research, the use of the Delphi method by using the expert panel questionnaire as tools to achieve the objectives of the study was utilised. In the process of forming a questionnaire, there were six steps involved, as follows:

(1) Designing and piloting the questionnaire

The questionnaire was divided into two sections. Part A: respondent background and Part B: economic attributes. The questions listed in the survey were based on facts obtained during the literature review and analysis stages. This questionnaire was developed as a tool to achieve the research objectives.

(2) Pre-testing of a questionnaire

Prior to the FGD meeting, a questionnaire was disseminated to the expert panels which was aimed for them to review. Several improvements were made based on the comments from the expert panels from several points of view such as fit for the study, not misleading and met the objectives of the study as well as language.

(3) Selection of the respondents

Respondents for this study comprised expert panels who trained in professional areas, namely valuers, estate agents and property management registered with the Board of Valuers, Estate Agent, Appraisers and Property Managers (BOVEAP) Malaysia.

(4) Distribution of the questionnaire

Questionnaire distribution by an expert panel was selected by hand. The panel of experts was asked to fill out the questionnaire during the FGD session.

(5) Data analysis

The feedback from the respondents was analysed by using statistical software.

(6) Selection of the attributes

The findings from the data analyses have been selected and contributed in the identification of variables for a valuation model for residential property exposed by floods. Only significant attributes, by the characteristics and assessment criteria adopted by the local valuers, were used in this research. This is because some of the attributes listed were based on the literature review had been identified as not suitable within the atmosphere of the residential property market in Malaysia.

3.1 Selection of the expert panel

Experts with comprehensive and in-depth knowledge of valuation, gained through practice or education, were chosen for this research. A written survey was sent to experts as part of the process. Its aim was to help experts reach a consensus on current knowledge gaps. Each respondent had the option of remaining anonymous. Unlike a quantitative survey, the Delphi method was not aimed for a representative sample of respondents. The respondents were chosen for their in-depth knowledge of the investigation's topic. Using the Delphi method, the selection was based on the background of the expert and was more important than quantity. The expert was selected according to the requirement stated in Table 1. Rogers and Lopez (2002) required all selected expert panellists to meet at least two of the conditions (authorship, employed in practice with five years' experience, conference presenter, member or chair of the committee). The requirements for the selection of the expert panel for this research are shown in Table 1.

The requirements as presented in Table 2 and Figure 2 demonstrate the characteristics that the expert panel needed before the selection was done. Each of the individuals listed were considered as an expert and must fulfil at least four criteria mentioned above. They needed to be practiced and experienced in the real estate industry. The expert who had an active involvement with the professional bodies, publications and presentations in local and international conferences, had an advantage.

Each of the criteria for the selection of the expert contributed as a point of achievement. The individual was considered an expert, and the consensus took into account when they met a minimum of ten points from the qualification achievement. The expert panel with a professional registration with BOVEAP earned 4 points. Professional involvement in the real

Characteristics	Requirements
Identifying potential experts	Practice and involved in real estate industry and registered with the BOVEAP
Qualifying panellist as experts	Experts must satisfy at least four of the following criteria: (1) Professional registration with BOVEAP – such as registered valuer, registered estate agent and registered property manager (2) Years of experience: at least five years of experience in the real estate industry (3) Academic qualification: Minimum of bachelor's degree in real estate or any related field (4) Member/committee of professional bodies (local/international): Minimum one involvement in any professional bodies related to real estate (5) Member or chair of a nationally recognised committee (6) Invited to present at any conference (local/international) (7) The primary or secondary writer of peer review journals/articles (8) Writer/editor of a book or book chapter on the topic of property valuation, economy and disaster (floods)

Table 1. Requirements of selection for the expert panel

Source(s): Hallowell and Gambatese, 2010

Expert panel qualifications (achievements)	Points (each achievement)
(1) Professional registration with BOVEAP	4
(2) Year of professional experience	
• <5 years	1
• 5–10 years	1
• 10–15 years	2
• 15–20 years	2
• 20–25 years	3
• >25 years	3
(3) Highest of academic qualification	
• Diploma	1
• Bachelor degree	2
• Master	3
• PhD	4
(4) Member/committee of professional bodies	2
(5) Member/chair of a nationally recognised committee	2
(6) Invited to present at any conference	1
(7) The primary/secondary writer of peer-reviewed journal/articles	1
(8) Writer/editor of a book or book chapter	1

Table 2.
Point system for the expert panel selection qualification

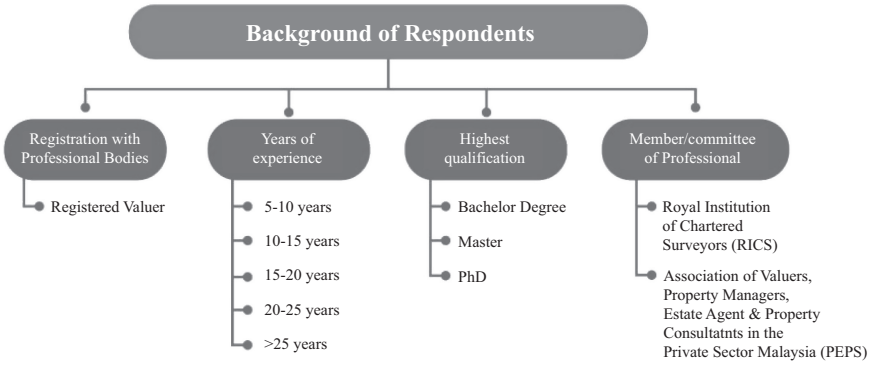

Figure 2.
Selection of expert panel criteria

estate industry, for less than 5 years (1 point), 5–10 years (1 point), 10–15 years (2 points), 15–20 years (2 points), 20–25 years (3 points) and over 25 years (3 points). The highest academic qualifications earned included Diploma (1 point), Bachelor Degree (2 points), Master (3 points), and Ph.D. (4 points). Participation as a member of professional bodies and national committee earned 2 points each. Invitations to present at any conference, primary or secondary writer of peer-reviewed journal and writer or editor or book chapter each received 1 point. The point system was used in this research to reach the minimum level of qualification and achieved the goal of conducting this research project.

3.2 Survey instrument

The survey instrument for the Delphi Method used the expert panel questionnaire. There were six steps involved in questionnaire development as follows:

3.2.1 Designed and piloted the questionnaire. The questionnaire consisted of two parts: respondent information and economic attributes. The survey was designed based on the literature review. The Likert scale was used to measure the expert opinion used to collect the

consensus of all the experts involved in the study. The scale of the questionnaire was 1, 2, 3, 4 and 5, which indicated "much less importance", "less importance", "moderately important", "important", and "strongly important".

3.2.2 Pre-testing of the questionnaire. Before distributing the questionnaire to the respondents, the pre-testing questionnaire was needed to check the content, wording, sequence, form and layout, question difficulties and instructions. In addition, the expert evaluation on the questionnaire for this research could be dramatically improved by feedback from two types of experts: (1) topic experts that have in-depth knowledge and expertise about the subject matter of this research and (2) survey methodologies' experts on how to collect the most accurate data for the research questions. This expert evaluation could shape the content and form of a questionnaire survey and result in better data quality and more valuable insights.

3.2.3 Identify the target population or respondent. The target population for this research was the expert involved with and practiced in the real estate industry. In addition, the target population was also registered with the BOVEAP. The sampling frame was identified based on the list of registered valuers and estate agents provided by BOVEAP.

3.2.4 Questionnaire distribution. The questionnaires were distributed to real estate players such as registered valuers, registered estate agents, academicians and other practitioners such as government officers from the Valuation and Property Services Department, Ministry of Finance, Malaysia. Twenty-eight questionnaires were distributed by hand during a property convention or seminar and hand delivered to the valuation firms. The survey needed to be distributed by hand because there was a need for a brief explanation to respondents. Using this method, there would be no missing value and the analysis would be more reliable in this research.

3.2.5 Data analysis (consensus from the experts). The consensus gathered from the questionnaire was analysed using the Statistical Package of Social Science (SPSS) to identify the most significant factors in determining residential property values. In the analysis, the minimum and maximum of expert values was used for each of the attributes, standard deviation and mean.

3.2.6 Selection of economic attributes. The results from the questionnaire's analysis were considered as the most significant economic attribute choice by the consensus of the experts. All the findings were ranked from the most significant attributes to the most insignificant attributes. The best eleven attributes were used for the development of economic valuation models. The choice of economic attributes in this research refers to the analysis results from the questionnaire distributed to the expert panel. In addition, a selection was made based on the relevance of these attributes to the nature of the real estate industry implemented in Malaysia in terms of market conditions, lifestyle and needs.

Panelists were asked to perform individual brainstorming to produce lists based on two prompts in the initial round (or Round 0). The first prompt enquired about the general issues in valuations. The Delphi panellists created a list of items related to research objectives, which aided the evaluability assessment's target clarification process. The panellists were asked to list particular types of information that would be useful in establishing a valuation model to value residential areas affected by flood events. The Delphi panellist's list of items for the second prompt contained various forms of useful information and was intended to aid in the development of assessment questions for which the answers would be useful. During this initial round, panellists also completed the follow-up survey. The researcher started analysing the data after receiving the brainstormed lists by four main categories, including the responses to the first prompt into organisational objectives and the responses to the second prompt into assessment details. Using all of the data, the researcher read the narrative responses and generated one item for each thought or idea expressed in the qualitative data. When more than one panellist shared the same thought, the researcher only produced one

survey item to reflect that thought. The researcher decided whether or not the comments were important to the subject and whether or not they contained any irrelevant details. This type of qualitative data analysis can be described as "distilling" the information (Nelson *et al.*, 2005). The remaining three rating rounds used the survey items generated in this phase.

The Delphi survey's study was prioritised, and findings were briefly discussed during the FGDs. The participants were then asked to construct a hierarchy with sub-indices of their choosing using the chosen indicators (social, economic, environmental vulnerability, etc.). They started by sorting the indicators on a sheet of paper one by one. The iteration function started with the generative round, in which group members were given a prompt that described a study issue, problem or subject. Project brainstorming created ideas and feedback about the issue or problem among stakeholders or panellists. For a second round of feedback, the researcher distilled the answers and introduced them to the panellists in the form of a survey. There was a total of four iterations: Generative Round, Round One, Round Two, and Round Three. As this project wanted to prevent the possible bias of expert's answers being affected by the views of others as well as pre-existing relationships between them, the sessions were therefore conducted under individual sorting schemes.

In particular the Delphi method comprised of three rounds that needed to be completed by all invited experts, as below:

(1) Round 1: All experts were given a set of questionnaires consisting of four main attributes that required them to rate based on their experience and judgement.

(2) Round 2: All experts were given a set of questionnaires that required them to provide suggestions on the economic attributes' analyses in detail. During the session, open-ended questions were given based on the four attributes. In addition, panellists discussed extensively in detail each of the attributes. When the researcher used qualitative data (comments, explanations for scores, etc.) as a means of qualitative feedback between iterations, this is known as controlled feedback. Panellists could read, comment on, and critique all aspects of the problem virtually simultaneously between iterations to control the input delivered in a structured format.

(3) Round 3: Individual sorting scheme was conducted which required all experts to participate. The objective was to let all experts and the researcher meet together to discuss and review all the answers given from the previous rounds. Statistical group response was quantitative feedback based on numerical scores of each item (e.g. medians and interquartile ranges, or means and standard deviations). The ideas and thoughts, as well as the descriptive statistics of the scores, were listed after the final iteration.

3.3 Reliability and validity test

Reliability refers to the degree of consistency; as Kerlinger (1986) puts it: if the scale has high reliability, the scale is homogeneous. According to Nunnally (1978), alpha values equal to or greater than 0.70 are considered as sufficient conditions. In conclusion, these measures have adequate reliability.

Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. It is considered to be a measure of scale reliability. Cronbach's alpha can be written as a function of the number of test items and the average inter-correlation among the items. Below, for conceptual purposes, we show the formula for the Cronbach's alpha:

$$\alpha = \frac{N \cdot \bar{c}}{\bar{v} + (N-1) \cdot \bar{c}}$$

Here: N is equal to the number of items.

c-bar is the average inter-item covariance among the items

v-bar equals the average variance

Source: Cronbach (1955)

4. Results and discussions

In this research, twenty-eight local experts from both industry and an academic point of view agreed to contribute to this research as shown in Table 3. Seven respondents (25%) were valuers, with an average score of 11–16 points. The academicians comprised four respondents (14%) with average scores of 13–17 points. Subsequently, government officials recorded a total of fourteen (50%) involvement with an average score of 10–19 points. Other participants included three respondents (11%) with an average score of 11–19 points.

The reliability test shows that the result of Cronbach's alpha is 0.920 and concluded that the instruments (expert panel questionnaire) and analysis for this research was reliable. A Cronbach alpha of >0.7 has been recommended as acceptable (Nunnally, 1978). Table 4 tabulates the validity testing which assesses the degree of validity and validity of the measuring instruments used in this research (questionnaire). Referring to the results, it can be concluded that there were 41 items which can be used as attributes in identifying a valuation model for residential property in flood risk areas. The reliability test results show the Cronbach's alpha value of 0.920. Furthermore, all items achieved a Cronbach alpha greater than 0.50, showing good inter-rater reliability. The degree of similarity between the items is referred to as internal consistency. As a result, things that made up a domain should have a mild correlation with one another but contribute independently to the overall domain ranking.

That is, a valid research instrument is a truly appropriate instrument for measuring what was measured. Since this research involved an expert panel, the total number of respondents of 28 is considered as significant with this research since they represent experts based on expert panel criteria.

Results from the several rounds of the Delphi method have provided several interesting findings. In conducting the valuation task, the valuer needed to identify significant factors that would affect the property value. The assessment was based on the valuation model attribute's framework for the purpose of valuing residential property with high risk exposure to floods. This research focused on the impact of a flood on residential property and considered forty-one attributes involved.

The findings revealed that there were four types of attributes that affected residential property value. Based on the consensus given by the expert panel, flood attributes consisted of flood depth, frequency and duration as the main significant factors for this research. For the structural attributes, the factors that were significant were the age of the house, floor/building size, land size, tenure, type of house and property condition. The selected structural attributes related to the housing specification compared to other facilities incorporated with

Table 3. Background of the experts

Backgrounds	Number	Percentage (%)	Total points
Valuer/estate agent	7	25	Between 11 and 16
Academician	4	14	Between 13 and 17
Government officer	14	50	Between 10 and 19
Others	3	11	Between 11 and 19
Total	28	100	

	Items	Cronbach's alpha
1	Depth_of_flood	0.945
2	Duration_of_flood	0.914
3	Age_of_house	0.953
4	Floor_building_size	0.967
5	Land_size	0.965
6	Tenure_title	0.945
7	Type_of_house	0.954
8	Building_material	0.931
9	Bathroom	0.913
10	Bedroom	0.924
11	Parking_space	0.916
12	Living_area	0.954
13	Garage	0.943
14	Swimming_pool	0.954
15	Air_conditioning	0.934
16	Property_condition	0.931
17	Sewerage	0.946
18	Elevator_lift	0.978
19	Education_institution	0.939
20	Park_lake	0.917
21	Golf	0.824
22	Mosque_Church	0.914
23	Convenience_store	0.921
24	Hospital	0.794
25	Mass rapid Transit	0.691
26	Bank	0.842
27	Bus Rapit Transit (BRT)	0.784
28	Industrial_Area	0.785
29	Commercial_Area	0.723
30	Sea_River	0.589
31	Highway_road	0.649
32	Neighbourhood_greenery	0.592
33	Crime_rate	0.894
34	Floodplain	0.514
35	GDP	0.428
36	Population	0.742
37	Interest_rate	0.681
38	Inflation	0.592
39	Cost_const	0.781
40	RPGT	0.640
41	House_speculation	0.742

Table 4.
Reliability statistics

the house. The locational attributes that were significant included a convenience store and distance to a highway. A natural disaster such as an earthquake or flood were considered attributes that affect the residential property value.

The ranking for each category of attributes shows the consensus of the experts and represents the significance of each attribute. The structural attributes for residential property consisted of the number of bedrooms, bathrooms and living area considered the most significant attributes. Locational attributes were the most highly significant attributes by the valuers in valuation practice. The amenities provided in the residential area have a positive impact on property value (Melanda *et al.*, 2016). The distance of a residential area to a convenience store (Chiang *et al.*, 2015), shopping mall, highway, mosque, bank, and LRT/MRT station positively impact property value.

The environmental attributes consider the crime rate, disaster (earthquake and floods), and neighbourhood greenery as the factors in the quality of life and environment in a residential area. Increasing crime rate, lack of green space, environmental pollution, uncoordinated urban development and increasing vulnerability to disaster all have a negative impact on property value (Adegoke, 2017). Gallimore *et al.* (1996) mentioned that home seekers would be willing to pay for an apartment in a neighbourhood that is free of crime, kidnapping and other forms of social vices.

After considering the results of the analysis of the questionnaire distributed to the expert panel in the real estate industry in Malaysia, only eleven significant economic attributes were used in the development of the valuation model. In addition, the selection of these attributes also considered the market conditions, local lifestyle, technology and property market patterns in Malaysia. The appropriate economic attributes used in this research were the number of bedrooms, building age, flood duration, flood depth, flood frequency, base lending rate (BLR), interest rate, distance to the LRT/MRT station, shopping mall and river (see Table 5).

Table 6 presents the analysis from the Delphi methods based on four major attributes, namely structural attributes, locational attributes, environmental attributes and macroeconomic attributes. The mean and standard deviation were both stable, indicating that the findings were reasonable estimates. The Delhi analyses from several rounds have structural attributes comprising sixteen attributes with mean ranges from 2.64 (swimming pool) to 4.29 (property condition). In these attributes it seems property condition, floor/building size, land size, type of house/building and building materials were ranked among important attributes under the category of structural. It can be seen attributes such as elevator/lift, sewerage, property condition, air-conditioning, swimming pool and garage achieved lower scores and were mostly related to strata housings as the percentage of this type of house is considered as only a small percentage in the case study area.

In the second attribute which is locational attributes, a total of thirteen attributes were listed among the important attributes in identifying a valuation approach for housing under flood risk by the expert panels. All panels had similar judgements in locational attributes. The range of mean was between 2.15 (industrial area) and 3.54 (highway/road). Among other attributes that scored high standard deviation were convenience store, mosque/church, hospital and MRT/LRT station. This was expected as these attributes were considered as very important in the choosing of a house under the factor of location.

The third attribute of environment consisted of a total of seven important attributes. Among the important attributes were frequency of flood, duration of flood, disaster zone, crime rate and depth of flood. It is noted that all panel experts put flood related attributes as major attributes under the environment attributes. The findings also revealed in these attributes, close range of mean indicates all expert panels viewed that all attributes seem very important under the category of environment.

The Delphi analysis also had final attributes which were macroeconomic attributes, and listed a total of seven attributes. Under these attributes, factors such as inflation, interest rate, GDP, population and house price speculation were among the important attributes perceived by the panel of experts. It can be seen factors that relate to the house price were among the factors ranked very important under the macroeconomics attributes. The majority of expert panels viewed that these factors were the most important factors in developing a model for

Table 5.
Reliability statistic: Cronbach's alpha

Cronbach's alpha	No. of items
0.920	41

		Attributes	Std. Dev	Median	Mean	Category of rank	Category of rank
Structural attributes	1	Age of house	0.86	4.00	3.93	6	10
	2	Floor/building size	0.85	4.00	4.14	2	5
	3	Land size	0.88	4.00	4.11	3	6
	4	Tenure/title	1.02	4.00	3.82	7	14
	5	Type of house/ building	0.79	4.00	4.04	4	8
	6	Building material	0.69	4.00	4.04	5	9
	7	Number of bathrooms	1.18	3.00	3.18	13	31
	8	Number of bedrooms	1.32	4.00	3.43	10	24
	9	Parking space	1.17	3.00	3.25	12	29
	10	Living area	1.07	3.50	3.46	9	23
	11	Garage	1.09	3.00	3.32	11	28
	12	Swimming pool	0.91	3.00	2.64	16	41
	13	Air conditioning	1.26	3.00	3.11	14	32
	14	Property condition	0.90	4.00	4.29	1	4
	15	Sewerage	1.15	4.00	3.71	8	16
	16	Elevator/lift	0.90	3.00	3.00	15	35
Locational attributes	1	Education institution	0.88	3.00	3.04	6	33
	2	Park/lake	0.85	3.00	2.86	10	38
	3	Golf course	0.84	3.00	2.53	12	42
	4	Mosque/church	1.14	4.00	3.43	3	25
	5	Convenience store	1.04	4.00	3.53	2	20
	6	Hospital	1.03	3.00	3.43	4	26
	7	MRT/LRT station	0.99	3.00	3.21	5	30
	8	Bank	1.05	3.00	3.00	8	36
	9	Bus Rapid Transit (BRT)	1.05	3.00	3.00	9	37
	10	Industrial area	1.15	2.00	2.15	13	43
	11	Commercial area/ mall	1.23	3.00	3.04	7	34
	12	Sea/river	1.23	3.00	2.79	11	39
	13	Highway/road	0.92	4.00	3.54	1	19
Environmental attributes	1	Neighbourhood greenery	1.17	4.00	3.46	7	21
	2	Crime rate	1.28	4.00	3.82	4	13
	3	Disaster zone	1.26	4.00	3.89	3	11
	4	Floodplain	1.26	4.00	3.89	2	11
	5	Frequency of flood	1.25	4.50	4.07	1	7
	6	Depth of flood	1.20	4.00	3.79	5	15
	7	Duration of flood	1.23	4.00	3.89	2	12
Macroeconomic attributes	1	Gross domestic product	0.88	4.00	3.61	3	17
	2	Population	0.63	4.00	3.57	4	18
	3	Interest rate	0.50	5.00	4.57	2	2
	4	Inflation	0.49	5.00	4.64	1	1
	5	Cost of construction	1.04	3.00	2.75	7	40
	6	Real property gain tax	1.07	4.00	3.43	6	27
	7	House price speculation	0.74	3.00	3.46	5	22

Table 6.
Delphi method analysis

house price values under the risk factor. The overall results of the Delphi method analyses based on four categories of attributes are exhibited in Table 6.

5. Summary

This study aimed to identify attributes for valuation models in determining value for a flood valuation model. There has been very limited study (especially in Malaysia) that explored the characteristics in the valuation process to obtain a final value for the purpose of valuing residential property impacted from flood events. This study overall provides a considerable contribution to the literature knowledge of property valuation, specifically from the context of Malaysia in determining valuations. In particular, this research has analysed the role of real estate professionals such as valuers in conducting a valuation and determining attributes for residential property affected by flooding from a local perspective.

Climate change, which triggers flood events in Malaysia, has significantly impacted the residential areas. The need to have a systematic model for flood valuation is highly necessary to provide fair value and fair market value according to Malaysian Valuation Standards (MVS) as well as International Valuation Standards (IVS). Nevertheless prior to obtaining a value, there were several processes that needed to be identified in order to ensure the development of the model was according to the criteria of valuation mode for residential property in flood risk areas. Therefore, the Delphi method was chosen which required a systematic approach involving expert panels in valuation areas to identify the attributes which have been included in the valuation model for residential property affected by the flood risk.

The Delphi technique was the best technique especially when the research needed to develop a new model, particularly in the valuation technique. The valuation technique has been established for many years; nevertheless as the real estate industry has evolved due to rapid development, the technique to identify the value of a property has also changed. In this case, residential properties are currently facing flood risk factors which could affect the value. As such, the involvement of stakeholders in the industry was vital, which was done by using the Delphi technique. In addition, given the existence of interrelationships between criteria, Delphi methods that recognise interdependence between criteria were preferred in identification of a flood valuation model.

The model of valuation to identify flood risk for residential property has not been widely used among valuers in Malaysia. The findings of this study can be used by all existing and prospective property stakeholders in determining their investment value and, at the same time, will be a tool for valuers and researchers in property valuation modelling. In order to set up the attributes, an in-depth literature review survey was undertaken to establish the four major attributes affecting valuations, namely structural, locational, environmental and economic. Based on the four major attributes, the panel of experts identified specific attributes which will be based on the valuation model for residential property in flood risk areas. The findings from the Delphi technique were helpful in framing the assessment that followed. The need for stakeholders to consider the valuation model for residential property under flood risk was the most useful outcome of the two Delphi studies. For valuers, this became persuasive knowledge. Knowing that stakeholders were passionate about learning about this fundamental theory, the panel of experts was able to begin the process in identifying a valuation model. Furthermore, the value-added knowledge gained from this research can be used by valuers while conducting the valuation task related to the flood-prone market scenario for all valuation purposes. The additional knowledge of the impact of a flood amongst real estate players in the decisive move to align the professionals with the challenge of flood risk will also have a significant impact on the valuer's profession.

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