ASSESSING REAL ESTATE INVESTMENT ALTERNATIVES: A MULTI-CRITERIA AND MULTI-STAKEHOLDER DECISION AID TOOL

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ABSTRACT

Investment decisions in private real-estate demand the consideration of several qualitative and quantitative criteria, as well as the different or even conflicting interests of the participating stakeholders. Meanwhile, certain indicators are subject to severe uncertainty, which will eventually alter the expected outcome of the investment decision. Even though multi-criteria decision making (MCDM) techniques have been extensively used in real-estate investment appraisals, there is limited evidence from the private rented sector, which constitutes a large part of the existing real estate assets. The existing approaches are not designed to capture the inherent variability of the decision environment, and they do not always achieve a consensus among the participating actors. In this work, through a rigorous literature review, we were able to identify a comprehensive list of assessment criteria, which were further validated through an iterative Delphi-based consensus-making process. The selected criteria were then used to construct an Analytical Hierarchy Process (AHP) model evaluating four real world, real estate investment alternatives from the UK private rented market. The volatility of the financial performance indicators was grasped through several Monte Carlo simulation runs. We tested the described solution approach with preference data obtained by seven senior real estate decision-makers. Our computational results suggest that financial performance is the main group of selection criteria. However, the sensitivity of the outcome indicates that location and property characteristics may greatly affect real estate investment decisions.

Keywords: multiple criteria; decision support; MCDM; AHP; Delphi; real estate; investment appraisal

1. Introduction

Real estate has always been a popular field for investment. The Private Rented Sector (PRS) used to be a minority investment market, mainly due to low demand and the perception of low returns compared to other investment assets. The PRS deals with the construction and modification or purchase of properties, with the goal of renting them privately. It plays a vital socio-economic role, specifically in the UK market, by serving major demographic segments (e.g. professionals, students) who ask for housing variety and flexibility, either for the short or long term (Treasury, 2010).

In recent years, the PRS sector has faced rapid growth, and accounts for 20.3% of all UK households. Interestingly, in London the corresponding proportion of households that are PRS is 30% (Office for National Statistics, 2017). Since 2002, the PRS has doubled in size and Knight Frank (2017) estimates that the figure will rise to 24% by 2021. In addition, the continuous rise of housing prices and rents has led individuals and large institutional investors, as well as companies outside the field of real estate, to turn their attention to investment in the PRS. The sector has become popular since it offers a low-risk investment vehicle with long-term growing returns, as well as a continuous increase of the asset value due to the steady rise of house prices.

Multiple Criteria Decision Analysis (MCDA), or Multiple Criteria Decision-Making (MCDM), has been widely used as a support tool for complex investment decisions where quantitative and qualitative assessment criteria exist (Zopounidis & Doumpos, 2002). Quantitative factors, such as financial indicators (e.g. NPV), can be easily understood during the decision-making process, i.e., a project with higher returns is preferred over another with less. However, decision-making that involves qualitative criteria faces significant complications. For instance, the choice among alternative locations (e.g. A and B) is a matter that has no evident solution since it requires the consideration of the stakeholders' preferences and experience. MCDM may provide the methods and tools that are needed to quantify comparisons with qualitative criteria. Furthermore, in the presence of multiple criteria, there will be trade-offs among the criteria by the decision-maker, since the final selection will take into account a list of different or even conflicting objectives. For instance, the decision-maker might prefer larger investments in prestigious locations over low-valued assets in infamous or remote locations. Similarly, other interested parties may express alternative preferences regarding the value and the location of the asset. Consequently, MCDM methods are suitable for investment appraisal in the PRS since they compare the existing alternatives for selection according to the identified list of criteria and their importance, and finally provide a rating or ranking of the alternatives.

Researchers have mostly focused on the risks associated with real estate investments and suggest that an understanding and quantification of the risks can lead to better decision-making (Atherton et al., 2008; Chen and Khumpaisal, 2009; D'Alpaos and Canesi, 2014). Despite the value of risk assessment, other factors can drive a decision in real estate, and are usually omitted from the process, such as the financial performance of the investment or other qualitative criteria that the asset might have. Another stream of research focuses on real estate investments from the perspective of portfolio selection and management (Kallberg et al., 1996; Andrew and Glenn, 2003). The research focuses on portfolio diversification, and how each investment asset can create overall value for a particular portfolio. There have been few attempts to address the investment appraisal process itself, yet, to the best of our knowledge, instead have focused on the individual characteristics of the process such as the fairness of the market value and transaction price, the profit maximization or the technical characteristics of the project (Kaklauskas et al., 2007; Maliene, 2011). However, only a small part of the existing literature addresses investment appraisal of real estate projects from a micro-perspective, while there is no mention of the private rented sector. Whether the investor is an experienced individual in

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real estate, a large institution, or someone from outside of the sector who is trying to diversify their portfolio and take advantage of the situation, the fact is that expertise and research in this sector are limited, and the investigation of these investment decisions will provide useful insights for all of the stakeholders.

Investment decisions in real-estate assets stem from a balanced consideration of factors generated by the behavior or preferences of multiple stakeholders. On the one hand, investors usually look to optimize profit in the short and long term, while financial institutions alter their financial support models according to the growth and risk trends of each market and the quality of the asset (investor aspect). On the other hand, sellers look for the right moment to maximize the return on their old investment and tenants' behavior regarding price, quality or even flat-sharing can set the price of a property in a specific area (market aspect). The above factors are the reason why the present study used a multi-stakeholder approach to take into account criteria from different points of view. The behavior of the investor's side is captured by the opinions of actual investors in the area and the market aspect by the opinions of experienced consultants.

The objective of the present study is to model investment decisions in PRS properties with an MCDM method, and to support the selection from among the existing alternatives in the market. In order to achieve this goal, the work follows a sequential workflow, beginning with a literature review of the existing knowledge and frameworks on real estate investment appraisal, as well as the selection of the appropriate MCDM method to structure our problem. Subsequently, a list of criteria that investors and consultants take into consideration in the investment process is provided and a consensus reaching method is used to determine the final list of criteria and quantify their importance. Finally, with the use of the selected MCDM method, a preference model for the selection of the best PRS alternative for investment is created. Taking all of the previous discussion into consideration, we can conclude that this research should address particular aspects of the investment appraisal of private rented properties.

In summary, the current study contributes to the literature by:

- Providing a comprehensive list of criteria that decision-makers take into account before investing in a PRS property or project. The composition of this list was based on the existing literature and was further validated and extended by investors and consultants of the sector.
- Quantifying the significance of each criterion with the use of opinions from experts from the sector, through a consensus-reaching technique.
- Analyzing the problem using a hierarchical structure and constructing a decision-making tool to support investors' decisions in the private rented sector.

2. Literature review

2.1 Multiple criteria decision-making

Multiple criteria decision-making has grown as an important part of modern decision science and operations research, and supported by computational and mathematical tools allows the subjective evaluation of performance criteria and alternatives by decision-makers (Zavadskas et al., 2014). Vast technological advancements and rapid economic growth have changed the nature and complexity of modern society's problems, requiring

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decision-makers to deal with problems that have multiple criteria and multiple decision alternatives. The popularity of and the need for MCDM applications over the last 15-20 years has been evidenced by the increased number of studies in this field. From 1999 to 2000, there were 628 research studies about MCDM (Toloie-Eshlaghy, 2011), while from 2000 to 2014, there have been 393 papers on the application of such methods in various decision problems (Mardani et al., 2015). The areas of application of the methods vary, with the most popular areas being transportation and logistics, business and financial management, managerial and strategic planning, project management and evaluation and energy, environment and sustainability. Other significant fields of application are supply chain management, manufacturing systems, information technology management and military operations and strategy.

One of the most eminent MCDM methods, in terms of application in decision models and publications, is the Analytic Hierarchy Process (AHP), which was developed by Saaty (1980). Almost one-third of MCDM applications have used AHP, and this is because it is simple to use and able to break down the components of the problem in a hierarchical structure. Popular applications of MCDM methods have also been developed with the use of the elimination and choice expressing reality method (ELECTRE), the analytic network process (ANP), the technique for order of preference by similarity to ideal solution (TOPSIS), the preference ranking organization method for enrichment evaluations (PROMETHEE), other aggregation decision-making methods and with the hybrid use of the existing methods (Mardani et al., 2015).

The modeling of financial problems is more complex and often follows a different logic that considers the complexity and ill-structured nature of the problems, the existence of multiple criteria, which are sometimes conflicting, and the subjectivity of the decision-makers in the evaluation process (Roy, 1988; Zopounidis & Doumpos, 2002). Not only the complex and multidimensional nature of financial decisions, but also the increased importance of making effective financial decisions, makes MCDM a well-suited methodology to address these kinds of problems. Consequently, MCDM methods have been used systematically over the last decades as a tool to aid in financial decision making (Zopounidis & Doumpos, 2002; Spronk et al., 2005). Especially in the last ten years, the application of MCDM in financial decisions has increased dramatically with the number of publications since 2002 tripling those from before 2002 (Zopounidis et al., 2015).

Portfolio optimization, credit risk and bankruptcy, corporate performance, asset evaluation and investment appraisal are the principal areas in which MCDM methods have been used in financial decisions, with the AHP method used in 124 papers out of 273 studies (Zopounidis et al., 2015). Decisions in the real estate sector and real estate investments usually require a mixed knowledge of asset evaluation, investment appraisal, and technical diligence. The required diversity of the factors and the existence of multiple conflicting criteria (e.g. selecting low cost over high quality) increase the complexity of the decision-making process, and therefore the necessity of multiple criteria analysis. MCDM methods have been applied in the real estate sector, either prior to the decision point to assist the evaluation and/or risk assessment of a real estate investment or after the investment decision to evaluate the performance of the asset and the investment efficiency.

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The following section presents all of the relevant literature in real estate decision making and investment appraisal, especially the proposed decision frameworks with MCDM methods.

2.2 Decision-making in real estate

The existing MCDM applications on real estate can be classified into two main research streams as follows: studies that propose frameworks prior to the decision point in order to assist the process (pre-investment/decision studies) and studies that assess the outcome of the decision to provide useful insights and proposals for future decisions (post-investment/decision studies).

Decision models in real estate have been developed to assist either the investment appraisal of development projects or the valuation of investment on existing properties. Zavadskas et al. (2004) analyzed the market for commercial property development in Eastern Europe by proposing a model to choose among alternative projects with the principal objective being the maximization of profit. Another model in commercial development was proposed by Chen and Khumpaisal (2009), who addressed risk assessment in commercial real estate development with the use of ANP, a more complex version of the AHP method. They developed a multiple criteria model to assess social, economic, environmental and technological risks. Rocha et al. (2007) attempted to address the uncertainties that real estate investments present in emerging economies, which are usually related to demand, price, and costs. They proposed a model for the housing development market that determines the optimum investment strategy to cover demand, the right timing for construction and the maximum expected income. Jiang et al. (2007) also address the risks in real estate development with a decision model based on the AHP technique and simulation of the factors that influence the calculation of NPV. The study hierarchically breaks down the uncertain variables that can affect the net inflow and outflow of the project, which are mainly related to market competition and the construction process. Monte Carlo simulations are also conducted to provide the range of NPV values in each year of the project, which allow the investor to decide whether or not to invest in the project.

Atherton et al. (2008) investigated the risk factors that affect the profit calculation in real estate development appraisal. The proposed model approaches profit calculation with residual valuation and traditional cash flow analysis, followed by simulation or forecasting of the uncertain variables and a sensitivity analysis of the NPV and IRR values. A fund divestiture situation in the Indonesian real estate market was the reason to develop another decision model in real estate development. Ronyastra et al. (2015) appraised four real estate projects under a given budget constraint and constructed a ranking of the alternatives based on PROMETHEE, an MCDM method suitable for building outranking relations. For investment decisions on existing properties, Uysal and Tosun (2004) attempted to break down the valuation of a household residency in the Turkish market, and suggested MCDM as the best tool for this analysis. Kaklauskas et al. (2007) emphasized that and proposed a methodology to define the utility and market value of a real estate property. In their work, they analyzed the theoretical framework of the proposed model using the method of complex criteria assessment (COPRAS), an MCDM method that evaluates the alternatives in terms of the degree of utility and significance. Lutzkendorf and Lorenz (2007) identified a list of key sustainability performance indicators and highlighted the need for simultaneous consideration of

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economic, environmental and social criteria before planning to invest in a property. A combination of the above was attempted by Lopez et al. (2010), who designed a software tool to aid decisions about selling or buying real estate. Tiesmeier (2016) worked the valuation models of existing properties by introducing a model for real estate decision support, focusing on luxury residencies in Spain. The author highlights the need for structuring the problem on an MCDM method using the AHP technique.

In most of the pre-decision models, the authors addressed the importance of risk assessment during the investment appraisal stage, believing that a better understanding of the risks will lead to a better decision. Even though this is a major issue in investment appraisal, only a few researchers succeeded in imprinting the complexity of real estate decisions and incorporating all of the relevant criteria (financial, technical, etc.) to construct a decision model. Nevertheless, most of them agreed that MCDM frameworks were important and suitable in real estate decisions. Next, we discuss the post-decision models, which analyze investment decisions in real estate after the time that these decisions have been made. Even though these models cannot help the decision-maker make a particular decision, they offer valuable insights on investment efficiency and help them make better decisions in the future.

Kettani et al. (1998), in the Canadian real estate market, first investigated the outcome of an investment and its effect on the market. They proposed a model that estimates the behavior of the market, with respect to the objectives that different stakeholders (property buyers/sellers, institutional investors, real estate brokers) might consider. Wang (2005) presented another model, which analyzed real estate investment decisions and measured investment performance. The framework evaluates government real estate investments in China, according to a range of technical and non-technical factors, and is built upon the knowledge of previous decisions and aims to discover possible projects for investment. It intends to reform the investment strategy in real estate and provide an online-based decision-making tool for the Chinese government.

The selection of real estate investment projects and their influence in the regional economy were analyzed by Ginevicius and Zubrecovas (2009). By providing an extended list of economic efficiency and the projects' efficiency criteria, they included every stakeholder in the real estate environment and attempted to analyze the impact of a particular selection on each one of them. The study gives valuable stimuli on the criteria that should be included in the investment appraisal of real estate projects to achieve better investment efficiency. Risk and uncertainty in real estate decisions has also been addressed with regards to the global financial crisis. D'Alpaos and Canesi (2014) attempted to correlate risk factors and uncertainties due to the global financial crisis with decision variables. This is another model that emphasizes risk assessment, but is well-tailored in the current era of fluid economy and uncertainty. Table 1 provides a synopsis of the analyzed decision models, categorized by the point where the decision is made in relation to the assistance point of the developed model.

Overall, the investigation of investment decisions in real estate has been limited. To the best of our knowledge, there are no studies aiding investment decisions in the PRS. This study attempts to address this gap by constructing a decision support tool for the investment appraisal of PRS properties in the UK or other similar real estate markets. For its development, we used the AHP since its hierarchical structure encompasses the

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problem specifications; it is simple and transparent and can be enriched through the consideration of multiple stakeholders' preferences.

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Table 1
List of decision models in real estate investment appraisal

Study	Decision Point	Focus	Real Estate Sector	Region	MCDM method
Adair and Hutchinson, 2005	pre	risk assessment	land properties	UK	-
Atherton et al., 2008	pre	profit calculation, risk assessment	property development	-	-
Chen and Khumpaisal, 2009	pre	risk assessment	commercial	UK	ANP
D'Alpaos and Canesi, 2014	post	risk assessment	all relevant	-	-
Ginevicius and Zubrecovas, 2009	post	investment efficiency	all relevant	-	ELECTRE
Jiang et al., 2007	pre	NPV calculation, risk assessment	property development	-	AHP
Kaklauskas et al., 2007	pre	utility and market value definition	all relevant	-	COPRAS
Kettani et al., 1998	post	market behaviour prediction	all relevant	Canada	-
Lopez et al., 2011	pre	decision supporting tool	all relevant	-	-
Lutzkendorf and Lorenz, 2007	pre	market value fairness	all relevant	-	-
Maliene, 2011	pre	evaluation of transaction price	specialised properties	-	ELECTRE
Rocha et al., 2007	pre	risk assessment, strategy guidance	residency development	-	-
Ronyastra et al., 2015	pre	optimum portfolio selection	commercial, retail, office	Indonesia	PROMETHEE
Tiesmeier, 2016	pre	decision structuring	luxury residencies	Spain	AHP
Uysal and Tosun, 2004	pre	residency selection	household residencies	Turkey	-
Wang, 2005	post	investment performance	government	China	-
Zavadskas et al., 2004	pre	profit maximisation	commercial properties	Eastern Europe	ELECTRE
Current study	***pre***	***alternatives evaluation***	***private rented sector***	***UK***	***AHP***

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3. Methodology

3.1 Research design

The research methodology of the present study aims to address the gap identified in the literature review by developing a multi-criteria mechanism that can incorporate the preferences of multiple stakeholders and aid in the assessment of real estate alternatives in the PRS under financial performance uncertainty. Curating an appropriate MCDM method is of vital importance in order to construct an effective decision model and reach the desired quality of results. Guarini et al. (2018) investigated the selection of MCDM methods in real estate decisions and proposed a methodology to select the best-suited method for the specific needs of the evaluation. According to their model, the AHP seems to be the most appropriate method for the investment appraisal of PRS properties since it is a full aggregation, low input approach that can analyze quantitative, qualitative or mixed type indicators.

In addition, the AHP is the most suitable method to structure a decision problem with a large number of criteria and sub-criteria and a relatively small number of alternatives. Taking into consideration the framework of Guarini et al., as well as the fact that AHP is the dominant MCDM method of application in the literature, and especially in the field of complex financial decisions, we selected it to approach the examined decision problem. This study aims to provide a decision model that is generally acceptable and incorporates a balanced opinion of experts. Therefore, we used the Delphi technique to obtain a high quality of input, and this method also helps structure the problem and identifies the appropriate list of decision criteria. The Delphi technique is one of the best techniques to reach consensus in a decision-making problem (Sekhar et al., 2015), especially in problems where there are no clear criteria for evaluation (Taleai and Mansourian, 2008).

In addition to the assessment and weighting of each criterion, the AHP requires the evaluation of the alternatives based on the significance attributed to each of the assessment criteria. The qualitative criteria in the evaluation process are assessed with the experts' opinion, while the quantitative ones are based on secondary data.

Quantitative criteria, such as financial indicators (i.e. future cash flows), often contain growth factors which are either empirical estimates or assumed based on historical data. Therefore, it is important to incorporate a method in the financial modeling stage to model the uncertainty occurring from these factors and provide more robust input estimates. Loizou and French (2012) proposed the use of a Monte Carlo simulation as the best method to address risk and uncertainty in real estate decisions. In addition to that, the effectiveness of Monte Carlo in three of the decision models described in the literature review renders it a suitable method to address this issue in the financial modeling stage (Jiang et al. 2007; Atherton et al., 2008; Ginevicius & Zubrecovas, 2009). The list of the experts that participated in the study, along with their role and experience is provided in Table 2. All of the participants were approached due to their extensive expertise in the UK PRS real estate market.

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Table 2
List of experts

Expert name	Role description	Years of experience
Participant 1	Investor - Owner of property management company	12
Participant 2	Investor - Private Real Estate Investor	23
Participant 3	Investor - Private Real Estate Investor	15
Participant 4	Investor - Owner of Real Estate Investment company	44
Participant 5	Consultant - Senior Real Estate Consultant in major consultancy	10
Participant 6	Consultant - CEO of major real estate consultancy	30
Participant 7	Consultant - Head of Capital Markets in major real estate consultancy	18
Participant 8	Consultant - Professor of Real Estate	27

Figure 1 represents the research workflow and demonstrates the construction of the decision model. The research process starts with a literature review of relevant papers, followed by data collection through a 3-round Delphi, then financial modeling of the alternatives and finally, an analysis of the data with the Analytic Hierarchy Process (AHP).

The literature review is essential to generate an initial list of criteria to input into the Delphi method, and to position our study among the existing studies. The Delphi method is used to determine the final list of criteria and quantify their weights, which is an essential step for AHP analysis. The AHP analysis also requires an assessment of the alternatives based on the final list of criteria. The input of qualitative criteria requires experts' opinions, while the financial criteria are determined in the financial modeling stage using the information about the alternatives that is provided by the investors.

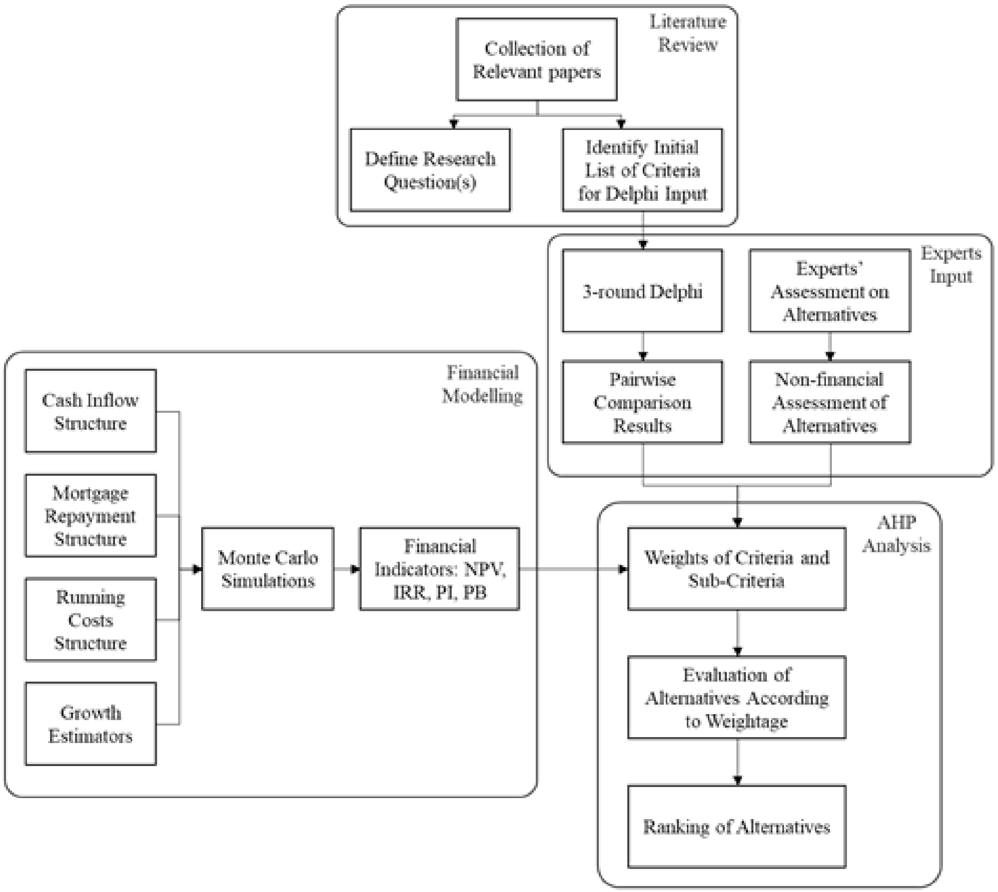

Figure 1 Research workflow

3.2 Analytic Hierarchy Process (AHP)

The AHP models the decision-making problem as a hierarchical tree by breaking down the objective of the problem, the criteria, the sub-criteria and the alternatives to reach a decision point (Saaty, 1986). Figure 2 illustrates the main components of the AHP, i.e., upper level (objective) and lower levels (criteria, sub-criteria, and alternatives). The principle of AHP is the pairwise comparison of criteria and of groups of sub-criteria using the fundamental scale of absolute numbers as a scaling method (Saaty 1977, 2008).

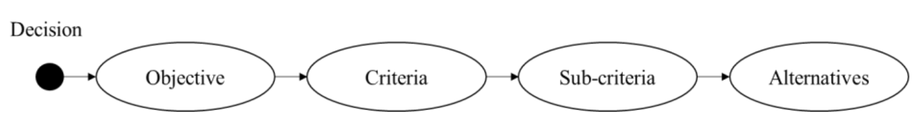

Figure 2 Generalized representation of an AHP hierarchy

The AHP starts with the definition of the decision problem and its objectives, and ends with the evaluation and ranking of the alternatives. It follows the algorithm of the following basic steps (Saaty, 1986, 1990, 2008, 2013; Saaty & Vargas 1987):

Step 1: Define the problematic situation and the decision objective.

Step 2: Structure the hierarchy of the decision, starting with the broad objective and continuing with the decomposition of the situation into criteria, sub-criteria, and alternatives.

Step 3: Collect data by conducting pairwise comparisons within each level of the criteria or sub-criteria, according to the fundamental scale of absolute numbers.

Step 4: Construct pairwise comparison matrices of each level of criteria and of the alternatives under each criterion (square matrix of size n for the criteria themselves and n×m matrix for the comparison of alternatives – n represents the number of criteria and m the number of alternatives). The diagonal elements of the square matrix are equal to one, since it represents a comparison of a criterion with itself, while the value of the rest of the cells (i,j) determines the importance of one criterion over another with regards to the objective of the problem. If the value of the cell (i,j) is greater than one, it indicates that the criterion in the i^{th} is more important than the criterion in the j^{th} column, while if the value is less than one it indicates the opposite.

Step 5: Data normalization and priority extraction. Compute the division of each element towards the sum of the corresponding column. Then, the sum of the i^{th} row in the normalized matrix determines the weight of the i^{th} criterion (eigenvector wi) as a percentage. Finally, the weights of sub-criteria are calculated with regards to the weights of the main criteria by multiplying the percentages of a group of sub-criteria with the weight percentage of the main criterion.

Step 6: Calculate the consistency ratio (CR) as in formula (1):

$$CR=(\text{Consistency Index (CI)})/(\text{Random Index (RI)}) \quad (1)$$

where: $CI=(Max.eigen\ value-n)/(n-1)$ and RI is a $randomly\ generated\ matrix.$

Saaty (2005) proposes that the CR should be no more than 0.1 in order to have consistent judgement.

Step 7: Evaluate the alternatives for each sub-criterion. Find the normalized values Pj(i.j) of the alternative j under the criterion I, by dividing the value of (i,j) in the n×m matrix towards the sum of the i^{th} row.

Step 8: Rate and rank the alternatives. The rating of the alternative j is determined by the algebraic sum of Pj(i.j) for all the criteria i. According to this rating, the alternatives are being ranked.

Step 9: Report the final scores for each criterion, sub-criterion, and alternative.

3.3 The Delphi technique

The Delphi method is considered one of the most well-known methodologies that allow a consensus to be reached in a decision-making problem (Sekhar et al., 2015). The use of

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the method originated in the 1950s, when it was first used in a number of surveys conducted by RAND Corporation to develop a technique that would make it possible to gain the most reliable consensus from a group of people with specific expertise (Dalkey & Helmer, 1963; Okoli & Pawlowski, 2004; Arof, 2015). It is the most effective method in terms of collecting experts' opinions about problems, in which there are no clear criteria for evaluation (Taleai & Mansourian, 2008), and it lies between qualitative and quantitative research techniques (Steward, 2001).

The Delphi method is an iterative process of questionnaires with controlled feedback, given to a panel of experts, who are called panelists and are anonymous (Thangaratinam & Redman, 2005). An "expert" is considered an individual with relevant knowledge and experience in a particular area of research that is determined by the objectives of the study (Cantrill et al., 1996). The research is conducted in multiple rounds of questionnaires. The first round usually involves brainstorming and seeks to obtain an open response about the topic. The panelists are asked to complete an open-ended questionnaire, describe their particular point of view and identify key factors that affect the decision-making process of the problem (Arof, 2015). The subsequent rounds are much more specific to the situation and the research question, and seek to quantify the identified factors from the first round. In the second round, panelists rate or rank the importance of each factor according to their expertise, while in the subsequent rounds they review and confirm their responses in order to effectively reach the desired consensus (Powell, 2003).

The characteristics of the method vary with regards to each study. The first round assesses the qualitative part of the situation, especially in projects with limited literature, while the subsequent rounds quantify the factors identified through the qualitative process. A two or three-round Delphi (depending on the use or not of the first round) is usually considered suitable and effective for reaching a consensus (Iqbal & Pipon-Young, 2009), while repeated rounds may lead to fatigue of the participants (Walker & Selfe, 1996). The size of the panel varies and there are no strict rules on its composition. The number of participants depends on the availability of experts on the particular topic, as well as on the time available to conduct the study. While studies have been conducted with as few as two and as many as three thousand participants, Turoff and Linstone (2002) suggest between ten to fifty panelists.

In contrast to other consensus-reaching methods (e.g. focus groups) in which people interact with each other, the Delphi method maintains anonymity among the panelists (Hartman, 1981). This is to avoid the disadvantage of a dominant individual or of collective group thinking, which can affect the individual opinions of the experts (Kim et al., 2013).

In the present study, the Delphi technique is used in the preliminary stage of research to identify, shortlist and quantify the criteria that real estate experts take into consideration during the investment appraisal of a project (steps one to three of the AHP). The Delphi technique is conducted in three rounds, and the panel of experts consists of seven experts, including four real estate investors and three senior real estate consultants. Figure 3 displays the process of the Delphi technique in the present study.

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In the first round, the participants were asked to answer an open-ended questionnaire to explain their views and the criteria that they take into consideration when they appraise a real estate investment. They were also asked to comment on the criteria identified in the relevant literature (contribution to steps 1 & 2 of the AHP). Table 3 contains the questions that the participants were asked during the first round of the Delphi technique.

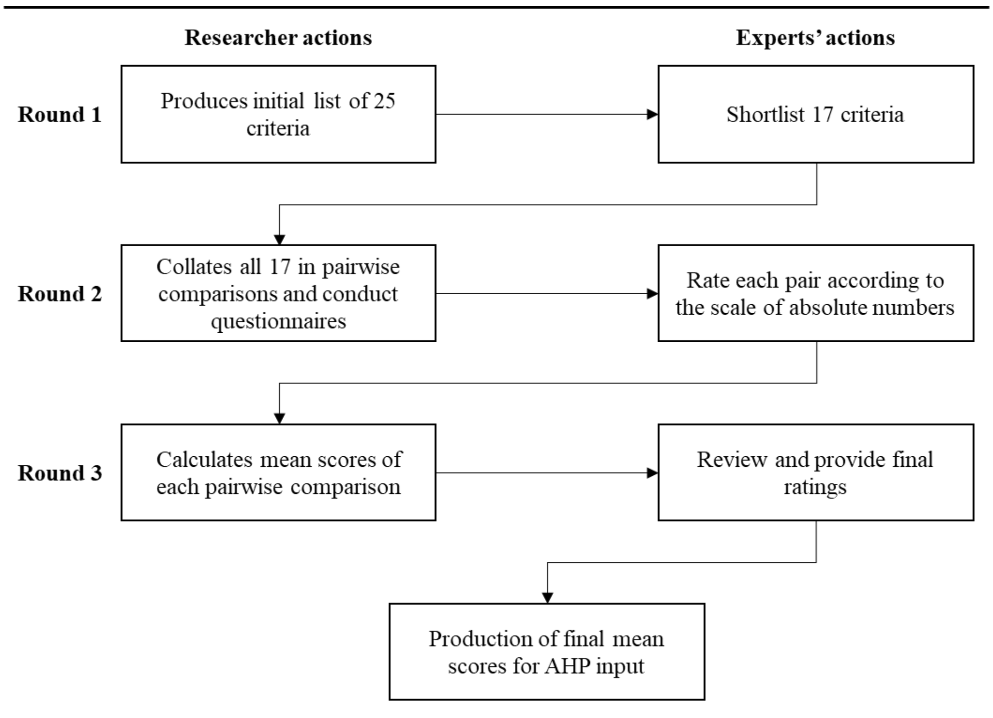

Figure 3 Applied Delphi process in the study

Table 3
Open-ended questions for the first round of Delphi

Questions
1. Can you describe your approach in real estate investment projects?
2. What kind of project do you prefer/suggest for real estate investment?
3. Which method of financing do you usually prefer/suggest?
4. Name all of the possible financial aspects that could affect your decision about a real estate investment (e.g. NPV, IRR, Profitability Index).
5. Do you consider location a major criterion when you invest? In your opinion, what are the criteria that affect the location factor?
6. Which real estate criteria do you take into consideration (e.g. total area, property condition)?
7. What other criteria come to mind?

Table 4 shows the initial list of criteria for property investment according to the literature and the opinions of the investors and consultants who participated in the study. The last column identifies which of these criteria have been shortlisted according to the

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participants regarding their suitability for the present assessment and in an effort to avoid overlapping criteria.

Table 4
Initial list of criteria

Main criteria	Sub-criteria	Source	Short-listed
Financial	Initial Investment Outlay	Ginevičius and Zubrecovas, 2009; Tiesmeier, 2016	Yes
	Total Selling Price	Kaklauskas et al., 2007; Ginevičius and Zubrecovas, 2009; Maliene 2011	Yes
	Net Cash Flow	Ginevičius and Zubrecovas, 2009;	No
	Net Present Value (NPV)	Ginevičius and Zubrecovas, 2009; Ronyastra et al., 2015	Yes
	Profitability Index	Ginevičius and Zubrecovas, 2009; Ronyastra et al., 2015	Yes
	Payback Period	Ginevičius and Zubrecovas, 2009; Ronyastra et al., 2015	Yes
	Internal Rate of Return	Ginevičius and Zubrecovas, 2009;	Yes
	Mortgage Structure and Eligibility	Ginevičius and Zubrecovas, 2009; Recognised by the investor	No
	Maintenance Running Costs	Tiesmeier, 2016; Recognised by the investor	No
Location	Prestige of Locality	Maliene, 2011; Uysal and Tosun, 2014; Tiesmeier, 2016	Yes
	Market potential	Zavadskas et al., 2010; Maliene, 2011; Ronyastra et al., 2015	Yes
	Distance from Places of Interest (City Center, Universities, Businesses etc.)	Ginevičius and Zubrecovas, 2009; Maliene, 2011; Uysal and Tosun, 2014; Tiesmeier, 2016	Yes
	Public Transportation	Ginevičius and Zubrecovas, 2009; Zavadskas et al., 2010; Maliene, 2011; Tiesmeier, 2016	Yes
	Existence of Car parking	Ginevičius and Zubrecovas, 2009; Zavadskas et al., 2010; Maliene, 2011; Tiesmeier, 2016	Yes
Real Estate (property assessment)	Presence of competitors	Ginevičius and Zubrecovas, 2009; Zavadskas et al., 2010;	No
	Year of Built	Recognised by the consultant	No
	Property Condition	Maliene, 2011; Uysal and Tosun, 2014; Tiesmeier, 2016	Yes
	Design / Layout	Maliene, 2011; Tiesmeier, 2016	Yes
	Total area	Kettani et al., 1998; Kaklauskas et al., 2007; Maliene, 2011; Uysal and Tosun, 2014; Tiesmeier, 2016	Yes
	Number of Bedrooms	Maliene, 2011; Tiesmeier, 2016	Yes
	Type of Bedrooms	Recognised by the investor	No
	Energy Efficiency	Tiesmeier, 2016; Recognised by the consultant	Yes
	Other Amenities (Parking	Kaklauskas et al., 2007; Uysal and	Yes

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	Garage, Garden etc.)	Tosun, 2014; Tiesmeier, 2016	
Other	Risk Profile of the Project	Ronyastra et al., 2015	No
	Social Benefit	Ginevičius and Zubrecovas, 2009; Ronyastra et al., 2015	No

The rationale behind the eliminated criteria was explained by the participants. In the financial criteria group, there was no need to include the net cash flow criterion since it is represented by the Net Present Value (NPV) criterion. Mortgage structure and running costs were eliminated because they are included in the calculation of cash flows. The location criteria group remained the same because the decision makers considered all of the sub-criteria important. In the real estate criteria group, the experts suggested that the presence of competitors is irrelevant to the present problem, the year built is represented through the property condition criterion and the type of bedrooms criteria is represented in the design/layout criteria, while they suggested the title property assessment for the group. Although the other criteria groups contain two very important criteria for real estate projects, they are not considered relevant in the present decision-making problem.

Once the final list of criteria, sub-criteria and the four alternatives to be considered for investment were identified, the present decision-making problem can be structured according to the AHP. Figure 4 represents the decision tree that supports the decision of selecting the best real estate project for investment.

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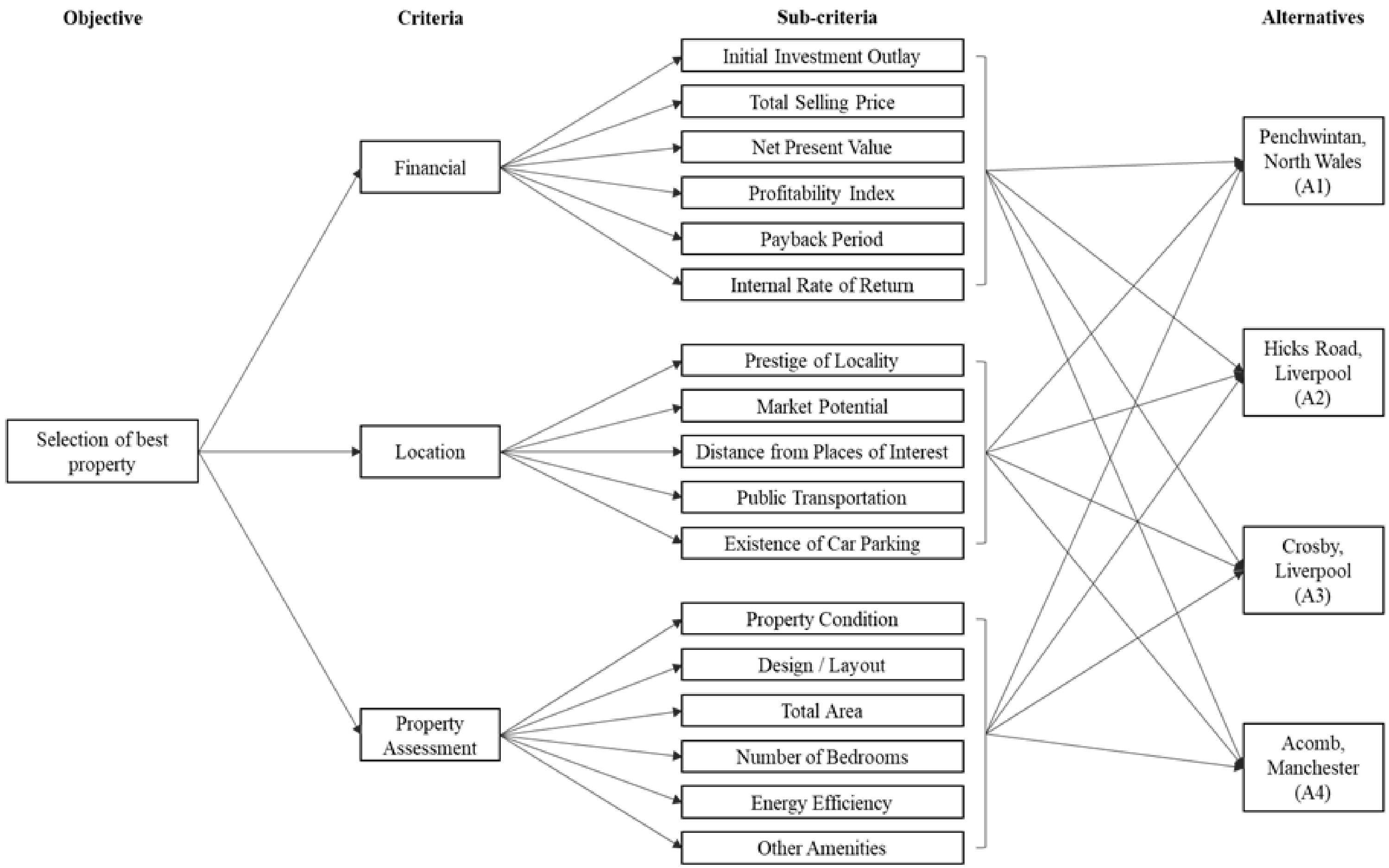

Figure 4 Decision tree

During the second round, the participants conducted a pairwise comparison of the final criteria and sub-criteria, according to the fundamental scale of absolute numbers. In the third round, participants were asked to compare the criteria again, using the same process as in round two. This time, the participants were provided with the average panel answer from round two and their individual answer in each particular question, and were asked to confirm or change their responses. This is the point in the process where a consensus should be reached. The mean scores from round three were used as input in step 3 of the AHP.

3.4 Financial modeling

Financial indicators such as net present value, internal rate of return, profitability index and payback period are key criteria in real estate investment projects. It is necessary to know the value of each indicator to evaluate the alternatives in order to apply the AHP. In the present study, the investors identified eight properties as investment opportunities, from which four were used in the assessment. All of the properties are located in the Northwest region of England, which is the main area of interest for the participating investors. The properties are located less than 40 miles away from each other so that it was possible to compare them. The alternative projects are being financed through special mortgages provided by UK banks for the private rented sector. The investors give a downpayment of an initial amount, which is a proportion of the total price of the property, and thereafter repay the rest of the amount in monthly installments for a predetermined period of years. In this paper, installments are considered fixed for the total period of the mortgage. In addition, for each alternative, the decision-makers have provided data on monthly rental income and running costs (Table 5). The period of the project and the repayment of the mortgage was considered 20 years. The discount rate is 8%, which was the rate suggested by LaSalle (2015) and the desired rate of the decision-makers for the private rented sector.

Table 5
Data for alternatives assessment

List of Criteria	Penchwintan, (A1)	Hicks Road, (A2)	Crosby, (A3)	Acomb, (A4)
Location	North Wales	Liverpool	Liverpool	Manchester
Initial Outlay (£ K)	45	40.5	35	55
Total Area (m^2)	117.5	120	150	180
Number of Bedrooms	5	5	4	8
Monthly Income (£)	2180	2300	2000	3500
Monthly Costs (£)	400	420	350	530
Monthly Mortgage Installment (£)	631	568	450	871
Rental Income Growth Rate (Std. Deviation)	2.46% (2.51%)	3.23% (2.09%)	3.23% (2.09%)	3.23% (2.09%)
Cost Growth Rate (Std. Deviation)	2.22% (1.07%)			
Discount Rate r	8%			
Period T (years)	20			

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Rental income and running costs are two variables which are not fixed and are expected to change throughout the total period of the investment. To address this issue in the financial modeling, we used estimators of growth for these two major data. For the rental income growth, we used the annual growth rate provided by the UK Housing Observatory of the Lancaster University Management School (Yusupova et al., 2015) for each particular region of the alternatives, and for the cost growth, we used the inflation rate in the UK market as the estimator (Office for National Statistics, 2018).

The financial indicators for the AHP analysis were Net Present Value (NPV), Internal Rate of Return (IRR), profitability index or Profit to Investment ratio (PI) and Payback Period (PP). The calculation of NPV contains some estimated values (i.e., income and cost growth estimators) which also affects the outcome of IRR, PI and PP. Therefore, to provide a more precise and valid input for the AHP analysis, we run Monte Carlo simulations to absorb the uncertainty of these factors.

4. Results

4.1 Delphi results

The mean scores and standard deviations were collected from the two quantitative rounds of Delphi. A mean score greater than one indicates that criterion 1 is superior to criterion 2. The closer the value to nine the higher the degree of importance of one criterion over another, while the closer the value to one the more equally the two criteria contribute to the objective. A mean score less than one indicates that criterion 2 is superior to criterion 1 with a degree of importance equal to 1/(mean score). For example, in the main group of criteria, the financial criterion is expected to be the most important since it scores above one when compared with both location and property assessment (3.43 and 3.14, respectively). Standard deviation figures are provided to highlight if the experts changed their individual opinions to comport with the rest of the panel or not. The reason why the Delphi technique is used in these kinds of knowledge-seeking situations is because it provides the experts an opportunity to re-evaluate and reflect on their initial views, take into consideration the answers that other experts gave, and then modify or hold fast to their ratings. In fact, in all of the pairwise comparison cases, the standard deviation figures were decreased from round 2 to round 3 (SD2=2.45, SD3=1.18), indicating that the experts did change their initial ratings to compromise with each other. This not only verifies the successful application of the Delphi method with the experts' opinions, but also provides the AHP with more reliable input.

Apart from reaching a consensus in general, there were some disagreements in certain pairwise comparisons between the investors and the consultants. In the pairwise comparison of location with property assessment criteria, the investors rated them as having almost equal importance (1.34), while the consultants' opinion indicated a moderate importance of location over property assessment. In their feedback, the latter group stated that market potential is a factor that can define the market value of the property in the future and should be taken into consideration more than the property assessment criteria. Other points of disagreement were the comparisons of property condition, design/layout and energy efficiency factors with the number of bedrooms. The consultants suggested that the first factors were far more important because they affect running and maintenance costs, and tenant satisfaction, while investors insisted that the number of bedrooms, which affects the rental income of the property was more important.

The mean scores from round 3 were used to construct the pairwise comparison matrices for each group of criteria, which were then used as the starting point of the AHP analysis.

4.2 Financial modeling results

The simulated results of the financial indicators after 5000 iterations are shown in Table 6. The mean score of each indicator was used in the AHP analysis, assuming that the number of iterations was enough to provide a high accuracy of input. In addition, the standard deviation, the minimum, and the maximum values were also provided to better understand the behavior of the financial indicators due to the use of estimated values. Standard deviation figures are provided to define the lower and upper boundary of each indicator, demonstrating the worst- and best-case scenarios.

Table 6
Monte Carlo simulation results of the financial indicators

Financial Indicators		A1	A2	A3	A4
NPV	Mean	148.54	196.28	178.24	321.20
(£ K)	SD	17.11	16.68	14.56	25.17
	Min	101.12	144.28	129.55	242.12
	Max	221.05	257.10	226.01	410.81
IRR	Mean	35.72%	45.64%	47.78%	52.79%
(%)	SD	1.56%	1.41%	1.43%	1.50%
	Min	31.01%	41.65%	43.66%	48.05%
	Max	41.73%	49.78%	53.52%	58.07%
PI	Mean	4.29	5.87	6.06	6.83
(times)	SD	0.39	0.41	0.40	0.44
	Min	3.19	4.64	4.85	5.38
	Max	5.73	7.36	7.30	8.46
PP	Mean	3.62	2.58	2.39	2.05
(years)	SD	0.25	0.19	0.18	0.19
	Min	2.92	2.00	1.83	1.49
	Max	4.63	3.20	3.12	2.69

As Table 4 demonstrates, even the financial indicators simulation results show the complexity of the investment decision. The table shows only four out of the seventeen criteria that each alternative evaluated, and even though they are very similar the rankings of the alternatives are different when each individual indicator is considered. The NPV results indicate that the A4 alternative is the best to invest in, followed by A2, A3, and A1. The IRR, PI and PP results also indicate that A4 is the best investment; however, the following order is different than with NPV (A3, A2, and A1). Therefore, even within the same group of financial sub-criteria, a different alternative can be preferred for each sub-criterion, and the complexity of the decision increases even more when the criteria from the other groups are incorporated in the analysis. Having analyzed all of the components of the AHP model proposed in this paper, in the next section we present the results of our study.

4.3 AHP results

Table 7 presents the normalized matrix of the main group of criteria after the weight analysis in the AHP. Among the three main criteria, the financial criteria are the most important to consider in the investment appraisal of PRS properties. They have three times the weight of location and four times the weight of the property assessment criteria.

Table 7
Normalized matrix of main criteria

Criteria	Financial	Location	Real Estate	Weights
Financial	0.621	0.694	0.516	61.0%
Location	0.181	0.202	0.320	23.5%
Real Estate	0.198	0.104	0.164	15.5%

Tables 8, 9 and 10 present the normalized matrices and the corresponding weights within each group of sub-criteria. Among the financial sub-criteria, NPV of future cash flows is the dominant criterion, and accounts for one-third of the group, followed by PI which accounts for about one-fifth. Initial investment outlay, IRR, and PP contribute almost equally to the decision, while the selling price is the least considered criterion since financing options are available to overcome the obstacle of a high selling price. Within the location sub-criteria, the prestige of locality and the market potential are the most important criteria, and account for one-third each. The first determines the attractiveness of the location and often defines the present market value of the property. The latter can define the market value of the property in the future and is very important in the PRS because investors in the sector do not only invest because of the rental income from the property, but also to own a valuable asset in the long-term. In the group of property assessment sub-criteria, the property condition and the total area are the most important decision factors since they are usually related to the price fairness of the property. Other amenities is the least considered factor, since the amenities increase the price of the property and the running costs without creating any extra value for the owner. However, these weights only correspond inside their group and need to be multiplied by the weight of their corresponding main criterion to determine the final weight on the investment decision. In addition, the importance of the criteria is only one part of the decision process; the other part is the assessment of the alternatives on each criterion, and the final selection and ranking synthesizes these two parts.

Table 8
Normalized matrix of financial sub-criteria

Sub-Criteria	Initial Outlay	Selling Price	NPV	PI	PP	IRR	Weight
Initial Outlay	0.093	0.248	0.088	0.102	0.074	0.052	11.0%
Selling Price	0.024	0.064	0.158	0.041	0.070	0.052	6.8%
NPV	0.375	0.145	0.357	0.458	0.521	0.222	34.6%
PI	0.183	0.312	0.156	0.200	0.171	0.321	22.4%
PP	0.148	0.109	0.081	0.137	0.118	0.253	14.1%
IRR	0.177	0.122	0.159	0.062	0.046	0.099	11.1%

Table 9
Normalized matrix of location sub-criteria

Sub-Criteria	Prestige of Locality	Market Potential	Distance from Places of Interest	Public Transpor-tation	Car Parking	Weight
Prestige of Locality	0.425	0.551	0.328	0.288	0.224	36.3%
Market Potential	0.212	0.275	0.500	0.329	0.312	32.6%
Distance from Places of Interest	0.151	0.064	0.117	0.288	0.240	17.2%
Public Transportation	0.106	0.060	0.029	0.072	0.168	8.7%
Car Parking	0.106	0.049	0.027	0.024	0.056	5.3%

Table 10
Normalized matrix of property assessment sub-criteria

Sub-Criteria	Property Condition	Design/ Layout	Total Area	No. of Bedrooms	Energy Efficiency	Other Amenities	Weight
Property Condition	0.333	0.399	0.351	0.249	0.284	0.228	30.7%
Design / Layout	0.123	0.147	0.198	0.256	0.081	0.157	16.0%
Total Area	0.245	0.192	0.258	0.332	0.319	0.257	26.7%
No. of Bedrooms	0.119	0.051	0.070	0.089	0.199	0.137	11.1%
Energy Efficiency	0.105	0.162	0.072	0.040	0.089	0.169	10.6%
Other Amenities	0.075	0.048	0.052	0.034	0.027	0.051	4.8%

Table 11 provides the final weights of all of the sub-criteria, and therefore their accountability on the decision model, as well as the evaluation of the alternatives according to each criterion. It also includes the objective function, which determines what the decision-maker looks for in the evaluation of an alternative according to the particular criterion. Min indicates that the lowest value of the alternatives is desired and the criterion accounts negatively in the AHP score, while max indicates that the maximum value is being sought and the criterion accounts positively in the AHP score.

Table 11
Data to obtain AHP rating and ranking

List of Criteria	Objective Function	Weight	Evaluation of Alternatives				Units
			A1	A2	A3	A4	
Initial Outlay	Min	6.68%	45	40.5	35	55	£ K
Selling Price	Max	4.17%	150	135	109.9	199.9	£ K
NPV	Max	21.13%	148.2	195.0	177.5	319.0	£ K
PI	Max	13.67%	4.32	5.83	6.10	6.82	times
PP	Min	8.60%	3.62	2.56	2.38	2.05	years
IRR	Max	6.77%	35.80	45.65	47.84	52.88	%
Prestige of Locality	Max	8.52%	6.2	4.5	3.4	8.5	rating
Market Potential	Max	7.64%	8.4	4.3	5	3	rating
Distance from Places of Interest	Min	4.03%	0.9	2	2.3	0.5	miles
Public Transportation	Min	2.04%	0.1	0.1	0.5	1	miles
Car Parking	Max	1.23%	8	4	5	6	rating
Property Condition	Max	4.77%	5.5	1	4	6	rating
Design / Layout	Max	2.48%	3	2	3	6	rating
Total Area	Max	4.15%	117.5	120	150	180	m^2
No. of Bedrooms	Max	1.72%	5	5	4	8	No.
Energy Efficiency	Max	1.65%	66	1	64	70	rating
Other Amenities	Max	0.74%	5	5	3	7	rating

From the Delphi input and the AHP analysis, it is evident that the decision-makers agree that the financial indicators have higher importance than the qualitative criteria of the decision, such as location and property assessment. Among the seventeen total criteria, NPV is considered the most important with 21.13% of the total weight, followed by PI which accounts for 13.67%. These two criteria are the only ones with a weight higher than 10%. With all of the financial criteria accounting for 61% of the total weight, the Monte Carlo was more than essential to absorb uncertainty from the financial figures and to provide significant AHP inputs. In addition, the qualitative criteria (location and property assessment) accounted for 39% of the total weight, and will obviously affect the final selection, especially in cases where an alternative might score well in quantitative factors and fail to score well in qualitative ones when compared to the others. Therefore, these criteria should not be ignored, in order to consider the realistic and complex nature of the decision analysis and to reach a quality decision that will include every important factor.

Based on the objective function, the weight of each criterion and the evaluation of each alternative, the final AHP rating was calculated and the alternatives were ranked accordingly in Table 12.

Table 12
Rating and ranking of the alternatives

Alternative	AHP Rating	Rank
Penchwintan (A1)	2.55	2
Hicks Road (A2)	1.62	4
Crosby (A3)	1.77	3
Acomb (A4)	3.06	1

From the case study of the four properties, the Acomb (A4) property achieved the highest AHP rating and was the number one choice for investment. Acomb had the best scores in five out of six of the financial criteria, which account for the majority of the total weights, and was also the best property in eight out of the eleven qualitative criteria. Therefore, this is a natural and expected outcome. However, the complex nature of the investment decision and the effectiveness of the present decision model was highlighted when we excluded the A4 alternative.

Penchwintan (A1) ranked second in the overall evaluation with an AHP rating higher than the A3 and A2 alternatives. Penchwintan (A1) achieved the worst scores in financial evaluation, but good scores in the qualitative criteria when compared to A3 and A2, making it the second-best option for investment. In the initial discussion with the experts when the four alternatives for investment were handed out, one of the investors stated, “with a first glimpse and without having done any kind of analysis, the A1 option seems a very good opportunity”. This might be a coincidence or an exception, but to a certain degree, it indicates the appropriateness of a MCDM application in investment decisions and the capability of the method to model decision instincts and rules of thumb. Crosby (A3) managed to rate higher than Hicks Road (A2), despite the fact that its NPV score (the most important criterion) was lower. The two projects had close scores in the rest of the financial criteria, but the high performance of Crosby when compared to Hicks Road, ranked the first one-third in the overall ranking of the alternatives, making the property with the second highest NPV the worst investment alternative.

The final ranking of the alternatives not only indicate the complexity of the investment decision, but also the impact of the multiple criteria approach in the investment appraisal of a property.

5. Conclusion

A decision-making model for investment in PRS properties was developed in the present study, which included financial performance indicators and other qualitative criteria. With the proposed model, interested parties can evaluate real estate alternatives in this sector. The decision model was delivered to the participating experts to assist them in their future selection of properties in the area or in other relevant markets. The case study of the four alternatives was done not only to assist the investors with this specific decision-problem, but also to illustrate the use of the developed multiple criteria procedure. The methodology was developed in order to structure the problem according to the decision objective, include all the relevant criteria, capture high-quality input data and absorb uncertainty to the greatest possible extent. The AHP was selected as the best MCDM method to achieve the desired decision outcome, which is to provide a rate and rank for each alternative. The Delphi technique and Monte Carlo simulations were used along with the AHP method, in order to enhance the quality of the data and create a robust decision model. It is important to highlight the effectiveness of the three-round Delphi technique, which helped structure the problem hierarchically with the relevant criteria, and reached the desired consensus in the third round of the pairwise comparisons, which was the primary reason of its use.

The findings from the case study indicated the need for multiple criteria frameworks in real estate investment appraisal. Even though financial performance is the most important driver for investment decisions in the sector, other qualitative factors cannot be excluded from the decision analysis. According to the experts' opinions, the financial criteria accounted for the 61% of the total weight, with the rest being the qualitative criteria (i.e., location and property assessment). In a corresponding case study presented by Ronyastra et al. (2015), the financial criteria accounted for 73% of the total, which demonstrates the significant importance of this type of criteria in a real estate problem, however, the qualitative aspects of the decision should not be ignored. In the present study, despite the fact that the property which scored the best in the financial criteria was the best investment selection, the qualitative criteria determined the order of ranking of the rest of the alternatives, leaving the alternative with the worst financial performance ranking second. Similarly, in Ronyastra et al. (2015), the alternative with the best NPV was positioned second after an alternative with a much lower risk profile. Both studies highlight the importance of qualitative criteria in real estate decision-making.

From a managerial perspective, our model helps investors make more informed decisions, with tangible evidence, on the selection of one alternative over another. In addition, it constitutes a tool for property managers to determine the potential of each property in the market. The practical implications of the study are the identification of the criteria and their weights, and the quality of the input and the application of the decision model. This research identified all of the relevant criteria and has categorized them into three groups of sub-criteria, including financial indicators, location criteria, and property assessment. The location and property assessment criteria are both qualitative criteria but are categorized into discrete groups because, according to the experts, location plays a major role in this sector. A high quality of input regarding the weights of the criteria and the evaluation of the alternatives was achieved and increased the robustness of the model. The decision model was implemented by the investors and can be applied to other cases of PRS investments. Moreover, the model can also be used in other real estate markets (e.g. commercial, office or retail development) with little or no modifications.

This research also has some implications for the academic community. The decision model was constructed using both the AHP and Delphi methods, and the link with the financial modeling stage provides a higher degree of objectivity in real estate decisions when compared to models that only use experts' judgments. The Monte Carlo simulation addresses the uncertainty of the financial indicators by incorporating exogenous factors which are beyond the control of the decision makers.

Future studies should provide a sensitivity analysis on the impact of cost and income in order to assess their effect on the final decision. Another interesting pathway for future research would be to incorporate the operational constraints of the investors. As a future step, we aim to develop a graphical user interface embedding the proposed decision model, therefore facilitating its broader use in the industry. Ultimately, the proposition of multi-criteria methods should always consider the trade-offs between inclusivity and complexity. In detail, validating the importance of each criterion with multiple stakeholders may reduce or increase the number of decision nodes depictured in the focal hierarchy. However, increased numbers of criteria (n), despite improving the resolution of the model, result in quadratic increases in the pairwise preference data required [n(n-1)/2)]. Therefore, the proposed method can serve as a decision aid mechanism rather than a decision-making tool. Ultimately, we may conclude that the final decision will be based on the participating stakeholder's opinions, experience and managerial insights.

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REFERENCES

Adair, A., & Hutchison, N. (2005). The reporting of risk in real estate appraisal property risk scoring. *Journal of Property Investment & Finance, 23(3)*, 254-268. doi: https://doi.org/10.1108/14635780510599467

Andrew, M., & Glenn, M. (2003). Public and private real estate in a mixed-asset portfolio. *Journal of Real Estate Portfolio Management, 9(3)*, 193-203. doi: https://doi.org/10.1111/j.1540-6229.2011.00306.x

Arof, A.M. (2015). The application of a combined Delphi-AHP method in maritime transport research-a review. *Asian Social Science, 11(23)*, 73. doi: https://doi.org/10.5539/ass.v11n23p73

Atherton, E., French, N., & Gabrielli, L. (2008). Decision theory and real estate development: a note on uncertainty. *Journal of European Real Estate Research, 1(2)*, 162-182. doi: https://doi.org/10.1108/17539260810918730

Ball, M. (2010). *The UK private rented sector as a source of affordable accommodation.* York: Joseph Rowntree Foundation.

Cantrill, J.A., Sibbald, B., & Buetow, S. (1996). The Delphi and nominal group techniques in health services research. *International Journal of Pharmacy Practice, 4(2)*, 67-74. doi: https://doi.org/10.1111/j.2042-7174.1996.tb00844.x

Chen, Z., & Khumpaisal, S. (2009). An analytic network process for risks assessment in commercial real estate development. *Journal of Property Investment & Finance, 27(3)*, 238-258. doi: https://doi.org/10.1108/14635780910951957

D'alpaos, C., & Canesi, R. (2014). Risks assessment in real estate investments in times of global crisis. *WSEAS Transactions on Business and Economics, 11(1)*, 369-379.

Dalkey, N., & Helmer, O. (1963). An experimental application of the Delphi method to the use of experts. *Management science, 9(3)*, 458-467. doi: https://doi.org/10.1287/mnsc.9.3.458

Geltner, D., & Kluger, B. (1998). REIT-Based pure-play portfolios: The case of property types. *Real Estate Economics, 26(4)*, 581-612. doi: https://doi.org/10.1111/1540-6229.00758

Ginevičius, R., & Zubrecovas, V. (2009). Selection of the optimal real estate investment project basing on multiple criteria evaluation using stochastic dimensions. *Journal of Business Economics and Management, 10(3)*, 261-270. doi: https://doi.org/10.3846/1611-1699.2009.10.261-270

Guarini, M.R., Battisti, F., & Chiovitti, A. (2018). A methodology for the selection of multi-criteria decision analysis methods in real estate and land management mrocesses. *Sustainability, 10(2)*, 507. doi: https://doi.org/10.3390/su10020507

Hartman, A. (1981). Reaching consensus using the Delphi technique. *Educational Leadership, 38(6)*, 495-97.

Hui, E.C.M., Lau, O.M.F., & Lo, K.K. (2009). A fuzzy decision-making approach for portfolio management with direct real estate investment. *International Journal of Strategic Property Management, 13(2),* 191. doi: https://doi.org/10.3846/1648-715x.2009.13.191-204

Jiang, G. M., Hu, Z. P., & Jin, J. Y. (2007). Quantitative evaluation of real estate's risk based on AHP and simulation. *Systems Engineering-Theory & Practice*, *27(9),* 77-81. doi: https://doi.org/10.1016/s1874-8651(08)60054-x

Kaklauskas, A., Zavadskas, E.K., Banaitis, A., & Šatkauskas, G. (2007). Defining the utility and market value of a real estate: a multiple criteria approach. *International Journal of Strategic Property Management*, *11(2)*, 107-120. doi: https://doi.org/10.3846/1648715x.2007.9637564

Kallberg, J.G., Liu, C.H., & Greig, D.W. (1996). The role of real estate in the portfolio allocation process. *Real Estate Economics, 24(3)*, 359-377. doi: https://doi.org/10.1111/1540-6229.00695

Kettani, O., Oral, M., & Siskos, Y. (1998). A multiple criteria analysis model for real estate evaluation. *Journal of Global Optimization, 12(2)*, 197-214.

Kim, M., Jang, Y.C., & Lee, S. (2013). Application of Delphi-AHP methods to select the priorities of WEEE for recycling in a waste management decision-making tool. *Journal of Environmental Management, 128*, 941-948. doi: https://doi.org/10.1016/j.jenvman.2013.06.049

Knight Frank Research (2017). *The UK tenant survey. Multi-housing 2017*. PRS Research, UK.

LaSalle Investment Management (2015). *The case for UK Private Rented Sector*,.European Research & Strategy.

Loizou, P., & French, N. (2012). Risk and uncertainty in development: A critical evaluation of using the Monte Carlo simulation method as a decision tool in real estate development projects. *Journal of Property Investment & Finance, 30(2),* 198-210. doi: https://doi.org/10.1108/14635781211206922

López, V., Santos, M., & Montero, J. (2010). Fuzzy specification in real estate market decision making. *International Journal of Computational Intelligence Systems, 3(1)*, 8-20. doi: https://doi.org/10.2991/ijcis.2010.3.1.2

Maliene, V. (2011). Specialised property valuation: Multiple criteria decision analysis. *Journal of Retail & Leisure Property, 9(5)*, 443-450. doi: https://doi.org/10.1057/rlp.2011.7

Office for National Statistics (2017). *English housing survey. Headline Report 2016-17.* Ministry of Housing Communities & Local Government, UK: 2017.

Office for National Statistics (2018). Inflation and price indices, UK.

Okoli, C., & Pawlowski, S.D. (2004). The Delphi method as a research tool: an example, design considerations and applications. *Information & Management*, *42(1)*, 15-29. doi: https://doi.org/10.1016/j.im.2003.11.002

Powell, C. (2003). The Delphi technique: myths and realities. *Journal of Advanced Nursing*, *41(4)*, 376-382. doi: https://doi.org/10.1046/j.1365-2648.2003.02537.x

Rocha, K., Salles, L., Garcia, F.A.A., Sardinha, J.A., & Teixeira, J.P. (2007). Real estate and real options - A case study. *Emerging Markets Review, 8(1),* 67-79. doi: https://doi.org/10.1016/j.ememar.2006.09.008

Ronyastra, I.M., Gunarta, I.K., & Ciptomulyono, U. (2015). A multi criteria decision analysis for reinvestment action portfolio selection problem in an Indonesian real estate company. *Procedia Manufacturing, 4,* 558-567. doi: https://doi.org/10.1016/j.promfg.2015.11.076

Saaty, T. L. (1977). A scaling method for priorities in hierarchical structures. *Journal of Mathematical Psychology, 15(3),* 234-281. doi: https://doi.org/10.1016/0022-2496(77)90033-5

Saaty, T. L., & Vargas, L. G. (1987). Uncertainty and rank order in the analytic hierarchy process. *European Journal of Operational Research, 32(1),* 107-117. doi: https://doi.org/10.1016/0377-2217(87)90275-x

Saaty, T. L. (1986). Axiomatic foundation of the analytic hierarchy process. *Management Science*, *32(7)*, 841-855. doi: https://doi.org/10.1287/mnsc.32.7.841

Saaty, T. L. (1990). How to make a decision: the analytic hierarchy process. *European Journal of Operational Research*, *48(1)*, 9-26. doi: https://doi.org/10.1016/0377-2217(90)90057-i

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences, 1(1),* 83-98.

Saaty, T. L. (2013). Analytic hierarchy process. In *Encyclopedia of Operations Research and Management Science*, 52-64. Boston, MA: Springer. doi: https://doi.org/10.1007/978-1-4419-1153-7_31

Sekhar, C., Patwardhan, M., & Vyas, V. (2015). A Delphi-AHP-TOPSIS based framework for the prioritization of intellectual capital indicators: A SMEs perspective. *Procedia-Social and Behavioral Sciences*, *189*, 275-284. doi: https://doi.org/10.1016/j.sbspro.2015.03.223

Soaita, A.M., Searle, B.A., McKee, K., & Moore, T. (2017). Becoming a landlord: strategies of property-based welfare in the private rental sector in Great Britain. *Housing Studies, 32(5)*, 613-637. doi: https://doi.org/10.1080/02673037.2016.1228855

Stewart, J. (2001). Is the Delphi technique a qualitative method?. *Medical Education, 35(10)*, 922.

Taleai, M., & Mansourian, A. (2008). Using Delphi-AHP method to survey major factors causing urban plan implementation failure. *Journal of Applied Sciences, 8(15)*, 2746-2751. doi: https://doi.org/10.3923/jas.2008.2746.2751

Tiesmeier, D. (2016). MCDM Problem-structuring framework and a real estate decision support model, Doctoral dissertation, Manchester Business School.

Treasury, H.M. (2010). Investment in the UK private rented sector. London: HM Government.

Turoff, M. and Linstone, H. (2002). *The Delphi method: Techniques and applications*.

Uysal, F., & Tosun, Ö. (2014). Multi criteria analysis of the residential properties in Antalya using TODIM method. *Procedia-Social and Behavioral Sciences, 109*, 322-326. doi: https://doi.org/10.1016/j.sbspro.2013.12.465

Walker, A.M., & Selfe, J. (1996). The Delphi method: a useful tool for the allied health researcher. *British Journal of Therapy and Rehabilitation, 3(12)*, 677-681. doi: https://doi.org/10.12968/bjtr.1996.3.12.14731

Wang, W.K. (2005). A knowledge-based decision support system for measuring the performance of government real estate investment. *Expert Systems with Applications, 29(4)*, 901-912. doi: https://doi.org/10.1016/j.eswa.2005.06.017

Worzala, E., & Bajtelsmit, V. (1997). Real estate asset allocation and the decision-making framework used by pension fund managers. *Journal of Real Estate Portfolio Management, 3(1)*, 47-56.

Yusupova, A., Pavlidis, E. G., Paya, I., & Peel, D. A. (2015). UK Housing Observatory, Department of Economics, Lancaster University Management School.

Zavadskas, E. K., Turskis, Z., & Kildienė, S. (2014). State of art surveys of overviews on MCDM/MADM methods. *Technological and Economic Development of Economy, 20(1)*, 165-179. doi: https://doi.org/10.3846/20294913.2014.892037

Zavadskas, E.K., Ustinovichius, L. & Stasiulionis, A. (2004). Multicriteria valuation of commercial construction projects for investment purposes. *Journal of Civil Engineering and Management, 10(2)*, 151-166. doi: https://doi.org/10.1080/13923730.2004.9636299

Zopounidis, C. and Doumpos, M. (2002). Multi-criteria decision aid in financial decision making: methodologies and literature review. *Journal of Multi-Criteria Decision Analysis, 11(4-5)*, 167-186. doi: https://doi.org/10.1002/mcda.333