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VOLUME 15

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Announcement

Notes to Contributors



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Valuation and Property Services Department (JPPH)
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Objective

The Journal of Valuation and Property Services is a publication specifically intended for property professionals to keep abreast with the developments in the property industry as well as the real estate profession.

This journal serves as a platform for the exchange of information and ideas on property issues. It seeks to:

- i. address areas of major interest and practical relevance to the real estate profession.
- ii. create awareness of new theories, techniques and applications as well as related concepts relevant to the real estate profession.
- iii. discuss policy issues and regulations and their implications on the property market.

We therefore welcome articles with theoretical and practical relevance to the real estate industry and profession, property valuation, property management, property investment and market analysis.

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REAL ESTATE DECISION-MAKING IN A WORLD OF INCREASING UNCERTAINTY ABOUT SECURITY: THE IMPACT OF CRIME ON RESIDENTIAL PROPERTY VALUES

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A fuller version of the paper, in particular the statistical analysis, is contained in McIlhatton, D, McGreal, S, Taltavul de la Paz, P and Adair, A (2016) Impact of Crime on Spatial Analysis of House Prices: evidence from a UK city, accepted for publication by *International Journal of Housing and Market Analysis*

ABSTRACT

Security is playing an increasingly important role in decision making across many aspects of life including decisions about real estate. Since the last ITERS conference in 2014 political uncertainty and instability has increased in various parts of the world and the threat of crime, political instability and terrorist activity has been heightened in the conscience of government, corporate and individual decision-making. Such uncertainty is highlighted in the Safe Cities Index 2015 (EIU, 2015) and the Global Terrorism Index 2015 (IPE, 2015) measuring the direct and indirect impact of terrorism across 162 countries in terms of the effect on lives lost, injuries and damage to property and recording an 80% increase in incidents over the previous year the highest level ever recorded. In order to examine the impact of crime and fear of crime on property values we have to turn to the literature in particular those studies examining the influence of crime and fear of crime on property values globally. Much of this research has identified that crime has a negative pricing effect on residential property, although to varying degrees. However, there is little literature examining the impact of crime on property value and the role which government can have in managing such impact. Building on previous work, this paper seeks to add to the current knowledge base through an understanding the impact of crime on house prices and areas at risk in the future. The latter is designed to enable decision-makers to have an understanding of where potential interventions may need to go in the future in order to maintain and enhance economic and social vitality in real estate decision-making.

1.0 INTRODUCTION

The real estate literature indicates that the impact of crime or the fear of crime is an externality that is perceived to have a detrimental influence on the way neighbourhoods are regarded with a consequential negative impact on property values. While such perceptions are widely held and are supported by the literature the reality is much more complex with such pricing effects being more variable than uniform.

In addition much of the literature focuses on wider socio-economic relationships including measures of multiple deprivation consequently masking the impact of property value and performance. Nevertheless the international spread of the literature indicates the global significance of this area of research.

The current study seeks to extend the current knowledge base on the impact of crime on residential property values utilizing a comprehensive data set of property, neighbourhood/location, socio-economic and crime variables for Belfast, Northern Ireland. Belfast provides a laboratory where submarkets historically have been segmented on the basis of religious belief, especially in the north and west of the city whereas in the south and east of the urban metropolitan area housing submarkets are structured more on income and socio-economic status (Adair et al, 1996) and in this respect are similar in structure to other major UK cities.

The following hypothesis is tested namely that spatial effects due to religious segregation that have persisted historically should be marked and how these relationships are related to the incidence of crime and vary by type of crime. A further question is do segregated housing markets show greater sensitivity to crime or is the impact of crime reduced by more homogeneous resident groups within submarkets?

The structure of the paper comprises a critical review of key issues in the relevant literature in section 2 drawn from an international perspective. In particular there is an examination of how spatial analysis, spatial lag and spatial error, have been used in previous studies. The database, variables and models that underpin the analysis are outlined in section 3 followed by an examination of the models and results in section 4. The final section draws conclusions.

2.0 RISK, UNCERTAINTY AND IMPACT OF CRIME ON HOUSE PRICES

The Global Risks Survey (WEF, 2015) identifies a series of risks that in the estimation of the World Economic Forum global regions are least prepared for. In the case of East Asia and the Pacific, Latin America and the Caribbean, and South Asia failure of urban planning is among the first three risks. In such regions, urbanization is especially rapid and the failure of urban planning can lead to a wide range of catastrophic scenarios from social unrest to pandemic outbreak. The other two regional risks are terrorist attacks and water crises.

In the case of Europe the risks are high structural unemployment or underemployment followed by large-scale involuntary migration and profound social instability. Both unemployment and migration flows into Europe are expected to remain high on the agenda going forward and are driving factors of social instability.

The impact of a recent wave of 190,000 immigrants into Sweden during 2015 has seen Stockholm as one of Europe's fastest growing cities with house prices rising by 14% over the year and apartment prices increasing by 150% over the decade (Economist (2015, November 7th). It is this social instability that creates uncertainty and poses a threat to real estate markets. Uncertainty is highlighted in the Global Terrorism Index published in 2015 measuring the direct and indirect impact of terrorism across 162 countries in terms of the effect on lives lost, injuries and damage to property and recording an 80% increase in incidents over the previous year the highest level ever recorded.

The threat to life and property is now very real at a macro level but it is at the micro or local level that the threat posed to real estate is often measured. There is a significant evidence base of the adverse impact of crime on house prices but most of this work remains in the academic field as professional bodies are concerned that publishing such statistics could have an unnecessarily detrimental effect on property prices.

Indeed evidence exists that freely available information on hospital and school league tables can have an undue influence on local house sale prices. In the UK the Home Office has committed to making public statistics relating to burglary, street robbery, vehicle crime and anti-social behaviour in specific neighbourhoods. Contrary to the RICS the Home Office claims that there is no proven link between published crime figures and house prices.

Finding definitive proof of the link between local crime rates and property values is difficult as it is felt that deprived neighbourhoods are more susceptible to crime and often already suffer from lower than average house prices. But even this statement is contested.

Evidence from the Economist (2015, January 31st) cites research in Leicester UK in one of the poorest neighbourhoods primarily occupied by immigrants. The local unemployment rate is three times the national average yet school performance and educational attainment among children is high. Indeed levels of crime and anti-social behaviour are higher in the more wealthy areas.

Further evidence from the Economist (2014, April 8th) indicates that gentrification of certain boroughs in London has seen a marked reduction in crime and a corresponding rise in property values. Twenty years ago few middle-class people wished to live in Hackney due to high crime rates, severe congestion and pollution and poorly performing schools.

In the academic literature there is a large volume of research on the impact of externalities on house prices. Crime or perception of crime is included amongst those factors considered to lower property prices in a neighbourhood yet in comparison to other externalities the impact of crime has received significantly less attention than other variables possibly arising from the potential high correlation and multicollinearity between crime and socio-economic variables.

Nevertheless the literature acknowledges that the impact of crime can be complex. For example Taylor (1995) while showing that high crime levels result in weaker attachments of residents to and satisfaction with their neighbourhood, the desire to move and lower house prices simultaneously suggests that crime neither spurs mobility nor necessarily decreases local involvement.

Tita et al (2006) take a slightly different perspective and argue that crime is an important catalyst for change in the socioeconomic composition of communities, while such change is considered to occur gradually over time, crime is seen to be capitalised into local housing markets quickly and provides an early indicator of neighbourhood transition. Gibbons and Machin (2008) demonstrate that prices within urban areas exhibit highly localised variations that cannot be explained solely by differences in the physical attributes of dwellings but also reflect the role of local amenities and disamenities in generating price variation within cities in particular the role of transport accessibility, school quality and crime.

There is a larger literature on the impact of externalities such as urban parks which are generally perceived as beneficial environmental amenities and hence should have a positive impact on house price. However the propensity of parks to attract specific types of crime may also have negative impacts on house price (Troya and Grove, 2008). In a study in Baltimore they show that park proximity is positively valued by the housing market where the combined robbery and rape rates for a neighborhood are below a certain threshold rate¹ but negatively valued in locations above that threshold. Their analysis showed that the further the crime index value is from the threshold value for a particular property, the steeper the relationship is between park proximity and house price.

Similarly, Matthews et al (2010) in an analysis of property crime in Seattle show that theft crimes are 23% higher for those census tracts with a public park. In relation to Stockholm, Ceccato and Wilhelmsson (2011) argue that if local crime levels are above the national average, in those circumstances park proximity has a negative impact on property values.

At a macro-level, Pope and Pope (2012) compiled information on changes in property values and crime during the 1990s in nearly 3000 urban zip codes throughout the US. Their analysis shows strong statistical significance between crime and property values, with estimated elasticities of property values ranging from -0.15 to -0.35 and notably, zip codes in the top decile in terms of crime reduction saw property value increases of 7–19%.

In Northern Ireland, Mueller and Besley (2012) assessed the impact of civil unrest on house prices and sought to estimate the peace dividend resulting from the cessation of violence. They utilize data on the pattern of violence across regions and over time to estimate the impact of the peace process. Their research indicates a negative correlation between murders and house prices. In relation to the distinctive social geography of Belfast, McCord et al (2013) show how “peace walls” that cut across segregated communities has resulted in a decline in value of 29.6 per cent for properties located within 250m of a peace wall, which is still a feature of divided communities, notably in the north and west of the city.

In terms of research into the design of real estate, Mohit, Mohammad Abdul and Kulliyyah, Hanan Mohamed Hassan Elsawahli (2010) focus on the “Safe city program” adopted by Malaysia aimed at creating violence and crime free cities. Their research indicates that changes in the built environment and modifications in space design can impact residents’ and offenders’ perceptions of criminality.

¹ Depending upon model construction, the threshold occurs at a crime index value of between 406 and 484 that is, between 406% and 484% of the national average (the average rate by block group for Baltimore is 475% of the national average).

Baharon, AH and Muzafar Shah Habibullah (2009) examine the causality between income inequality and crime in Malaysia over the period 1973-2003. They found that income inequality had no meaningful relationship with any category of crime and were not cointegrated. They conclude that there is ambiguity in the empirical studies of crime economics regarding various income variables leading to often mixed and contradicting results.

A critical review of the literature indicates an increasing focus upon spatial analytics reflecting the growth of geographically referenced databases for both housing markets and the spatial incidence of crime. Such analysis is characterized by complexity arising from the potential presence of spatial auto-correlation in data and the existence of spatial dependence or spatial lag (spatial autoregressive parameter), and spatial interaction arising from heterogeneity, the variation of relationships across space, or spatial error (Anselin, 1988).

Overall the literature indicates that a complex set of factors may influence the relationship between crime, the location of crime and impact on house price requiring both robust datasets and the application of spatial modelling techniques to measure the effect of spatial lag and spatial error. The next sections of the paper review the dataset and variables utilized for this research in Belfast (section 3) and the techniques employed (section 4).

3.0 RESEARCH DESIGN

The research design is based on a robust data set of property, location, socio-economic, neighbourhood and crime variables for Belfast as outlined in the fuller paper (McIlhatton et al, 2015). There is a historic pattern of housing submarkets segmented on the basis of religion, catholic and non-Catholic, in the west and north of the city whereas in remaining parts of Belfast they are structured more on the basis of income and socio-economic status (Adair et al, 1996). Property variables are sourced primarily from the Northern Ireland Quarterly House Price Index containing sales transactions across a wide network of selling agents over twelve quarters from the first quarter of 2012 to the final quarter of 2014. The sample size (n=4325 properties) includes properties for which specific address was available thereby facilitating the geo-coding of each property. For each property, house type is categorized as one of terraced house, semi-detached house, detached house, semi-detached bungalow, detached bungalow or apartment. Age band contains six categories (from pre-1919 to new development), the floor area of the property, number of bedrooms, and number of reception rooms, heating type and whether the property has a garage. Each property also has a location variable in the form of local X and Y coordinates.

Seven neighbourhood/location variables are included namely: distance to bus stop, distance to retail centres, distance to open space/parks, distance to interface areas, distance to police stations and distance to train stations. The spatial distance of these variables was calculated in a proprietary GIS using a Euclidean distance calculation tool.

The focus of the research is the impact of crime on property values between 2012 and 2014. The paper utilizes six specific crime variables, namely violence against the person, criminal damage, drugs offences, burglary, theft and other crime. The crime data was sourced from police.uk which is published by the United Kingdom Home Office and provides X and Y coordinates of individual crime. Socio-economic variables are captured through a multiple deprivation index, sourced from the Northern Ireland Statistics and Research Agency.

There are two stages to the analysis, firstly an exploratory examination of crime variables with the objective of identifying univariate/bivariate spatial patterns in the data and establishing the nature and direction of relationships between crime variables and house prices. Secondly the application of spatial auto-regression models (SAR) seeks to estimate the role of crime on house prices in Belfast controlling by spatial association. More specifically a SW2SLS (HET) (Spatial Weighted Two Stage Least Squares with Kelejian and Prucha (2010) robust standard errors) method is employed for the house price model specification.

Spatial patterns in house prices and crime variables are determined using Moran's I and Local Indicator Spatial Association (LISA) models enabling variation of spatial dependence between two variables to be examined. In determining Moran's I, the analysis utilizes the Queen contiguity matrix (GAL), based on actual contiguity of properties. For each of the crime variables, the analysis is consistent revealing high positive values. There is little variation in univariate Moran's I ranging from 0.936 for burglary to 0.868 for drugs offences.

The results infer the strong existence of spatial autoregressive patterns in the crime variables and clusters in Belfast. LISA analysis identifies the location of these clusters (Figure 1) representing the local clusters for the total crime variable with two main clusters identified. One cluster of a high and increasing incidence of high order crimes (H-H) is located in the centre/inner city area. The second cluster (L-L) is where a low numbers of crimes at a location are associated with lower crimes in the neighbouring area thereby creating a cluster in which the number of crimes is reducing. Strong L-L clusters are in suburban and out of town locations.

In general the same pattern is evident across each of the crime variables with only a small difference spatially, notably in relation to the H-H central location. For house price, univariate analysis records a Moran's I value of 0.45 suggesting a degree of spatial association of price data inferring that when the prices of neighbouring properties are likely to be high, the price of a particular property is high.

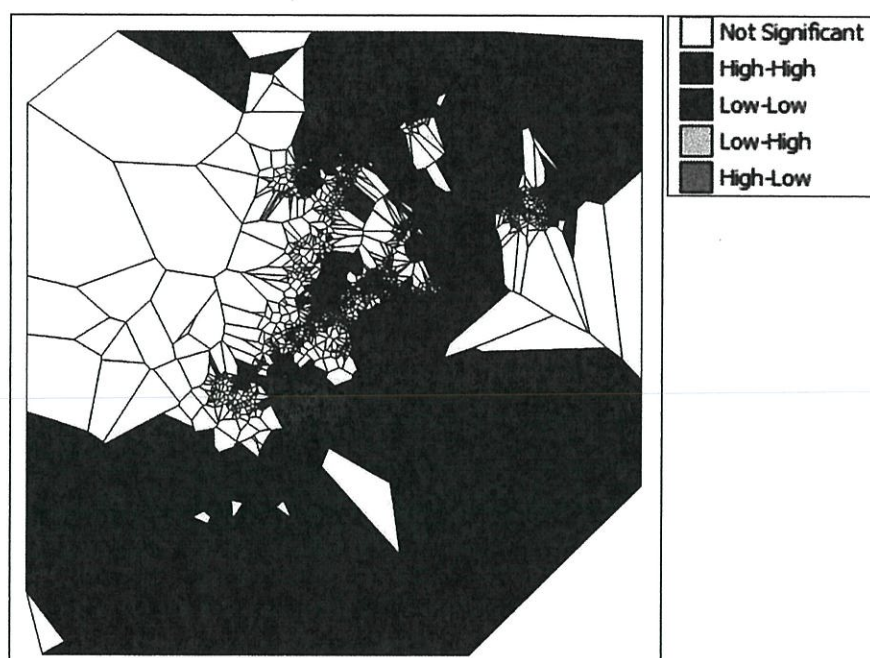


Figure 1: Total Crime Univariate Analysis LISA Clusters

Of particular interest is how spatial lagged crime variables could affect house prices, the power of such association and the existence of clusters. In this regard the Morans' I tests are undertaken in levels and in logs format (Table 1). The analysis, revealing low and negative Moran's I, is indicative of the relative non-existence of spatial association at an aggregate level. The outcome of no spatial association at a general level, while surprising, is apparent for all crime variables.

Table 1: Spatial analysis of crime variables, Moran's I and LISA

	Spatial model of crime	Spatial association between Price and Crime (using Gal Weight matrix)			
		Moran's I		LISA*	
	GAL (contiguity) Weight Matrix	levels	in logs	Statistically significant obs- %	No statistically significant obs -%
R14	0.907	-0.095	-0.178	45.76	54.24
VAP 14	0.888	-0.110	-0.249	44.72	55.28
BURGL14	0.936	-0.035	-0.041	45.83	54.17
THEFT14	0.896	-0.073	-0.103	45.16	54.84
CD14	0.928	-0.121	-0.179	47.77	52.23
DO14	0.868	-0.107	-0.235	39.82	60.18
A0014	0.883	-0.105	-0.182	41.06	58.94
		*Total observations		4325	

LISA analysis indicates that a spatial pattern exists for all of the crime variables at a local level with the number of significant observations varying between 39.83% for drugs offences to 47.77% for criminal damage. Various clusters are apparent across the city as illustrated in Figure 2 (total crime variable). In central/inner city locations, an L-H cluster indicates that the lower crime is in a neighbourhood the higher are the house prices. This area also includes neighbourhoods where high crime in the form of burglary (BURG) is associated with high house prices (H-H). Of particular interest is the occurrence of a number of H-L clusters and where these overlap with existing high priced locations, the effect of increasing crime will be to act as a dampening effect on house price.



Figure 2: Price – Total Crime Bivariate Analysis LISA Clusters

In relation to SAR model of house prices and crime the paper utilizes a hedonic perspective with prices explained through the property, location and crime variables. The model includes the six different measures of criminal offences as individual variables in order to capture their association with house prices rather than their summation into a total number of crimes hence avoiding aggregation bias. In this analysis, the crime data used refer to 2014 only.

As house prices show a spatial pattern (univariate Moran's I) and spatial auto regression, a SAR functional form was utilized in the model. The bivariate analysis demonstrates that crime types are spatially related to house prices defining clusters at a local level. Hence endogenous relationships between crime and housing characteristics were tested, no statistically significant association (no causal, nor spatial) was found to exist. High correlations are apparent between crime variables suggesting some simultaneous determination of crime types.

Furthermore crime variables show strong clusters that are spatially associated with price suggesting that crimes are more likely to be committed in some areas rather than in others, and that price and crime are endogenous.

The model for Belfast needs to adapt the hedonic model to include property characteristics, neighbourhood features and spatial association derived from both spatial continuity influence (spatial lag) and from the unobservable features (spatial error), and, as endogenous, the crime component. The latter is estimated using a set of instrumental variables (z) capturing their spatial association (z^*W) within the model. The analysis is cross-sectional based on a panel of data as defined in Equation 2.

$$(2) \quad P_i = \alpha + \rho W P_{i-j} + \sum [\beta'_1 k x_{ki}] + \sum [\beta'_2 f N_{fi}] + \sum \gamma' d C_{di} + \lambda W \varepsilon_i + \mu_i$$

Where,

- | | |
|---------------------------|--|
| C | are a set of the six endogenous crime variables. |
| W | is the spatial weight matrix which allows estimation of the spatial association. |
| β'_1 and β'_2 | are the robust parameters estimators for housing features and neighborhood characteristics in the spatial framework |
| γ' | is the IV estimated parameters measuring the association between crime and house prices. |
| P | is the spatial price autoregressive parameter to be estimated, capturing the effect on prices due to the proximity of other houses |

λ	is the spatial error parameter measuring the spatial association affection housing prices related to unobservable characteristics in the neighborhood
μ_i	is a vector of specific location error which are uncorrelated and normal distributed.

The continuous variables (price, size and distance variables) are measured in log terms, thus the model measures changes on variables and the parameter interpretation is pseudo-elasticity. The functional form described in the Equation is estimated using a General Spatially Weighted Two Stage Least Square (GSWTLS) with robust estimators as described in Kelejian and Prucha (2010).

4.0 RESULTS

Model results (Table 1) show high levels of association between the dependent, the independent and endogenous variables. Pseudo R^2 with values greater than 0.6 in all models suggests a high level of association. The spatial pseudo R^2 in excess of 0.68 across all models indicates that spatial relationships are strong in explaining house price variations in Belfast, an outcome in line with expectations. The overall model which includes all crime variables (Model 1) confirms that a spatial autoregressive pattern exists with both the spatial lag parameter ρ (0.28) and the spatial error parameter λ (0.27) having positive signs suggesting that circa 28% of the variation in house price arises from the price of adjacent properties and a further 27% is attributable to unobserved variables in the neighbourhood.

Table 2: General Spatially Weighted Two Stage Least Squares Model (GSW2SLS-HET) Of Housing Prices In Belfast

Dependent Variable:	Log (housing prices)...	MODEL	1	2	3	4	5	6	7	8	
			LPRI	LPRI	LPRI	LPRI	LPRI	LPRI	LPRI	LPRI	
Variable	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error	Coef	Std.Error	
a	2.780	0.294	3.155	0.350	1.06	0.27	0.697	0.324	2.595	0.302	
AGE1	-0.165	0.062	-0.045	0.061	-0.17	0.06	-0.078	0.060	-0.048	0.061	
AGE2	-0.155	0.075	-0.064	0.072	-0.17	0.07	-0.081	0.073	-0.069	0.072	
AGE3	-0.290	0.026	-0.199	0.020	-0.29	0.02	-0.210	0.020	-0.199	0.020	
AGE4	-0.214	0.022	-0.162	0.017	-0.23	0.02	-0.163	0.016	-0.165	0.017	
AGE5	-0.144	0.024	-0.103	0.021	-0.16	0.02	-0.110	0.020	-0.109	0.021	
BEDS	0.062	0.010	0.059	0.010	0.05	0.01	0.054	0.010	0.057	0.010	
GARAGE	0.053	0.011	0.050	0.011	0.07	0.01	0.073	0.011	0.053	0.010	
HEAT	0.081	0.082	0.106	0.091	0.11	0.08	0.113	0.087	0.113	0.090	
HEATTYPE	0.053	0.010	0.046	0.009	0.05	0.01	0.044	0.009	0.047	0.009	
LSIZE	0.725	0.027	0.765	0.027	0.74	0.03	0.746	0.028	0.769	0.027	
TYPE1	-0.092	0.024	-0.144	0.023	-0.11	0.02	-0.134	0.023	-0.145	0.023	
TYPE2	0.034	0.023	-0.047	0.021	0.02	0.02	-0.009	0.022	-0.047	0.021	
TYPE3	0.146	0.027	0.053	0.026	0.12	0.03	0.081	0.026	0.049	0.026	
TYPE4	0.004	0.035	-0.085	0.034	0.02	0.03	-0.001	0.034	-0.081	0.033	
TYPE5	0.128	0.030	0.056	0.029	0.12	0.03	0.097	0.030	0.056	0.028	
LD_BUS	-0.019	0.014	-0.044	0.012	0.01	0.01	0.038	0.014	-0.032	0.011	
LD_CBD	0.025	0.015	0.013	0.010	0.02	0.01	0.017	0.008	0.016	0.009	
LD_JBO	-0.016	0.013	-0.041	0.012	0.00	0.01	0.006	0.010	-0.032	0.011	
LD_OSP	0.040	0.009	0.015	0.008	0.03	0.01	0.021	0.008	0.013	0.008	
LD_PEACE	0.047	0.017	-0.002	0.014	0.08	0.01	0.059	0.015	-0.001	0.015	
LD_POLICE	-0.060	0.011	-0.031	0.009	0.01	0.01	-0.039	0.008	-0.035	0.008	
LD_TRAIN	0.017	0.010	-0.020	0.007	0.01	0.01	-0.006	0.007	-0.020	0.007	
LVAP14	-0.046	0.050	-0.056	0.015	0.15	0.02	0.110	0.020	-0.035	0.015	
LBURG14	0.138	0.023	0.084	0.028	0.08	0.01	0.038	0.014	-0.032	0.011	
LTHEF14	0.084	0.028	0.084	0.028	0.08	0.01	0.038	0.014	-0.032	0.011	
LCD14	-0.010	0.040	0.013	0.027	0.037	0.007	0.007	0.007	-0.020	0.007	
LD014	0.013	0.027	0.013	0.027	0.037	0.007	0.007	0.007	-0.020	0.007	
LA0014	-0.152	0.037	0.013	0.027	0.037	0.007	0.007	0.007	-0.020	0.007	
W_LPRI	0.280	0.023	0.354	0.019	0.35	0.02	0.376	0.018	0.376	0.018	
lambda	0.271	0.040	0.205	0.038	0.11	0.04	0.076	0.043	0.179	0.036	
Tests											
Pseudo R ²	0.6003		0.7568		0.7438		0.6003		0.7517		
Spatial Pseudo R ²	0.7361		0.7095		0.6891		0.752		0.702		
Instruments	LVAP14, LBURG14, LTHEF14, LCD14, LD014, LA0014, W_LPRI		LVAP14, W_LPRI		LBURG14, W_LPRI		LTHEF14, W_LPRI		LD014, W_LPRI		
Variables :											
Instruments Used:	MDMRANK, LBURG13, LTHEF13, LD013, LD013, LA0013, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5
Used:	MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5		MDMRANK, W_AGE1, W_AGE2, W_AGE3, W_AGE4, W_AGE5, W_BEDS, W_GARAGE, W_HEAT, W_HEATTYPE, W_LD_BUS, W_LD_CBD, W_LD_JBO, W_LD_OSP, W_LD_PEACE, W_LD_POLICE, W_LD_TRAIN, W_LSIZE, W_TYPE4, W_TYPE5

p-value<0.01, ** p-value<0.05

*** p-value<0.01, ** p-value<0.05

*MDMRANK is a variable used as instrument for every Crime variable due to it is highly related with every one with correlation larger than 0.8. The variable measure the deprivation rank for each house

The effect of individual crime variables (Models 2 to 7) highlights subtle changes in spatial association. The spatial lag parameter increases in each of the respective models suggesting that changes in the neighbourhood having increasing influence in determining changes in observed house prices. In contrast, the value of the spatial error parameter diminishes appreciably inferring that changes in house prices arising from unobserved variables reduces when the effects of a specific type of crime are considered. Presence of crime variable theft (Model 4) is associated with a null spatial error effect on house price change with λ being insignificant suggesting that no unobservable effects are influencing house price.

The addition of crime variables, either all variables as in Model 1 or individual crime variables (Models 2 to 7) does not fundamentally change the relationship.

The coefficients for property type (relative to apartments, omitted case) are generally negative across the respective crime specific models. Detached property, houses in particular (Type 3), have positive coefficients across the models which may simply be measuring a price differential with apartments though this observation is consistent with literature which suggests that certain types of crime, notably burglary, are associated with higher price property (Model 3, significant positive coefficient for detached houses and detached bungalows - Type 5).

The neighbourhood/location effects are less consistent than property variables regarding impact on house price. Proximity to a bus stop is statistically significant in a number of the crime-specific models. In the models violence against the person (VAP), criminal damage (CD), drugs offences (DO) there is a negative relationship between house price and distance to a bus stop whereas the model that includes the incidence of theft shows the reverse effect namely higher house price with distance from bus stops. These varying relationships suggest that house prices may be influenced to a subtle extent by the type of crime and proximity to a bus stop ie theft is higher with distance and house price is also higher but from an opposite perspective the probability of violence against the person increases with distance from a bus stop and hence serves to have a negative impact on house price.

Similar negative, significant relationships are apparent with the variable distance to train station in Model 2 (VAP), Model 5 (CD) and Model 6 (DO) suggesting that crime effect (type of crime) has an element of consistency across transport modes, an effect that has not been identified by previous hedonic studies considering the proximity of transport modes on house price.

Distance to open space (OSP) is often hypothesized as enhancing value however this analysis suggests the contrary. The model excluding crime variables (Model 8) shows a positive but not statistically significant effect whereas Model 1 which includes all the crime variables has the same sign but becomes statistically significant, with the inference that house price increases with distance from open space. Some previous studies have shown that crime increases in parks and other public spaces. The Belfast analysis is consistent with the literature in terms of perception of crime and impact on house price with models 3 (burglary), 4 (theft), 6 (drug offences) and 7 (other crimes) having significant positive coefficients for the association between price and open space.

Peace walls are a specific characteristic of Belfast and these divide segregated communities notably within inner city areas in west and north Belfast (McCord, et al, 2013). Proximity to a peace wall (PEACE) as expected shows a positive association with house price change, namely higher price with distance from a peace wall. The value of the coefficient for PEACE is appreciably higher in Model 1 and significant (includes all crime variables) relative to Model 8 (no crime variables included) inferring an added effect when crime measures are taken into consideration.

Distance to a police station is statistically significant across all models and is negatively associated to house prices. This suggests that the closer properties are to a police station the higher the price due to the perception of greater security and lower incidence of crime. This inference is supported by the larger coefficient for the variable distance to a police station in Model 1 (includes all crime variables) indicating that for every 1% reduction in the distance from a house to the police station there is a 0.06% increase in price.

The overall model (Model 1) shows a statistically significant association with house price and crime variables: two with positive relationships (burglary and theft) and one negative (other offences). Burglary is strongly significant, 1% increase in such attacks is associated with a 0.138% increase in house prices inferring that in more dynamic and higher priced neighbourhoods, the greater the incidence of burglary.

Theft has a similar relationship although lower effect (1% increase in theft is associated with a 0.084% price increase). In the case of other offences (AOO), the association is strongly significant but negative with a 1% increase associated with a reduction in house prices of 0.152% suggesting that such crimes are connected with less dynamic locations. In Models 2 to 7 the respective individual crime variables are all significant and as discussed are associated with a reduction in the spatial error parameter. The single crime variable models confirm the positive coefficients for burglary (Model 3) and theft (Model 4) lending support to the inference that these types of crime are associated with higher priced, higher income neighbourhoods whereas other types of crime namely violence against the person (Model 2), criminal damage (Model 5), drug offences (Model 6) have negative coefficients and are associated with a reduction in house price.

6.0 CONCLUSIONS

Political uncertainty and instability has increased in various parts of the world and the threat of crime, political instability and terrorist activity has been heightened in the conscience of government, corporate and individual decision-making. The general expectation of crime having a negative pricing impact on residential property is in reality much more complex and varies in its influence by type of crime, type and location of property. In this respect an original contribution of this paper is highlighting the nuances of various types of crime on house price. The paper by seeking to differentiate the impact of crime provides an analysis of the pricing effect, masked in many earlier studies by high correlation and multicollinearity between crime and socio-economic variables.

This study extends the body of knowledge by using an innovative approach to statistical modelling to draw out the complex interrelationships between type of crime, housing attributes, locational variables and house price. The addition of crime variables in their entirety or as individual variables does not fundamentally change the primary relationship of house size as the principal variable impacting on house price. The study also confirms earlier work that certain types of crime notably burglary is associated with higher priced property namely detached houses and bungalows and in this regard a number of interesting insight are provided by the analysis. Overall the research shows that burglary and theft are associated with higher income neighbourhoods whereas other types of crime namely, violence against the person, criminal damage, drug offences are mainly found in lower priced neighbourhoods.

Neighbourhood/ locational influences on price are shown to have a lesser impact than property characteristics, a finding common to other studies, yet in this analysis there are subtle differences. The findings indicate that the probability of violence against the person increases with distance from a bus stop with a negative impact on house price. Indeed the consistency of this finding across other transport modes (distance to train station) is an important consideration. Distance to a police station is negatively associated to house prices with proximity showing higher prices inferring greater security with the strongest effect for burglary where a 1% reduction in distance shows a 0.5% increase in price. An important finding is the sensitivity of certain types of crime to distance to the CBD.

In relation to open space, the analysis shows house price increasing with distance from open space, a finding that concurs with earlier studies and specific models including those for burglary, theft, drug offences and other crimes support this outcome.

Overall the analysis shows that crime does not have a uniform impact across the housing market but is highly differentiated with impact varying by property type. The study confirms that spatial information is essential in the analysis of the variation of property price.

More generally a criticism of hedonic pricing has been the influence of the unexplained error effects, the significance of this paper suggests that greater use of crime data and spatial analytics may enhance models and reduce error effects.

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REAL ESTATE MARKET TRANSPARENCY IN THE ASIA - PACIFIC REAL ESTATE MARKETS

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ABSTRACT

Improved real estate market transparency is fundamental to innovation in the real estate sector. Importantly, a key ingredient for increased investor confidence in the Asia-Pacific real estate markets has been the improved real estate market transparency in the Asia-Pacific markets in recent years. Using the JLL global real estate transparency index, countries are classified as high transparency, transparent, semi-transparent, low transparency and opaque.

This paper assesses changes in the real estate transparency for 21 Asia-Pacific real estate markets over 2001-2014. This is also assessed in a regional and global real estate market context. Differences in real estate transparency between the developed and emerging Asia-Pacific markets are also highlighted. The positioning of Malaysia in the global and Asia-Pacific real estate market transparency context is also discussed.

Keywords: *Real Estate Market Transparency, JLL, Asia-Pacific, Developed Markets, Emerging Markets, Malaysia.*

1.0 INTRODUCTION

With an increased emphasis on international real estate investing, a fuller understanding of the unique characteristics of these global markets is important. Information such as real estate market performance information, market players, legal system, planning system and the transaction process are key ingredients in defining the transparency and sophistication of real estate markets, with real estate transparency being an important factor in strategic real estate investment decision-making by institutional investors.

In this global context, the Asia-Pacific real estate markets are important. In 2011, investable real estate in Asia-Pacific was estimated to be \$7.0 trillion or 27% of global markets; by 2021, the Asia-Pacific market share is expected to be \$17.5 trillion or 37% of global markets (Pramerica REI, 2012). This has seen active involvement by a wide range of players in the Asia-Pacific real estate investment landscape including local, international, REITs/PCs, unlisted real estate funds, private equity funds, pension funds, sovereign wealth funds, insurance companies and high wealth individuals. Table 1 lists some of the major real estate investment managers, with their global rank (I&P RE, 2015). Often these investors have significant Asia-Pacific real estate exposure in their portfolios, via country-specific funds, Asia-Pacific funds or global funds with an Asia-Pacific component.

Table 1: Major Real Estate Investment Managers: 2015

-
- Brookfield : #1
 - Blackstone: #2
 - CBRE Global Investors : #3
 - Pramerica REI : #10
 - LaSalle : #13
 - CapitaLand : #15
 - Mapletree : #41
 - Gaw : #57
-

The various professional real estate associations have also played a key role in improving real estate transparency; this includes ANREV and APREA in Asia; with their mandates of supporting the unlisted and listed real estate markets. This has been supported by increased real estate information at a real estate market level by leading real estate players such as JLL, CBRE, Real Capital Analytics and GRESB. In particular, the JLL real estate transparency index (JLL, 2014) has been a key ingredient in facilitating real estate market transparency assessment.

Previous real estate market transparency research has been limited. Only Brounen et al (2007), Lieser and Groh (2011, 2014), Newell (2008) and Farzanegan and Fereidouni (2014) have assessed this key issue, with only Newell (2008) and Farzanegan and Fereidouni (2014) using the JLL real estate transparency index. Other related research has been in the broader area of real estate market maturity (e.g.: Chin et al, 2006; Ke and Sieracki, 2015; Keogh and D'Arcy, 1999); particularly focused on the emerging markets. Equivalent transparency research in the listed real estate markets has largely focused on corporate governance and disclosure issues (e.g.: An et al, 2011; Eichholtz et al, 2011; Lecomte and Ooi, 2013; Newell and Lee, 2012).

The purpose of this paper is to assess real estate transparency over 2004 – 2014 around four specific research questions:

RQ1: are the real estate markets becoming more transparent?

RQ2: are the Asia-Pacific real estate markets becoming more transparent in a regional and global context?

RQ3: which Asia-Pacific real estate markets have shown most improvement in real estate transparency?

RQ4: where does Malaysia position in the global real estate transparency landscape?

The real estate investment implications of improving real estate market transparency are also highlighted.

2.0 DATA SOURCES

JLL Real Estate Transparency Index

The JLL real estate market transparency index is produced every two years, with the 2014 index being the 8th edition (JLL, 2014). The 2014 JLL index assessed the real estate transparency for 102 real estate markets, based on the principal city in each country. The market coverage has increased significantly in subsequent years (e.g.: 2001: # = 47 markets; 2008: # = 81; 2012: # = 97), as well as several markets classified into distinct tiers (e.g.: Tier 1, 2, 3 for China, India, Russia; Tier 1, 2 for Brazil). The 2016 JLL real estate transparency index will be available in June 2016.

Real estate markets are classified into five (5) levels of transparency; high transparency, transparent, semi-transparent, low transparency and opaque. This is based on each market's real estate transparency index, scored as 1.0 (high transparency) to 5.0 (low transparency), with lower scores indicating higher transparency. Five transparency sub-indices contribute to the overall index, comprising performance measurement (25% weighting), market fundamentals (20%), governance of listed vehicles (10%), regulatory and legal (30%) and transaction process (15%). This sees 13 transparency topics assessed using 115 transparency measures (see JLL, 2014), comprising both quantitative measures (56) and qualitative measures (59), based on market data and survey information from JLL/LaSalle staff in their global network (see Table 2). These transparency measures have improved considerably over time; both in terms of number of questions and depth of questions. Importantly, real estate markets can improve their transparency level over time; e.g.: opaque to low transparency, semi-transparent to transparent.

Table 2: Profile of JLL real estate transparency index: 2004

Total number of markets: 102

Market maturity: Developed (21); Emerging (81)

Regions: Americas (20); Europe (33); **Asia-Pacific (21)**; Middle East/ North Africa (16); Sub-Sahara Africa (12)

Transparency levels:

Levels	#	%
High transparency	9	8.8%
Transparent	19	18.6%
Semi-transparent	33	32.4%
Low transparency	21	20.6%
Opaque	20	19.6%
Total	102	

Transparency category cut off-points:

High transparency: 1.00 – 1.70

Transparent: 1.71 – 2.45

Semi-transparent: 2.46 – 3.46

Low transparency: 3.47 – 3.97

Opaque: 3.98 – 5.00

Transparency sub-indices and topics:

- Performance measurement (25%): direct real estate performance indices; listed real estate securities indices; unlisted real estate fund indices; valuations
- Market fundamentals (20%): market fundamentals data for office, retail, industrial, hotel and residential sectors
- Governance of listed vehicles (10%): financial disclosure; corporate governance
- Regulatory and legal (30%): real estate tax; land use planning; building controls, enforceability of contracts; property registration; compulsory purchase; debt regulation
- Transaction process (15%): pre-sale information; bidding processes; professional standards of agents; occupier services.

Source: Author's compilation from JLL (2014)

The 2014 profile of the JLL real estate transparency index is given in Table 2. Of the 102 markets, there is extensive coverage of developed markets (21) and emerging markets (81), with Asia-Pacific accounting for 21 markets (5 developed; 16 emerging). Overall, the high transparency/transparent markets account for 27% of real estate markets, with the semi-transparent/low transparency/opaque markets accounting for 73% of real estate markets.

Table 3: Examples of real estate market transparency: 2014**High transparency:**

- #1: UK: 1.25
- #2: US: 1.34
- #3: Australia: 1.36**
- #4: New Zealand: 1.44**
- #5: France: 1.52
- #6: Canada: 1.52
- #7: Netherlands: 1.57
- #8: Ireland: 1.62
- #9: Finland: 1.69

Opaque (bottom 10):

- #93: Pakistan: 4.25
- #94: Belarus: 4.29
- #95: Angola: 4.36
- #96: Honduras: 4.41
- #97: Iraq: 4.45
- #98: Ethiopia: 4.46
- #99: Mongolia: 4.47**
- #100: Myanmar: 4.48**
- #101: Senegal: 4.52
- #102: Libya: 4.63

Source: Author's compilation from JLL (2014)

Table 3 presents the nine high transparency markets, representing the mature and developed markets across the Americas, Europe and Asia-Pacific. The UK is the most transparent global real estate market, with Asia-Pacific accounting for two of the top 9 markets (i.e.: Australia (3rd), New Zealand (4th)). Marginal differences are evident in these top end markets, with the US and Australia having previously been classified as the most transparent markets in 2012 and 2004 – 2010 respectively. Table 3 also shows the bottom ten most opaque real estate markets; largely focused on the emerging markets in Africa, Asia and Middle East/North Africa. Some countries are currently not assessed; e.g.: Syria, Sudan.

The transparency levels for the various 21 Asia-Pacific real estate markets are shown in Table 4; both by rank (Panel A) and score (Panel B). Importantly, the Asia-Pacific real estate markets figure prominently in the high transparency (2/9; 22%) and transparent (4/19; 21%) categories, with the emerging Asia-Pacific real estate markets mainly in the semi-transparent (11), low transparency (2) and opaque (2) categories.

Table 4: Asia-Pacific real estate market transparency: 2014**Panel A: By rank**

- **High transparency (2/9):** Australia (3), New Zealand (4)
- **Transparent (4/19):** Singapore (13), Hong Kong (14), Japan (26), Malaysia (27)
- **Semi-transparent (11/33):** Taiwan (29), China-Tier 1 (35), Thailand (36), Philippines (38), Indonesia (39), India-Tier 1 (40), India-Tier 2 (42), South Korea (43), China-Tier 2 (47), India-Tier 3 (50), China-Tier 3 (54)
- **Low transparency (2/21):** Vietnam (68), Macau (71)
- **Opaque (2/20):** Mongolia (99), Myanmar (100)

Panel B: By score:

- **High transparency:** Australia (1.36), New Zealand (1.44)
- **Transparent:** Singapore (1.81), Hong Kong (1.87), Japan (2.22), Malaysia (2.27)
- **Semi-transparent:** Taiwan (2.55), China-Tier 1 (2.73), Thailand (2.76), Philippines (2.84), Indonesia (2.85), India-Tier 1 (2.86), India-Tier 2 (2.90), South Korea (2.90), China-Tier 2 (3.04), India-Tier 3 (3.14), China-Tier 3 (3.26)
- **Low transparency:** Vietnam (3.59), Macau (3.65)
- **Opaque:** Mongolia (4.47), Myanmar (4.48)

Source: Author's compilation from JLL (2014)

As such, the JLL real estate transparency index is the global benchmark for real estate transparency across over 100 real estate markets. The JLL real estate transparency index is assessed for 102 markets over 2004 – 2014 to examine the issue of changing real estate transparency in an Asia-Pacific and global context.

3.0 REAL ESTATE TRANSPARENCY ANALYSIS

Regional Analysis

Table 5 (Panel A) presents the average transparency scores by market maturity and regions. Across the 102 real estate markets, the average transparency was 3.08, being mid-range in the semi-transparent category. Clear differences in transparency were evident for the developed markets (1.75; top end of transparent) and the emerging markets (3.42; bottom end of semi-transparent). With a transparency spread of 1.67 between the developed and emerging markets, this basically represents a difference of one transparency category. Differences are also evident across the regions. In particular, Asia-Pacific had the second highest level of transparency (2.81; mid-range of semi-transparent), only exceeded by Europe (2.50; top end of semi-transparent), with both Europe and Asia-Pacific having higher average transparency than the global average transparency (3.08).

Differences were also evident between the developed and emerging markets in the three major regions (see Table 5: Panel B). This saw the developed markets in Asia-Pacific with an average transparency of 1.74 (top end of transparent) and the emerging markets in Asia-Pacific with an average transparency of 3.14 (mid-range of semi-transparent). On a regional basis, this saw the developed versus emerging market transparency spread for Asia-Pacific (1.40) as being the second smallest spread compared to the spreads for Europe (1.21) and Americas (2.13).

The emerging markets in Asia-Pacific (3.14) were also the second most transparent amongst the emerging markets in the three regions, compared with Europe (3.01) and Americas (3.56). This highlights the levels of transparency seen in the emerging markets in the Asia-Pacific; particularly as institutional investors seek increased exposure to the global emerging real estate markets for enhanced returns and real estate portfolio diversification benefits.

Table 5: Sub-Category Real Estate Transparency Analysis

Panel A: Market maturity and region

Category	Average transparency
All	3.08
Developed	1.75
Emerging	3.42
Americas	3.35
Asia-Pacific	2.81
Europe	2.50
MENA	3.81
Sub-Sahara Africa	3.72

Panel B: Region x market maturity

Category	Average transparency	Spread (Dev. vs Emerg.)
Asia-Pacific:		
Developed (# = 5)	1.74	1.40
Emerging (# = 16)	3.14	
Europe:		
Developed (# = 10)	1.80	1.21
Emerging (# = 23)	3.01	
Americas		
Developed (# = 2)	1.43	2.13
Emerging (# = 18)	3.56	

Source: Author's compilation from JLL (2014)

Improvements in real estate transparency: 2012 – 2014

Table 6 (Panel A) presents the top improvers in real estate transparency in the Asia-Pacific over 2012 – 2014. India-Tier 1 and Tier 2 were the main improvers in real estate transparency, with no top 10 Asia-Pacific real estate markets improving transparency categories. It is important to note that the high transparency/transparent Asia-Pacific real estate markets such as Australia, New Zealand, Singapore, Hong Kong and Japan are already mature, developed real estate markets and improvements in their real estate transparency are expected to be marginal; particularly compared to the scope for improvements in the transparency of the emerging real estate markets in the Asia-Pacific.

Table 6: Asia-Pacific and Global Real Estate Transparency: Top Improvers: 2012-2014**Panel A: Asia-Pacific**

- #1: India-Tier 1: 3.07 → 2.86
- #2: India-Tier 2: 3.08 → 2.90
- #2: Thailand: 2.94 → 2.76
- #4: Vietnam: 3.76 → 3.59
- #4: Japan: 2.39 → 2.22
- #6: China-Tier 1: 2.83 → 2.73
- #7: Indonesia: 2.92 → 2.85

Panel B: Global

- #1: Nigeria: 4.58 → 4.03
- #2: Peru*: 3.95 → 3.44
- #2: Colombia: 4.05 → 3.54
- #4: Qatar*: 3.82 → 3.37
- #5: Zambia: 3.93 → 3.49
- #6: Ghana: 4.41 → 3.98
- #7: Romania: 2.96 → 2.56
- #8: Portugal: 2.54 → 2.18
- #9: Jordan: 3.97 → 3.62
- #10: Ireland*: 1.96 → 1.62

Source: Author's compilation from JLL (2014)

*: improved real estate transparency level

At a global level for the top 10 improvers in real estate transparency over 2012 – 2014, the Asia-Pacific markets figure less prominently (see Table 6: Panel B). No Asia-Pacific markets made the top 10 improvers, with the main improvers being the sub-Sahara Africa countries (e.g.: Nigeria, Zambia, Ghana) and several Latin-American countries (e.g.: Peru, Colombia).

These markets were mainly in the opaque and low transparency categories, reflecting the significant recent real estate developments in these markets. In two cases, they were also able to improve their transparency categories; i.e. Peru (low transparency to semi-transparent) and Qatar (low transparency to semi-transparent).

Improvements in Real Estate Transparency: 2008 – 2014

Table 7 (Panel A) presents the top improvers in real estate transparency in the Asia-Pacific since the GFC over 2008 – 2014. The main improvers over this 6-year period were China, Vietnam and Indonesia, as well as China – Tier 3, Indonesia, China-Tier 2 and India-Tier 3 improving their transparency category.

Table 7: Asia-Pacific and Global Real Estate Transparency: Top Improvers: 2008-2014

Panel A: Asia Pacific

- #1: China-Tier 3*: 3.97 → 3.26
- #2: Vietnam: 4.29 → 3.59
- #3: Indonesia*: 3.51 → 2.85
- #4: China-Tier 2*: 3.68 → 3.04
- #5: China-Tier 1: 3.33 → 2.73
- #6: Taiwan: 3.07 → 2.55
- #7: India-Tier 3*: 3.65 → 3.14
- #8: India-Tier 2: 3.38 → 2.90
- #9: India-Tier 1: 3.34 → 2.86

Panel B: Global

- #1: Turkey*: 3.75 → 2.72
- #2: China-Tier 3*: 3.97 → 3.26**
- #3: Vietnam: 4.29 → 3.59**
- #4: Indonesia*: 3.51 → 2.85**
- #5: China-Tier 2*: 3.68 → 3.04**
- #6: China-Tier 1: 3.33 → 2.73**
- #7: Algeria: 4.76 → 4.20
- #8: Taiwan: 3.07 → 2.55**
- #9: India-Tier 3*: 3.65 → 3.14**
- #10: Brazil*: 2.92 → 2.44, **India-Tier 2: 3.38 → 2.90, India-Tier 1: 3.34 → 2.86**

Source: Author's compilation from JLL (2014)

*: improved real estate transparency level

At a global level of the top 10 improvers in real estate transparency over 2008 – 2014, the Asia-Pacific real estate markets figured prominently (see Table 7: Panel B), being four of the top five improvers. The main improvers in real estate transparency were the Asian emerging markets (e.g.: China, Vietnam, Indonesia), reflecting the significant enhancements in these Asian markets since the GFC. In four of the top 7 Asia-Pacific improvers, they were also able to improve their transparency category; e.g.: China-Tier 3 (low transparency to semi-transparent), Indonesia (low transparency to semi-transparent).

Improvements in Real Estate Transparency: 2004 – 2014

For the 10-year period of 2004 – 2014, Table 8 (Panel A) presents the top 10 improvers in real estate transparency in the Asia-Pacific. Indonesia (1st) and India (2nd) were the top improvers; in both cases, also improving their transparency categories. Importantly, each of the top five Asia-Pacific improvers were all able to improve their transparency categories.

In a global context over 2004 – 2014, Table 8 (Panel B) presents the top improvers in real estate transparency over the 10-year period. Importantly, from an Asia-Pacific perspective, Indonesia was 3rd in this global context, with the Asia-Pacific having 4 of top 11 improvers in real estate transparency over this 10-year period. All of the top improvers were able to improve their transparency category; in some cases by two transparency categories e.g.: Romania (opaque to semi-transparent), Turkey (opaque to semi-transparent) and Brazil (low transparency to transparent). The top improvers were a diverse range of countries, covering Eastern Europe, Asia, Americas and MENA.

Importantly, over these 2-year, 6-year and 10-year timeframes, the Asia-Pacific countries were seen to be amongst the top improvers; often being in the top three in this global context for improvements for real estate market transparency. In addition to the high levels of real estate transparency seen in the mature developed real estate markets in the Asia-Pacific (e.g.: Australia, New Zealand, Singapore, Japan and Hong Kong), this presents a positive context for institutional investors seeking to include both the developed and emerging markets in the Asia-Pacific in their significant real estate portfolios.

Table 8: Asia-Pacific and Global Real Estate Transparency: Top Improvers: 2004-2014

Panel A: Asia-Pacific

- #1: Indonesia*: 4.11 → 2.85
- #2: India*: 3.90 → 2.86
- #3: Vietnam*: 4.60 → 3.59
- #4: China*: 3.71 → 2.73
- #5: Japan*: 3.08 → 2.22
- #6: Thailand: 3.44 → 2.76
- #7: Philippines: 3.43 → 2.84
- #8: Taiwan: 3.10 → 2.55
- #9: South Korea: 3.36 → 2.90
- #10: Malaysia: 2.30 → 2.27

Panel B: Global

- #1: Romania**: 4.71 → 2.56
- #2: Turkey**: 4.50 → 2.72
- #3: Indonesia*: 4.11 → 2.85**
- #4: Brazil**: 3.62 → 2.44
- #5: Abu Dhabi*: 4.31 → 3.20
- #6: Poland*: 3.12 → 2.02
- #6: Saudi Arabia*: 4.67 → 3.57
- #8: India*: 3.90 → 2.86**
- #9: Vietnam*: 4.60 → 3.59**
- #10: Egypt*: 4.67 → 3.67
- #11: China*: 3.71 → 2.73**

Source: Author's compilation from JLL (2014)

*, **: improved real estate transparency level

Is Real Estate Market Transparency Improving?

To examine this key research question, this issue was assessed in the short-term (2012 – 2014) and long term (2004 – 2014).

Over the 2 year period of 2012 – 2014, 96 real estate markets were assessed and 72% (69/96 markets) improved their real estate transparency. On a regional basis, Asia-Pacific was the 2nd best region for improvement, with 79% (15/19 markets) improving their real estate transparency. Asia-Pacific was only exceeded by Sub-Sahara Africa (89%; 8/9 markets), with less improvement seen in Europe (73%; 24/33 markets) and Americas (55%; 11/20 markets).

Over the 10-year period of 2004 – 2014, careful consideration needs to be given to the real estate markets selected to ensure an unbiased comparison. While the number of real estate markets has increased from 51 in 2004 to 102 in 2014, it is important to only consider those real estate markets that were assessed each two years. This is due to the additional markets added in each two years by JLL as typically being emerging markets in the low transparency and opaque categories, which has the effect of artificially dragging down the average transparency scores. Thus using these “benchmark” countries across all years ensures a consistent comparison. This sees 49 real estate markets considered in this 10-year transparency analysis, comprising Europe (23 markets), Asia-Pacific (14), Americas (8), MENA (3) and Sub-Sahara Africa (1).

Table 9 presents the average real estate transparency scores over 2004 – 2014 for the three major regions of Europe, Asia-Pacific and Americas. Overall, globally, real estate transparency has improved from 2.81 (mid-range of semi-transparent) to 2.37 (bottom end of transparent) over this 10-year period; being an overall 16% improvement. At a regional level, the Asia-Pacific improved from an average real estate transparency score of 2.89 (mid-range of semi-transparent) to 2.43 (bottom end of transparent); an improvement of 16%. This sees Asia-Pacific as the most improved region in real estate transparency, exceeding both Europe (2.34 to 2.05; 12% improvement) and Americas (3.06 to 2.76; 10% improvement). This strong Asia-Pacific performance reflects the significant growth and maturity in the Asian real estate markets in the last ten years, reflected in the establishment of significant REIT markets, improved regulatory environments, active role by institutional investors, increased real estate market information and strong leadership roles by ANREV and APREA.

Table 9: Is Real Estate Transparency Improving?

Region	2004	2006	2008	2010	2012	2014	Improvement 2004 - 2014	Percentage improvement 2004 - 2014
All	2.81	2.58	2.40	2.32	2.45	2.37	+0.44	16%
Asia-Pacific	2.89	2.69	2.66	2.61	2.51	2.43	+0.46 (#1)	16% (#1)
Europe	2.34	2.26	2.00	1.85	2.14	2.05	+0.29 (#3)	12% (#2)
Americas	3.06	2.83	2.75	2.73	2.83	2.76	+0.30 (#2)	10% (#3)

Source: Author's compilation from JLL (2014)

4.0 REAL ESTATE INVESTMENT IMPLICATIONS

This paper has clearly highlighted the improved real estate transparency seen in the global real estate markets in recent years. In particular, it has highlighted the strong evidence of improved real estate transparency in the Asia-Pacific real estate markets, as evidenced by some of the Asia-Pacific emerging markets being amongst the top improvers in real estate transparency in a global context; often seeing Asia-Pacific countries improve their real estate transparency category over this 10-year period.

With real estate transparency being a critical factor considered by institutional investors in their strategic real estate investment decision-making, the high levels of real estate transparency in the developed markets in the Asia-Pacific and the significant improvements in real estate transparency in the emerging markets in the Asia-Pacific set a very positive context for Asia-Pacific real estate investment by institutional investors. In particular, for those institutional investors seeking Asia-Pacific real estate exposure as part of their regional and global real estate mandates.

Importantly, going forward, there are opportunities for further improvements in real estate transparency and improved levels of transparency categories for several Asia-Pacific real estate markets. In the next JLL real estate transparency index report (to be released June 2016), there is the potential for upgrades in real estate transparency categories in the following Asia-Pacific real estate markets:

- Transparent → High transparency: Singapore, Hong Kong
- Semi-transparent → Transparent: Taiwan, China-Tier 1
- Low transparency → Semi-transparent: Vietnam

In addition, other global real estate markets with the potential to see upgrades in their real estate transparency categories in 2016 are:

- Transparent → High transparency: Switzerland, Sweden, Germany
- Semi-transparent → Transparent: Romania
- Low transparency → Semi-transparent: Slovenia, Zambia, Colombia
- Opaque → Low transparency: Ghana, Nigeria;

These cover real estate markets in Europe, Sub-Sahara Africa and Latin America.

Overall, these improvements in real estate transparency in the Asia-Pacific real estate markets and global markets have facilitated more informed real estate investment decision-making by institutional investors. Continued improvements in real estate transparency in the global markets are also expected to further support this strategic real estate investment process.

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MAJOR INFRASTRUCTURE INNOVATION AND THE PUBLIC RESPONSE: AIRCRAFT NOISE AND RESIDENTIAL PROPERTY MARKETS: BRISBANE AND GOLD COAST AIRPORTS

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ABSTRACT

Innovation and the expansion of major infrastructure are not always welcomed by the public. This is especially the case if this innovation and infrastructure is perceived to have a negative impact on the community that has a direct or indirect interest in the new development or infrastructure. All new innovation and infrastructure projects in Australia are most often challenged by individuals and interest groups for the potential impact that the new development may have on the environment, health of the community and most often the value of their property.

Over the past ten years in Australia there has been an increasing number of domestic and international air travellers and the subsequent increase in aircraft movements. This substantial increase in the number of flights and passengers has resulted in a number of Australian major airports developing additional runways and flight paths to meet these increased traveller and business demands. Two examples of this trend is the development of a second parallel runway at the Brisbane Airport and a new Instrument Landing System flight path at the Gold Coast Airport. Both these developments have attracted considerable public backlash and complaints to both the airport management and federal government departments, with the majority of these complaints based on the potential loss in value for houses that will be under the new flight paths or subject to additional or new aircraft noise.

This paper reviews the residential property markets across a range of suburbs in Brisbane, Gold Coast and Northern New South Wales that are under existing flight paths, adjoining existing flight paths or not affected by flight paths to determine the long term impact on residential property investment performance. This is the first major longitudinal study carried out in Australia specifically addressing the impact of aircraft noise on residential property investment performance based on prices and rents. The study covers over 50 residential suburbs over the period 1988 to 2014.

Keywords: *Airports, Infrastructure, Aircraft Noise, Property Values, Residential Property, Property Stigma*

1.0 INTRODUCTION

The impact of aircraft noise on surrounding property values has been the subject of much media attention and many international academic studies. Academic and media reports state that the impact of aircraft noise may reduce property values by up to 20%. Although many authors recognize that aircraft noise is one factor that is balanced against others in the decision to purchase a home, it is also common for locations with a high level of aircraft noise to be close to the CBD (Central Business District), transport, schools or other social infrastructure, factors which can add value to residential property depending on the individual value drivers of the purchasers.

Many studies adopting the Hedonic Price Models (HPM) have shown a reduction in price for houses located under flight paths or subject to aircraft noise; however, these studies have not considered if this possible lower initial price also results in lower capital growth in the longer term. This study has been undertaken to determine if the actual average annual investment performance (capital returns) of aircraft noise affected property is similar to the investment performance of houses in non or less affected locations over extended time periods or if any initial decrease in property prices when a residential property becomes subject to aircraft noise continues to be reflected in the ongoing capital return and volatility over time.

2.0 LITERATURE REVIEW

Literature on the impact of aircraft noise on communities can be categorised into the following areas:

- Impact on physical and mental health issues
- Stress levels
- Sleep deprivation
- Cognitive learning impacts on children
- Property impact
- Environmental impacts

The literature in relation to the negative impact of aircraft and transport noise on health, stress, the environment and learning is extensive (for example Brunelle-Yeung et al, 2014; Stansfeld et al, 2011 and 2005; Mahashabde et al, 2011; Eriksson et al, 2007; Upham et al, 2003; Hygge et al, 2002; Franssen et al, 2002). Additional studies have also identified the type and reason for aircraft noise complaints including factors such as number of aircraft movements, type of aircraft and deviation from established flight paths (Hume et al. 2003).

The impact of aircraft noise on surrounding property values has been the subject of much media attention and many international academic studies. Academic and media reports state that the impact of aircraft noise may reduce property value by up to 20%. Although many authors recognize that aircraft noise is one factor that is balanced against others in the decision to purchase a home, it is also common for locations with a high level of aircraft noise to be close to the CBD, transport, schools or other social infrastructure, which can add value to residential property.

A review of literature showed that the majority of academic studies in this area have been undertaken in the USA or The Netherlands with significantly less attention in the UK and Australia. Predominantly these studies have been based on econometric modeling using

hedonic price models, with the pre 1980 studies showing price reductions for aircraft noise impact from 2 to 24% (Mieszkowski and Saper, 1978; Gautrin, 1975). Nelson (1980) also lists the various authors and their studies to arrive at the above statistics.

Later studies from 1990 to 2000 also were HPM based and generally recorded reductions in prices for houses impacted by aircraft noise. Most commonly these later studies also found that there was some negative impact on residential properties. However, there were also studies that should the close proximity to an airport can actually result in higher residential house prices, but aircraft noise is not the only factor that determines residential property prices. Also the distance from the airport resulted in less impact, with for commercial and industrial property the impact was not significant compared to residential property (Pennington et al, 1990; Frankel, 1991; Collins and Evans, 1994; Levesque, 1994; Feitelson, 1996; Schipper, 1996; Kaufman and Espey, 1997; Johnson and Button, 1997; Schipper et al, 1998; Tomkins et al, 1998; Little V Dept Natural Resource QLD, 1999) NITRL.

Since 2000 the aircraft noise studies have also been Hedonic Price Model basis and have shown reductions in the most affected properties of 11 to 16%, with a lower impact on residential property rents (Morrell & Lu, 2000; Bell, 2001; Burns, 2001; WAPC, 2004; Theebe, 2004; McMillen, 2004; Praag & Baarsma, 2005; Baranzini & Ramirez, 2014; Lazie & Golaszewski, 2006).

Overall these academic studies showed the impact of aircraft noise on residential property was only evident beyond 60dB and had no impact up to this level.

All these studies have focussed on the potential price difference between residential properties affected or not affected by aircraft noise or airport operations. None of these studies has actually looked at the actual investment performance of aircraft noise affected property over an extended time period. A deficiency of the majority of these studies was the limited time period over which they were undertaken of 12 or 24 months, limited transaction data and the difficulty in isolating aircraft noise as the single influencing factor in resulting property values.

This study considers the issue of the impact of aircraft noise on the value of residential property performance in two South east Queensland locations; Brisbane and the Gold Coast in Brisbane, and is more comprehensive and longitudinally significant than previous international studies. The study is specific to Brisbane and covers one of the most extensive time periods for a study of this type, from the opening of the current Brisbane airport in 1988 through to December 2013. The data for this project comprised all residential house sales for 36 suburbs.

3.0 BRISBANE STUDY LOCATIONS

A total of 36 Brisbane suburbs were identified for the study based on the number of noise complaints to Air Services Australia and reported on their website. The suburbs were grouped according to high level of noise complaints (HNC), moderate levels of noise complaints (MNC) and suburbs that have not recorded any noise complaints or very limited occasional noise complaints over the past two years (NNC). The high noise complaint suburbs were located on the southern flight paths and within 10 kms from the existing main runway at Brisbane airport. The moderate MNC suburbs covered a range of locations to the south, west, north and east of the Brisbane airport but all inner ring or middle ring Brisbane suburbs and also within a 5-10km radius from the Brisbane airport. The NNC suburbs were also geographically diverse including inner ring, middle and outer middle ring suburbs of Brisbane.

Table 1: Brisbane Suburb Comparison

High Noise Complaints	Low Noise complaints	No/minimal noise complaints
Morningside	Gordon Park	Annerley
Coorparoo	Northgate	Mitchelton
Camp hill	Bulimba	New Farm
Cannon Hill	Mount Gravatt East	Mansfield
Tarragindi	Balmoral	Virginia
Seven Hills	Clayfield	Chelmer
Tingalpa	Ashgrove	Sherwood
Norman Park	Chapel Hill	Jindalee
Holland Park West	Wynnum	Forest Lake
The Gap	Fairfield	Kenmore
Murarrie	Hawthorne	Graceville
Belmont	Ascot	Hamilton

This research study is based on the analysis of residential property sale transactions for the 26 years from 1988 to 2013 inclusive across a range of Brisbane suburbs with varying exposure to aircraft movements and noise. Table 1 provides the classification and location of the suburbs analysed in the study.

Suburbs were classified initially based on the number of aircraft noise complaints (contacts and clients) recorded by Air Services Australia over the past 5 years. These suburbs were identified as High Noise Complaints (HNC); Moderate Noise Complaints (MNC) and Minimal/No Noise Complaints (NNC) based on the data and mapping provided in the Brisbane Airport Corporation Current and Future Flight Path and Noise Information Booklet. All suburbs analysed in the study were inner ring to outer middle ring suburbs of Brisbane and were located within a 14km radius from the Brisbane Airport existing runway (southern end). In total over 113,000 sale transactions were analysed to compare the residential property investment performance of these varying aircraft noise affected suburbs, based on median and average house prices, average annual capital returns, return volatility and the correlation between annual median and average house prices.

4.0 GOLD COAST STUDY LOCATIONS

18 suburbs were selected for the Gold Coast Airport study. Across the three aircraft noise complaint classifications the suburbs include a range of socio-economic status suburbs, with each of the classification having a mix of lower middle, higher middle and high socio-economic suburbs. Table 2 shows a breakdown of the total suburbs based on socio-economic status (median price range).

Table 2: Suburb and Study Area Location Classifications

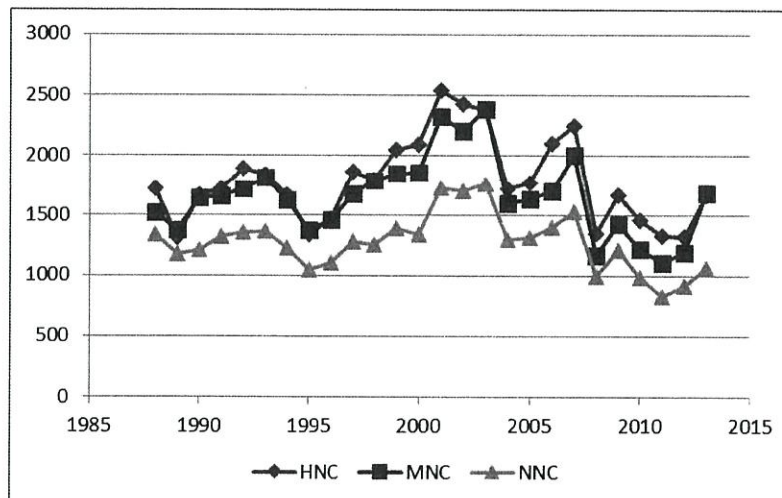
HNC	MNC	NNC	Southern Flight path	Northern Flight Path
Banora Point	Palm Beach	Labrador	Banora Point	Tugun
Fingal head	Tweed Heads	Southport	Fingal Head	Currumbin
Tugun	Tallebudgera	Burleigh Heads	Tweed Heads	Palm Beach
Currumbin	Miami	Bundell/ Sorrento	Tweed Heads South	Burleigh Heads
Kingscliff	Elanora	Molendir	Kingscliff	Miami
Terranora	Tweed Heads South	Ashmore	Terranora	Currumbin Waters
-	-	-	Chinderah	Coolangatta

This table confirms that the three noise complaint suburb classifications cover a range of socio-economic suburbs, with no aircraft noise classification being over represented by either high or low value suburbs to distort the study results.

5.0 RESULTS

5.1 BRISBANE: NOISE COMPLAINT SUBURBS

Figure 1 shows the volume of house sale transactions for the HNC, MNC and NNC suburbs for the period 1988 to 2013. The numbers of sales for the HNC and MNC locations were higher than the NNC suburbs, with the HNC suburbs having a high of 2,539 sales in 2001 and a low of 1,168 sales in 2008; however, this was expected as the majority of suburbs in the HNC classification locations are in the middle socio-economic locations of Brisbane, which traditionally have a higher rate of sales compared to the higher socio-economic suburbs of Brisbane.

**Figure 1:** Sales Volume Comparison: 1988-2013

The interesting findings from these suburb comparisons is the fact that despite the variation in the number of sales per annum, the actual trend in sales has been consistent across all the noise complaint areas, especially for the HNC and MNC suburbs, with all classifications showing increasing and decreasing rates of sales over each year of the 26 year period. This is also confirmed in Table 3, which shows the correlation between the numbers of annual sales across the three suburb classifications.

Table 3: Correlation Analysis: Sales Volume: Noise Complaint Comparison: 1988-2013

	<i>HNC</i>	<i>MNC</i>	<i>NNC</i>
HNC	1.00		
MNC	*0.90	1.00	
NNC	*0.89	*0.91	1.00

*Significant at the 5% Level

This table shows the correlation co- efficients are very highly positively correlated at $r = 0.90$ (HNC, MNC), 0.89 (HNC, NNC) and 0.91 (MNC, NNC). The very high significance of these correlations are evidenced by the fact that a significant co-efficient at the 5% level is $r = +/-0.37$. These results show that the location of a suburb under a flight path has no impact on the volume of residential house sales at any point in time compared to suburbs that have some or no exposure to flight paths and aircraft noise. Ownership of a property under a flight path and subject to aircraft noise in Brisbane does not affect the ability to sell that house compared to moderate or non-affected houses.

Figure 2 shows the annual trend in median house prices for the 36 suburbs from 1988 to 2013. From the period 1988 to 2000, there was limited movement in median house prices across all the 36 suburbs in Brisbane, with the HNC, MNC, NNC and Brisbane LGA median house prices increasing at a similar rate, with all classifications showing 100% increases in median prices over this 13 year period.

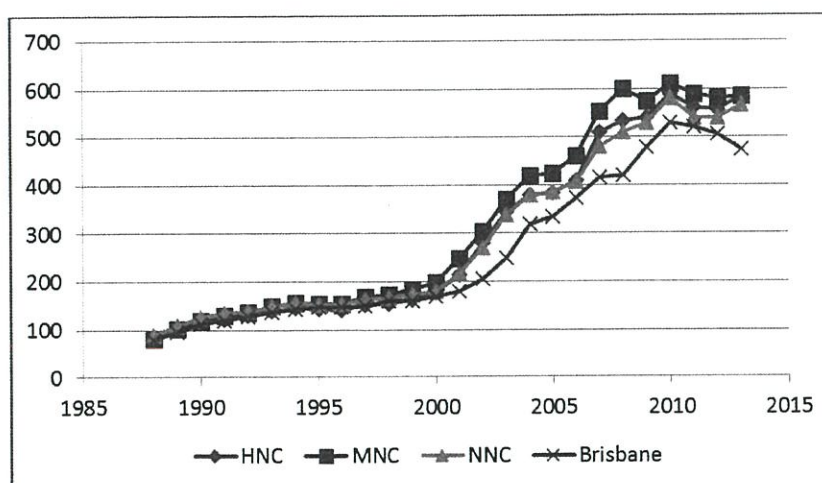


Figure 2: Median House Price: Noise Complaint Comparison: 1988-2013

However, from the year 2000, there has been a significant difference in the median price of the suburbs in the HNC, MNC and NNC suburbs compared to the Brisbane median house price. This is due to the fact that over the period 2000 to 2013 much of the growth in housing supply in Brisbane has been in the outer middle and outer Brisbane suburbs, with limited increases in housing supply in the suburbs in the inner and inner middle ring suburbs.

The other major finding from this analysis of the median house prices in the suburbs that are subject to high to moderate aircraft noise is that the trend in house prices has been very similar and the higher median house prices in the MNC suburbs is based more on the fact that half the suburbs in this noise classification are high socio-economic suburbs as described above.

This figure also shows that the trend in price movement from year to year has been virtually identical for the suburbs in the HNC classification compared to the suburbs in the NNC suburbs. This indicates that residential property prices in HNC suburbs of Brisbane are not adversely affected by aircraft noise compared to locations that have less or minimal aircraft noise issues and in a number of years the more convenient location of these suburbs to the Brisbane CBD and services has resulted in the median price being higher than non-affected locations.

Table 4 also supports the strong correlation between house price movements across the suburbs in the study. The annual change in median house prices between houses in the HNC to houses in MNC and NNC suburbs are highly positively correlated with correlation coefficients of $r = 0.95$ (HNC,AMNC) and $r = 0.96$ (HNC, NNC). These extremely high correlation coefficients state that over the 26 year time period the movement in house prices across the suburbs in the high, moderate and no aircraft noise complaint suburbs have been identical, regardless if the suburb is located close to the airport or under the various flight paths for the current Brisbane airport runway.

Table 4: Correlation: Suburb Comparison: Median Price: 1988-2013

	<i>HNC</i>	<i>MNC</i>	<i>NNC</i>	<i>Brisbane</i>
HNC	1.00			
MNC	*0.95	1.00		
NNC	*0.96	*0.93	1.00	
Brisbane	*0.62	*0.62	*0.69	1.00

*Significant at the 5% level

The investment performance of the HNC, MNC and NNC suburbs and the Brisbane Median house price are shown in Table 5. This Table shows that over the 26 year period the average annual capital return based on median house prices for HNC suburbs under the southern flight path has been 8.66%. This capital return has been greater than the average annual capital return for MNC suburbs (8.52%) and NNC suburbs (7.93%). All the HNC, MNC and NNC suburbs returned a higher average annual capital return compared to the Brisbane median capital return of 7.72%

Table 5: Capital Return and Investment Performance: Median Price 1988-2013

Location	Average Annual Capital Return (%)	Average Annual Volatility (%)	Risk return Ratio
High Noise	8.66	9.49	1.09
Moderate Noise	8.52	8.87	1.04
No/Low Noise	7.93	8.47	1.07
Brisbane LGA	7.72	8.35	1.08

The HNC suburbs also had the highest volatility at 9.49%, with the NNC suburbs having a very similar volatility to the Brisbane median volatility and the MNC suburb volatility. On a risk return basis based on median price change over the study period, each of the noise affected and non-noise affected suburbs have a very similar risk return ratio ranging from 1.04 (MNC), 1.07 (NNC), 1.08 (Brisbane) and 1.09 for HNC suburbs. This again shows that the investment performance and risk for houses in high aircraft noise suburbs is no different to the investment performance of the moderate and no noise suburbs with similar location characteristics.

5.2 SUBURB COMPARISON: HOUSES (HIGH NOISE COMPLAINT SUBURBS V MIDDLE SOCIO ECONOMIC SUBURBS)

The suburb comparisons above are based on levels of noise complaints with the HNC suburbs comprising the middle socio-economic suburbs on the southern flight path ranging from 2 to 7 kms from the current Brisbane airport runway. The MNC and LNC suburbs comprised a mixture of upper low, middle and high socio-economic suburbs. To compare the price difference between noise affected and moderate to non-noise affected suburbs, the 12 HNC suburbs were matched with 12 middle socio-economic suburbs in the MNC and LNC categories. This has allowed a comparison of median and average house prices for affected and non-affected suburbs to be assessed to determine average price differences for the period 1990 to 2013. If the variation in price is similar in each case than the main determinant of value in these matched socio-economic suburbs would be locational based rather than actual exposure to aircraft noise.

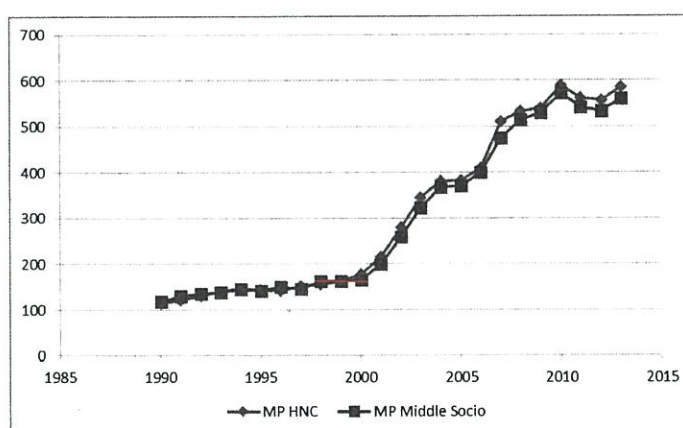


Figure 3: Houses Median Price: High Noise Complaint Suburbs v Middle Socio Economic Suburbs: 1988-2013

Figure 3 shows the trend in median prices movement for the period 1988 to 2013 based on the comparison of middle socio-economic suburbs in the HNC suburbs to the middle socio-economic suburbs in the MNC and NNC locations. This figure shows that from the period 1988 to 2000, the annual trend in the movement of median house prices for the HNC suburbs was virtually the same for middle socio economic suburbs in inner and middle ring locations of Brisbane, as well as the median price for houses in Brisbane. From 2000 to 2010 the median house price for the HNC and middle socio-economic suburbs have been higher but followed a similar trend to the Brisbane median house price. While the median house price in Brisbane showed a decline from 2010, this was not the case for the HNC suburbs from 2012 to 2013. This figure also shows that the change in annual median prices for HNC suburbs has been very similar to the middle socio-economic suburbs in the MNC and NNC locations and over a number of years has actually been higher.

Table 6: Correlation Analysis: Median and Average Prices 1988-2013

	<i>MP HNC</i>	<i>MP Middle Socio</i>	<i>Brisbane</i>
MP HNC	1.00		
MP Middle Socio	*0.86	1.00	
Brisbane	*0.62	*0.67	1.00

*Significant at the 5% level

Again, the very highly positive significant correlation between the movement in house prices in the HNC suburbs to middle socio-economic suburbs in Brisbane is confirmed in Table 7, with the correlation coefficient for HNC v Middle socio-economic $r = 0.86$ (significant coefficient at 5% level $r = 0.37$). The correlation between the HNC and middle socio-economic suburbs is stronger than the correlation with the Brisbane median house price.

Tables 7 again shows that over the full 26 year period of this study both the median house price in the southern flight path suburbs subject to the highest number of aircraft noise complaints and under the main southern flight path has shown a higher average annual capital return compared to middle socio-economic suburbs and the overall Brisbane housing market, with very similar volatility and risk/return ratios.

Table 7: Capital Return and Investment Performance: Median Price 1988-2013:
HNC v Middle Socio-economic Suburbs

Location	Average Annual Capital Return (%)	Average Annual Volatility (%)	Risk return Ratio
High Noise Suburbs	8.66	9.49	1.09
Middle socio Economic Suburbs	8.43	9.54	1.13
Brisbane LGA	7.72	8.35	1.08

With this very similar trend in the movement in annual median house prices between the HNC suburbs and middle socio-economic suburbs in Brisbane, the percentage difference in the median house price for each of the 26 years are shown in Table 8. From the median house price results, there have been 4 years during the period 1988-1992 where the median price for middle socio-economic suburb houses were higher than houses in the HNC suburbs, with the HNC suburbs recording a higher median price for each of the years from 1993 to 2013.

Table 8: Annual % Variation between HNC Suburbs and
Middle Socio-Economic
Suburbs: Median Price and Average Price

Year	Median Price Comparison (%)
1988	-1.23
1989	3.06
1990	-2.54
1991	-6.92
1992	-3.70
1993	1.45
1994	0.69
1995	2.13
1996	-6.00
1997	4.83
1998	-4.91
1999	0.00
2000	7.27
2001	7.50
2002	7.69
2003	6.81
2004	3.54
2005	3.51
2006	2.50
2007	7.37
2008	3.70
2009	1.89
2010	3.15
2011	3.88
2012	4.70
2013	4.46
Average Annual Difference	+2.11

5.3 GOLD COAST

The initial analysis compares the movement in house and unit prices based on the number of noise complaints received across a range of suburbs. Based on Air Services Australia data 18 suburbs were selected for analysis, with six suburbs classified as High Noise Complaint (HNC), six Moderate noise Complaints (MNC) and six suburbs with Minimal or No Noise Complaints (NNC). These suburbs are identified in Table 1. The majority of the HNC suburbs are located on the southern flight path and are predominately in NSW, with the MNC and NNC suburbs being located to the north and North West of the airport and are predominately Gold Coast suburbs.

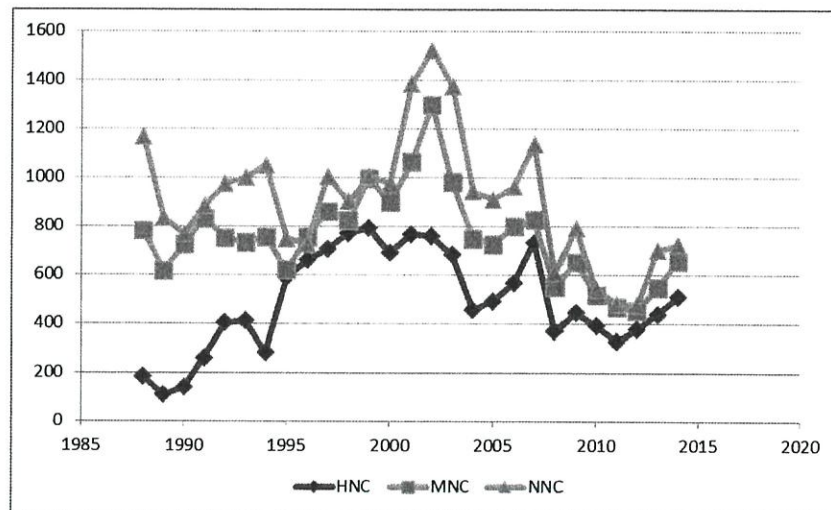


Figure 4: Noise Complaint Comparison: House Sale Transactions: 1988-2014

Figure 4 shows the movement in annual sales volume across the three suburb classifications for the period 1988 to 2014. The lower sales volume for the HNC suburbs from 1988 to 1995 reflects the increasing development of Kingscliff, with the suburbs in the MNC and NNC locations being more developed. Overall the suburbs in the HNC classification have a smaller housing stock (e.g. Fingal Head and Banora Pt) compared to suburbs in the MNC and NNC locations and this is reflected in the annual sales volume being lower. This figure also shows that although the sales volume for the HNC suburbs has been lower than the MNC and NNC suburbs the actual trend in annual sales volume has been relatively similar for the period 1995 to 2014, with sales volume peaks in 2002 and 2007 and a general decline in sales volume from 2009 to 2012. Based on the trend in the number of annual sales; suburbs with high levels of aircraft noise complaints have similar percentages of house sales compared to less affected locations.

Although the actual number of house sales per year varied between the HNC suburbs and the MNC and NNC suburbs, Figure 5 shows that the trend in median house price movement across the three suburb locations has been very similar over the 27-year period.

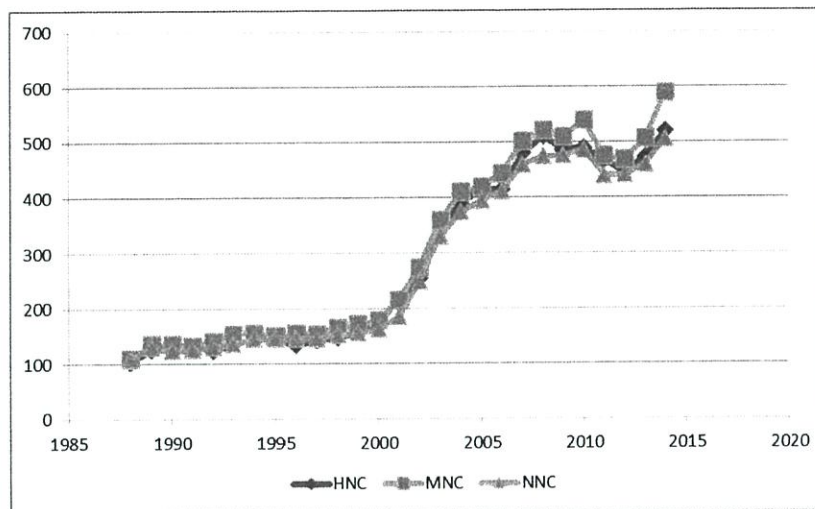


Figure 5: Median House Prices: Noise Complaint Comparison: 1988-2014

From 1988 to 2000, house price growth across all three aircraft noise classifications was very similar and relatively slow increasing from \$100,000 to \$110,000 in 1988 to \$162,000 for NNC suburbs; \$178,000 for MNC suburbs and \$175,000 for HNC suburbs in 2000. From 2001 all three aircraft noise classifications increased significantly in median house prices, with the HNC and MNC suburbs outperforming the NNC suburbs. This was also a period of increasing aircraft movements, with the introduction of foreign carriers to the Gold Coast and increased domestic air traffic.

This similarity in annual movement in median house prices is also reflected in Table 9. This table shows the correlation in median house price movements for the period 1988 to 2014. Based on the 27 year time period a significant positive correlation at the 5% level in annual house price movement would be $r = 0.37$. Table 3 shows that based on the Gold coast residential property market prices there has been a very strong positive correlation between HNC suburbs and MNC suburbs ($r = 0.84$) and HNC and NNC suburbs ($r = 0.84$).

This confirms that over the past 27 years the actual movement in median house prices across a range of Gold Coast located suburbs, with varying exposure to aircraft noise, has been virtually identical.

Table 9: Median House Price Correlation Analysis: Noise Complaint Suburbs: 1988 - 2014

	<i>HNC</i>	<i>MNC</i>	<i>NNC</i>
HNC	1.00		
MNC	*0.84	1.00	
NNC	*0.84	*0.93	1.00

* Significant at the 5% level

Table 10 shows the investment performance of the various aircraft noise affected and non-affected suburbs based on median house prices. This table compares the average annual capital returns, return volatility and risk/return ratios for the period 1988 to 2014. Over the 27 year period the HNC suburbs have shown an average annual capital return of 6.88%, compared to 6.45% for the NNC suburbs and slightly lower than the MNC suburbs. On a risk return basis the risk/ return ratios were very similar across all three classifications, ranging from 1.42 to 1.53.

Table 10: Capital Return and Investment Performance: Median Price 1988-2014

Location	Average Annual Capital Return (%)	Average Annual Volatility (%)	Risk return Ratio
High Noise	6.88	10.29	1.50
Moderate Noise	7.12	10.11	1.42
No/Low Noise	6.45	9.89	1.53

Based on these results, houses in the Gold Coast locations subject to aircraft noise have shown similar, and in most cases higher, average annual capital returns compared to non-noise affected properties. This indicates that residential property prices and investment performance is linked more closely to socio-economic status than aircraft noise impact across these specific Gold Coast and NSW locations. Location of residential property under Gold Coast flight paths has not had any significant effect on the ability to sell residential property as trends in sales volume are similar and there has been limited if any reduction in capital growth over extended time periods for residential houses subject to high or moderate noise complaint levels.

These results confirm that on the Gold Coast, the decision to purchase a residential property in any given location is based on a range of factors. Exposure to aircraft noise is only one factor associated with suburbs located under aircraft flight paths. These results conclude that residential property buyers on the Gold Coast and Far North Coast of New South Wales consider a range of factors such as distance to beaches, services, employment and schools in the purchase decision not just flight paths and aircraft noise. Consequently, aircraft noise affected locations achieved similar and often higher capital growth despite this exposure to aircraft noise.

The major conclusion from the analysis is that when the housing market is considered over extended time periods (greater than 12 to 24 months), houses subject to aircraft noise across the Gold Coast and Far North Coast of NSW have an equivalent, if not higher, higher average annual capital growth, with similar risk return ratios, when compared to less affected locations.

6.0 INVESTMENT PERFORMANCE, FLIGHT PATH LOCATION

The previous analysis only grouped the various suburbs based on the level of noise complaints received by Air Services Australia. The following analysis compares the residential housing investment performance for a range of Gold Coast and Far North Coast NSW locations and suburbs based on both their location under existing flight paths, as well as their socio-economic status. This analysis summary will be based on the median house price for these selected suburbs.

6.1 FLIGHT PATHS HOUSES (MEDIAN PRICES PRICES)

This house price analysis is based on a selection of suburbs that are:

- Subject to the current southern flight path
- Subject to the northern flight path
- Not subject to any existing flight paths (but would be considered to be affected by the proposed ILS flight path)
- Not subject to any existing or proposed flight paths

For this summary analysis the suburbs not affected by the northern and southern flight paths have been grouped. The actual suburb locations are identified in Table 2.

6.2 SOUTHERN FLIGHT PATH NSW

The median house prices for the seven locations under the southern flight path are shown in Figure 6. All these locations are located in the Tweed heads area and include a range of socio-economic suburbs. These range from the high value locations of Fingal Head and Kingscliff to the lower value locations of Tweed heads South and Chinderah. This graph shows that although the median price for houses has been highest in Fingal Head, the relatively high price variations for Fingal Head is more a factor of the low sales volume in this location together with a very small housing stock.

Although the median house price for Kingscliff has been higher than the other locations, this variation in median house prices has been more pronounced since 2000. Despite all these locations being under the existing flight path, the variation in median house price trend over the period 1988 to 2014, has been driven more by socio-economic status than actual house location. This is evidenced by the similar trend in median house prices for Tweed Heads South, Banora Pt and Chinderah (all lower value locations) and Tweed heads and Terranora (both middle value locations)

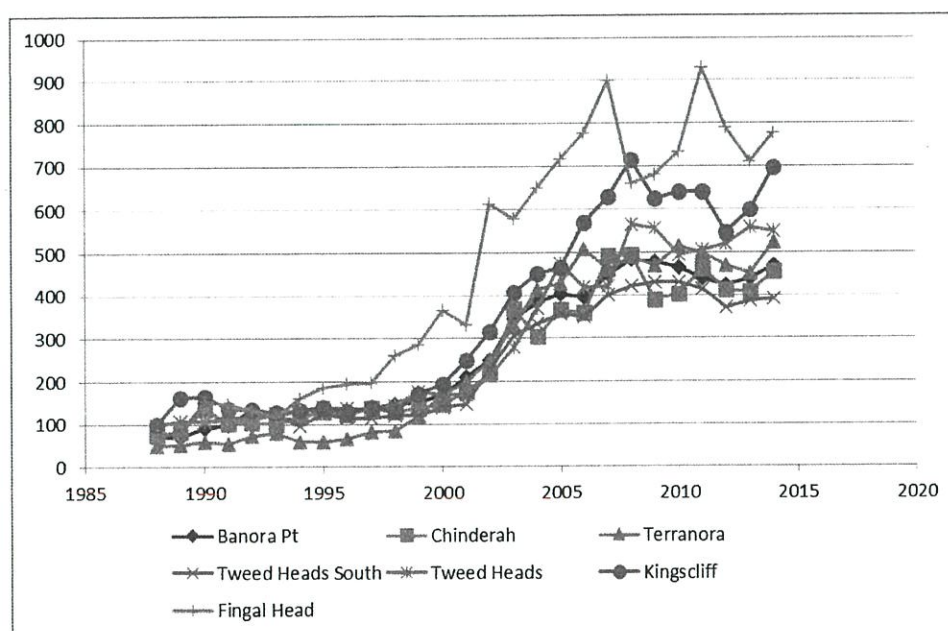


Figure 6: Median House Prices: Southern Flight Path: 1988-2014

The respective correlation coefficients for the southern flight path suburbs and towns are shown in Table 11. From this table it can be seen that there is a strong positive correlation between the movement in median house prices between Banora Pt and Chinderah ($r=0.59$); Banora Pt and Tweed Heads South ($r=0.47$) and Banora Pt and Terranora ($r=0.41$). All these are the lower value suburbs and locations exposed to aircraft movements and under the southern flight path. However Banora Pt only had a slight positive non-significant correlation with Tweed Heads, Fingal Head and Kingscliff.

Table 11: Median House Price Correlation Analysis: Southern Flight Path: 1988-2014

	<i>Banora Pt</i>	<i>Chinderah</i>	<i>Terranora</i>	<i>Tweed Heads South</i>	<i>Tweed Heads</i>	<i>Kingscliff</i>	<i>Fingal Head</i>
Banora Pt	1.00						
Chinderah	*0.59	1.00					
Terranora	*0.41	0.18	1.00				
Tweed Heads South	*0.47	0.33	0.34	1.00			
Tweed Heads	0.26	0.18	0.22	*0.44	1.00		
Kingscliff	0.26	*0.43	*0.39	*0.37	0.29	1.00	
Fingal Head	0.20	*0.43	0.05	0.31	-0.02	0.11	1.00

*Significant at the 5% Level

Other significant positive median price movement correlations tended to also have an adjoining location influence (Tweed Heads and Tweed Heads South $r=0.44$) and Kingscliff and Chinderah ($r=0.43$). Although all these suburbs and towns are subject to aircraft movements and noise, the value drivers for these locations also vary, hence the lower correlation coefficients. These factors include the permanent or holiday destination status, socio-economic status and location to major services.

Table 12: Investment Performance: Southern Flight Path: Median Prices 1988-2014

Suburb	Average Annual Return (%)	Volatility (%)	Risk/Return ratio
Banora Pt	8.38	13.53	1.61
Fingal Head	12.20	25.99	2.13
Tweed Heads	7.58	13.07	1.72
Tweed Heads South	6.44	15.45	2.40
Kingscliff	8.88	16.78	1.89
Terranora	10.57	16.43	1.55
Chinderah	9.09	21.78	2.40

Table 12 shows the investment performance of houses in suburbs located under or exposed to the Gold Coast Airport southern runway. Based on median house prices the average annual capital returns for these locations have ranged from 6.44% for Tweed Heads South to 12.20% for Fingal Head. Socio-economic status has not been a reliable indicator of investment performance across these locations, with both lower value locations of Chinderah and Terranora also recording high average annual capital growth of 9.09% and 10.57% respectively. Terranora median house prices not only produced a high average annual capital return but the volatility was actually lower than Kingscliff and Chinderah, both locations that recorded higher average annual capital returns. This also resulted in Terranora recording the best risk/return ratio of the seven locations.

These results show that location under the Gold Coast Airport southern flight path has not resulted in all locations having similar median house price movement across the 27 year period. Factors such as the nature of the location (socio-economic status, housing development type, size of the suburb or town, holiday destination or typical owner occupier residential) appear to have a greater influence on value than exposure to aircraft noise or aircraft movements.

6.3 NORTH FLIGHT PATH

Again the suburbs that form the basis of the North Flight path are listed in Table 2. All these suburbs are located on the Gold Coast and comprise suburbs that are predominately residential, with some beachside locations having a higher proportion of unit developments. As was the case for the southern flight path, these suburbs range from lower to high value locations based on median and average house prices.

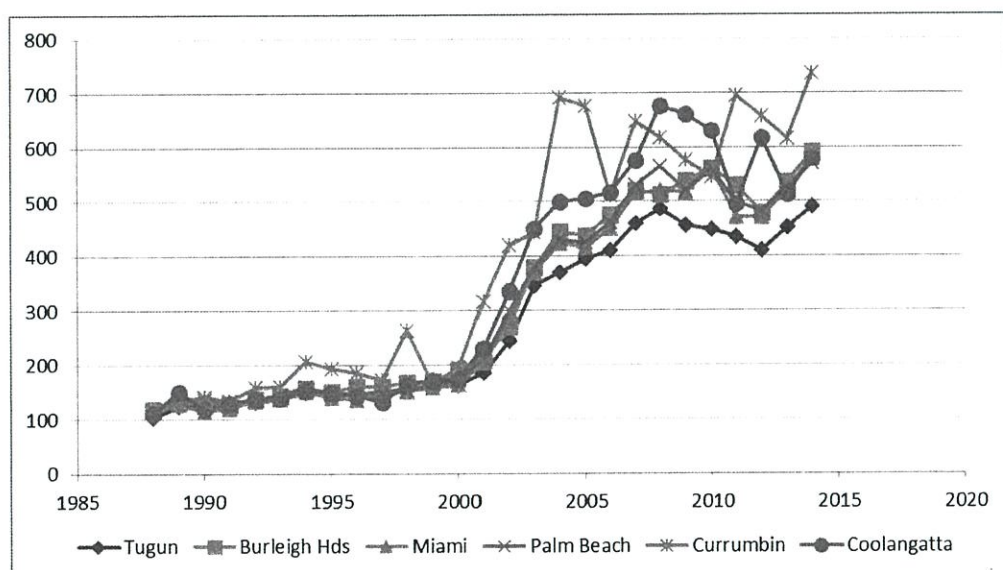


Figure 6: Median House Prices: Northern Flight Path: 1988-2014

The difference in investment and price performance of these northern flight path affected suburbs is also reflected in the socio-economic status. From 1988 to 2002, the median house price trend for the suburbs Tugun, Burleigh Heads, Miami and Palm Beach have been relatively similar, with all sectors, apart from Tugun, having significant median house price increases from 2002 to 2010. Since 2010 these suburbs have seen price decreases to 2012 and a recovery in prices from 2013. In

contrast residential house prices peaked in Tugun in 2008, with a decline in median prices until 2012, followed by a stronger recovery in prices in 2014. Currumbin and Coolangatta have shown a more volatile but higher median house price across the study period, with Currumbin median house prices peaking in 2008 and fluctuating since that date. The most volatile residential housing market in this section of the analysis has been Coolangatta, with a substantial increase in the median house price from 2004 to 2008; varying annually with a peak in median houses prices of \$735,000 in 2014 (Refer to Figure 7).

Table 13: Median House Price Correlation Analysis: Northern Flight Path: 1988-2014

	<i>Tugun</i>	<i>Burleigh Hds</i>	<i>Miami</i>	<i>Palm Beach</i>	<i>Currumbin</i>	<i>Coolangatta</i>
Tugun	1.00					
Burleigh Hds	*0.86	1.00				
Miami	*0.81	*0.82	1.00			
Palm Beach	*0.87	*0.81	*0.93	1.00		
Currumbin	0.29	0.33	0.34	0.34	1.00	
Coolangatta	*0.67	*0.55	*0.72	*0.72	*0.41	1.00

*Significant at the 5% Level

The correlation between the movement in median house prices for suburbs affected by aircraft noise and aircraft movement under the Gold Coast northern flight path have been extremely similar for all suburbs other than Currumbin. There have been extremely strong positive correlation coefficients for the middle value locations (Palm Beach and Miami $r=0.93$; Burleigh Heads and Miami $r=0.82$; Burleigh Heads and Palm Beach $r=0.81$). Table 13 also shows that there has only been one significant correlation coefficient for the high value suburb of Currumbin (Currumbin and Coolangatta $r=0.41$). Although all other correlation coefficients for Currumbin were positive, they were not significant at the 5% level.

Tugun was the only lower value suburb analysed in this section of the study and is the closest suburb to the Gold Coast airport and the suburb affected most by aircraft noise. If aircraft noise was the major value driver for this suburb, it would be expected that the median house price trend would be significantly different to less affected suburbs. This analysis shows that there is an extremely high positive correlation between the movements in median house prices for Tugun compared to all middle value locations (Burleigh Hds $r=0.86$; Miami $r=0.81$; Palm Beach $r=0.87$). The adjoining high value suburb of Coolangatta also has a very high positive significant correlation with Tugun ($r=0.67$). These correlation results confirm that the lower value and middle value suburbs subject to the northern flight path have performed identically across the study period in relation to the change in median house prices from year to year.

The investment performance for Gold Coast suburbs under the northern flight path is shown in Tables 14 and 15. Table 14 reports the investment performance based on median house prices. From this table it can be seen that the average annual returns have ranged from 6.65% for Tugun to 9.95% for Currumbin. However, the average

annual return for residential houses in Tugun have actually been very similar to the average annual return for houses in Palm Beach (6.87%) and Burleigh Heads (6.86%). On a risk/return basis the two better performing suburbs were Burleigh Heads (1.55) and Tugun (1.57). The higher average annual capital returns for Currumbin and Coolangatta were also at higher levels of volatility resulting in higher risk/return ratios of 2.42 and 2.18 respectively.

Table 14: Investment Performance: Northern Flight Path: Median Prices 1988-2014

Suburb	Average Annual Return (%)	Volatility (%)	Risk/Return ratio
Tugun	6.65	10.78	1.57
Currumbin	9.95	24.08	2.42
Palm Beach	6.87	11.79	1.72
Burleigh Heads	6.86	10.60	1.55
Miami	7.02	11.86	1.69
Coolangatta	7.56	17.14	2.18

On an average house price basis, the average annual capital returns for all suburbs, excluding Burleigh Heads, increased. On an average price basis the return from residential property in Tugun was slightly higher than Burleigh Heads.

6.4 NO FLIGHT PATH

In addition to the suburbs that are directly impacted by the current airport flight paths, a further 9 Gold Coast suburbs were analyzed for the period 1988 to 2014. These suburbs are currently not affected by any existing flight paths. These suburbs were analyzed to provide a direct comparison to the investment performance of suburbs that are impacted by aircraft noise and movements. Again, these suburbs are listed in Table 1 and comprise a selection of suburbs reflecting:

- Socio-economic status
- Location close to existing affected suburbs
- Location close to or removed from the Gold Coast beaches
- Holiday destination locations and predominately owner occupied residential locations

Table 15: Investment Performance: Non Flight Path: Median Prices 1988-2014

Suburb	Average Annual Return (%)	Volatility (%)	Risk/Return ratio
Labrador	6.82	12.51	1.83
Southport	6.93	12.20	1.76
Bundell/ Sorrento	5.65	11.93	2.11
Molendir	7.50	13.36	1.78
Ashmore	6.00	9.48	1.58
Varsity Lakes	6.63	10.94	1.65
Nerang	6.53	10.86	1.66
Helensvale	7.73	12.51	1.62
Burleigh Waters	5.93	8.67	1.46

Table 15 presents the investment performance of residential houses in these suburbs based on both median and average house prices. On a median house price basis the two suburbs with the lowest average annual capital return were Bundell/Sorrento (5.65%) and Burleigh Waters (6.15%). The highest returns were from Helensvale (7.73%) and Molendir (7.50%). The other suburbs had average annual capital returns ranging from 6.00% to 6.93%.

On an average house price basis, only Varsity lakes, Nerang, Helensvale and Burleigh waters recorded an average annual capital return higher for average prices compared to median prices. All other suburbs in this section of the study recorded a lower average annual capital return based on average house prices.

7.0 CONCLUSIONS

This study has focused on the long term investment performance of residential property located in Brisbane and on the Gold Coast of Queensland. These suburbs and locations are subject to a range of aircraft noise issues including location under flight paths and in locations subject to various levels of aircraft noise complaints.

Based on long term median annual house price movements suburbs located under the main southern flight path and subject to minimum 70 Decibel aircraft noise in Brisbane have shown average annual capital growth equivalent and in some cases higher than similar housing stock in location with aircraft noise less than 70 Decibels and not located under Brisbane Airport flight paths. The study based on the same research criteria and sales transaction data type also found that the long term investment performance was similar for residential property regardless of exposure to aircraft noise.

Correlation analysis of the annual change in house prices has also shown a very high positive correlation in the annual change in both the number of sales that occur each year in the various study locations , as well as the annual movement in house prices. This suggests that in both

property boom and bust markets the increase or fall in house prices will be similar regardless of the degree of exposure to aircraft noise.

In the Brisbane and Gold Coast residential property markets; residential property value drivers, such as proximity to transport, the main CBD, schools, recreation facilities and other services, have a more significant impact on long term residential property performance than aircraft noise factors.

HPM studies have shown that the location of a residential property close to an airport or subject to aircraft noise can have a lower price compared to non-affected residential properties in similar socio-economic locations in the same property market. This study has shown that in Brisbane and the Gold Coast that even if the house price may be lower due to aircraft noise issues, the actual annual movement in prices and therefore capital growth will be similar and at times higher than similar housing stock not affected by aircraft noise.

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COMPARATIVE OVERVIEW OF SMART CITIES INITIATIVES: SINGAPORE AND SEOUL

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Abstract

Since the advent of ICT in the mid-1990s, cities in many countries have reined in the potentials offered by technological development in making their cities better for the stakeholders. Smart City concept has been revealed as a city development concept that uses ICT as the foundation of initiatives and programmes that facilitate social and economic activities within the city. The Smart City concept has been adopted by Singapore and Seoul as a strategy to spur and sustain city development. This paper compares the Smart City initiatives of two cities in the region, namely Singapore and Seoul and attempts to provide a valuable insight into the implementation Smart City initiatives with regards to the six smart city dimensions as suggested by Giffinger. The findings revealed that the initiatives at these cities are related to the purpose and function of each city.

Keywords: *Smart City, Initiatives, Dimensions, Comparative*

1.0 INTRODUCTION

All through the world, city developers and managers have presented various city development concepts as an approach to enhance the city's sustainability. Among others, these concepts include Liveable, Green City, Sustainable City and Intelligent City. As opposed to being prescriptive, these concepts offer direction for the advancement and improvement for these cities. As beforehand specified, any proposed idea ought to be tailored to the requirements of the city, keeping in mind of the end goal of achieving the required improvement.

Smart City is a city development concept that has developed in prominence in the most recent decade. Turning into a "smart" city or unleashing the "smartness" possibilities of a city has been perceived as the best approach if a city chooses to remain prominent and sustainably manageable. Smart City principles have been suggested as a way of encouraging development and embracing sustainability.

A few cities have made attempts to make their city 'smart'. Seoul concocted 'Savvy Seoul 2015', touted as the "Fundamental Strategic Plan of Informatization of Seoul Metropolitan City" (Seoul Metropolitan Government, 2014). London and Birmingham have pursued on their "smart" arrangements as far as including smart initiatives, through financing and setting up forum for a coordinated effort (Centre for Cities 2014). For every case, the information and communication technology (ICT) was portrayed as being able to upgrade a city's effectiveness, imperativeness and appeal towards the well-being of its users.

This paper aims to introduce the Smart City concept and identify the various initiatives variations among the cities that have been identified as Smart City from previous studies. The initiatives are then compared so that an assessment can be made in relation to the city's functions and purpose. It has been observed that each city is unique in terms of its level of technology, demographic details, administrative structure, environment, geography and socio-political conditions. What is appropriate for one city may not work for another city. Thus, the implementation of Smart City principles for a city has to be studied within its pre-existing institutional framework in order to ensure a viable enhancement to the city development plans.

The Smart City initiative is seen as one of the solutions to arrest deteriorations due to scarcity of resources, inadequate and poor infrastructure, energy shortages and price instability, global environmental concerns, and human health concerns. Hence some view the Smart City as an icon of a sustainably liveable city. While a majority of discussions present rosy visions and ideal images of smart city (e.g., smart transportation, smart mobility, smart environment, smart energy, smart safety, and so on), little research has been made to identify the enabling factors of a smart city initiative (what really makes cities smart). What is really important to highlight is the notion that the success of Smart City initiatives is portrayed through the relation of these initiatives to the city's function and purpose.

2.0 SMART CITY CONCEPT AND CITY FUNCTIONS

The enormous improvement of information and communication technologies (ICT) and the strength of the Internet have seen the advancement of smart city. A deliberation has developed on new technology-based solutions, and new ways to deal with urban planning and living, which would guarantee future viability and well-being of metropolitan regions (Alawadhi et al., 2012; Dirks et.al. 2009; Nam and Pardo, 2011; Nijaki and Worrel, 2012; Yanrong et al., 2014). It is recognised that the concept of smart city is advancing and the work of characterizing and conceptualizing the term is still ongoing.

Having examined the smart city models from past work globally and locally, this paper intends to highlight the smart city initiatives under the six (6) smart city dimensions identified from the Giffinger's (2007) model for selected smart cities chosen in this study. This model has been selected as it has been adapted in the planning and development of Iskandar Malaysia, Johor in Malaysia whereby the dimensions under this model encapsulate the three (3) pillars of sustainable development: economy, social and environment. Giffenger et. al. (2007) has described smart city and its six characteristics through the evolution of a transparent and easy hierarchic structure, where each layer is described by the results of the previous layer. The six 'smart' characteristics that had been identified are: governance, economy, mobility, environment, people and living. These six characteristics known as dimensions were regarded as the relevant group characterising a smart city. Smart Governance comprises aspects of political participation, services for citizens as well as the operation of the government. Smart Economy includes factors all around economic competitiveness as, entrepreneurship and productivity. Smart Mobility incorporates local and international accessibility which can be portrayed by the availability of modern and sustainable transport systems. Smart Environment is described by attractive natural conditions, pollution, resource management and also efforts towards environmental protection. Smart People may not entirely distinguished by the degree of qualification or education of the citizens, but also by the character of social interactions regarding integration and public life and the openness towards the "outer" world. Ultimately, Smart Living comprises various aspects of quality of life which include civilization, wellness, safety, tourism and others.

It has been recognized from a report by the ITU-T Technology Watch Report 2013 that development of smart city requires thorough planning. It is necessary that national and municipal governments, citizens and every single other stakeholder concur on the smart city definition that they intend to accomplish. The smart city definition or strategy must address two (2) key functions: the city's chosen "functions" and "purposes", with its "functions" refers to the appearance and operation of a city and its "purposes to the benefits promised by a smart city model.

3.0 COMPARISONS BETWEEN SELECTED SMART CITIES

In order to examine the implementation of smart city initiatives from cities in the neighbouring Asian region, Singapore and Seoul were chosen. These cities have declared their smart city initiatives through the various city authorities' sources namely the city authority documents (www.ida.gov.sg, Seoul Metropolitan Government, 2014). Smart City initiatives identified from these cities include the information and data that were compiled through the content analysis of various sources namely the various authorities' websites and accessible official documents. In addition, visits to these cities were also made in an attempt to gather data and make observations. The six (6) Smart City dimensions were used to frame the content analysis. Despite the fact that the study has observed several differences of the smart city initiatives during the comparative exercise, it is found the city function – epitomized in the city's vision and mission – prevents a fair comparison between cities as the city function. Other factors as mentioned by Neirotti et al (2014) that may command the type and level of implementation of Smart City dimensions include elements that incorporate economic and technology-related variables, structural factors and other country-specific effects. A general portrayal of the profile of every cities are as follows:

Case 1: Seoul

Seoul with a population of approximately 10.04 million in 2013 is the capital and the largest metropolis of South Korea. It is ranked sixth (6) in the Global Power City Index and seventh in the Global Financial Centres Index. Seoul also exerts a major influence in global affairs as (7th) one of the five (5) leading hosts of global conferences (Fischer, 2012). The city's Gross Domestic Product (GDP) per capita (PPP) of \$39,448 was comparable to France and Finland in 2013.

The electronics, information technology and assembly-type of industries has overtaken the labour-intensive manufacturing industries (Ik-Yu, 2013; The primary of Seoul and the Capital Region, 2014) and the capital region, 2014). Seoul is the world's most wired city (16) (Cha & Come, 2011) and positioned joint first in innovation status by PwC's Cities of Opportunity Report 2014 (Price WaterHouseCooper, 2014). It has also the world's highest fibre-optic broadband penetration, resulting in the world's fastest internet connections with speeds up to 1 Gbps. Seoul provides free Wi-Fi access in outdoor spaces.

In 2013, the city authorities promulgated the city's vision for 2030 – a happy city based on communication and consideration which will be the highest values for the municipal administration of Seoul. Indeed, these values will play the central role in the city's pursuit of its long-term goals of upgrading the quality of life of its people, boosting the city's global competitiveness, building its uniqueness in the global community and securing sustainability as a major global city. A report published by ITU-T Technology Watch Report analysed Seoul's implementation of its 'Smart Seoul 2015' project. The report investigated the conceptual underpinnings of Smart Seoul, the use of smart technologies and mobile-web applications to provide citizen-centric services and the role of technical standards as the precondition for smart city functionality. It has been observed that Seoul has applied three (3) broad phases to the evolution of a smart city comprising: *The First Phase* (individual service level) – ICT application to improve individual city operations such as transportation, safety, environment and culture; *the Second Phase* (the vertical service level) – integration of related processes and services by smart technology within major sectors of a city, enabling the provision of more advanced services; and *the Third Phase* (the horizontal service level) – the point of smart city development at which there is no longer a distinction between different service areas, with all parts now seamlessly integrated within an efficient smart city ecosystem.

Case 2: Singapore

Singapore has a total population of 5.54 million as of June 2015 with 1.63 million non-resident populations (Singapore Department of Statistic, June 2015). It is a diversified and global economy which depends on foreign trade. It is also one of the world's major commercial hubs with the fourth-biggest financial centre. The country is an important financial centre leading in foreign direct investment. The GDP per capita in Singapore was last recorded at USD38,087.89 in 2014. It is rated highly in economic competitiveness, healthcare and education. The Economic Development Board (EDB) of Singapore has positioned the vision of Singapore to be a global city, a home in Asia for business, innovation and talent. Within the Smart City context, it has the vision of transforming Singapore by building the World's first Smart Nation by harnessing technology to the fullest with the aim of improving the lives of citizens, creating more opportunities and building stronger communities.

Infocomm Development Authority of Singapore (IDA) has been established to develop information technology and telecommunications within Singapore with a view of transforming Singapore into a smart city. IDA through its active support has seen the growth of innovative

technology companies and start-ups in Singapore. It works with leading global IT companies as well as developing excellent policies and capabilities as well as information technology and telecommunications infrastructure for Singapore.

4.0 SMART CITY DESCRIPTORS

In making the comparison of the initiatives undertaken in the selected cities i.e. Seoul and Singapore, a matrix of descriptors is developed. These descriptors attempt to show the level of implementation of the initiatives undertaken at these two cities. A summary of the descriptors is shown in Table 1 below. By using these descriptors, a comparative review is made on the smart city initiatives through the smartness level which are divided into four, namely, Basic, Medium, Advanced and State-of-the Art. The adoption of the levels of descriptors was a qualitative decision based on an assessment of the Smart City information gathered at both cities. The levels of achievement for each of the Smart City dimension for each city was assigned heuristically, informed by the initiatives gathered through content analysis of the relevant sources which are verified through fieldwork observation. The results of the comparative analysis are then depicted through a radar diagram revealing the smart city initiatives implementation at the two cities.

Table 1: The Descriptors for the level of achievement under each dimension

	Level of Achievement	Description
Smart Economy	Basic	Facilitating local economic activities (infrastructure, facilities, economic support system)
	Medium	Economic growth and value creation
	Advanced	Innovative economic growth
	State of the Art	Integrated ICT based economic hub
Smart Governance	Basic	Provision of basic public and social services
	Medium	Public participation in decision-making
	Advanced	Public-private partnership
	State of the Art	Fully Transparent government with ICT that provides real-time policy conveyance and input
Smart Mobility	Basic	Basic transportation and connectivity to ease movement and connectivity
	Medium	Full accessibility and some connectivity that further enhanced movement
	Advanced	Full accessibility and full connectivity together with an efficient traffic management system
	State of the Art	Full accessibility and full connectivity together with a sustainable traffic management system

Smart Environment	Basic	Provisions for safe and clean environment
	Medium	Protection of the environment
	Advanced	Enhancement via green technology in the environmental management system
	State of the Art	Usage of ICT in the sustainable environmental management system
Smart People	Basic	Provision and accessibility to basic level of infrastructure and programmes for the training and education towards enhancement of skills and knowledge
	Medium	Provision and creation of elaborate human capital improvement environment with physical and non physical platforms for the advancement of knowledge, skills and sharing ideals
	Advanced	Creation of a conducive ecosystem that attracts and develops human capital through physical and non-physical platform with advanced technological features for the advancement of knowledge, skills and sharing ideals towards a caring and open mind set
	State of the Art	Development and creation of a conducive ecosystem that attracts and develops human capital through the adoption of state of the art ICT and technology driven educational and training towards the cosmopolitanism, caring and open mind set of the nation
Smart Living	Basic	Provision of communal amenities and cohesive social environment
	Medium	Provision of extensive communal amenities and cohesive social environment
	Advanced	Availability of varieties and options for global communal amenities with cohesive social and living environment
	State of the Art	Creation of comprehensive global communal amenities with cohesive and integrated social and living environment towards community well-being.

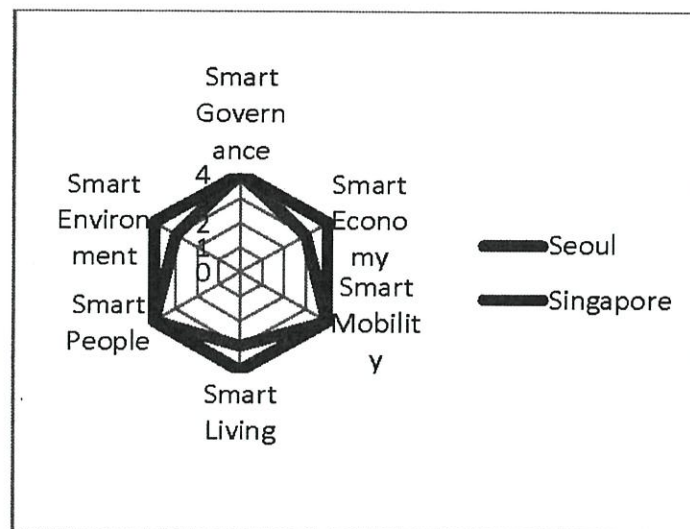
5.0 FINDINGS

From the assessment of the various initiatives at the two cities, smartness categories according to the six (6) dimensions are identified. Through a quantitative treatment of associating the smartness categories with numerical values, the scale of 1 is used to indicate the lowest level of achievement whilst the scale of 4 indicates the highest achievement. The level of smartness achievement for the initiatives undertaken for Seoul and Singapore is shown as in Table 2. The results of the determination of the level of provision is then plotted on a radar chart and is graphically shown as in Figure 1 .

Table 2: Level of Smartness Achievement for Initiatives

City	City vision and mission	Smart City Dimension Achievement	
Seoul	A happy city, global city based on communication and consideration	• Smart Economy	3
		• Smart People	4
		• Smart Governance	4
		• Smart Mobility	4
		• Smart Environment	3
		• Smart Living	3
Singapore	A global leader, a great city, a home in Asia for business, innovation and talent.	• Smart Economy	4
		• Smart People	4
		• Smart Governance	4
		• Smart Mobility	4
		• Smart Environment	4
		• Smart Living	4

The result of the determination of the value of provision is plotted on a radar chart and is graphically shown as figure 1 below:

**Figure 1:** Radar Chart Comparing Smart City Dimensions between Seoul and Singapore

6.0 ASSESSMENT OF OBSERVATION

It is observed that Singapore lead in the provision of the Smart City initiatives under all six (6) smart city dimensions. Each city was developed according to the visions of the city management that could be influenced by the greater national agenda. When comparison are made to the level of achievements for the initiatives under the six (6) Smart City dimensions, both these cities have their own strength catering for the achievement of its vision and mission.

It is clear from the web chart above that the different cities vary from one another in terms of their smartness. Singapore leads when it comes to the provision of smart city initiatives in all smartness dimensions. It is evident that Singapore outperforms Seoul in this respect, scoring as state-of-the-art smartness level on three (3) dimensions. Seoul with comparable strengths has shown high achievement for the other three (3) dimensions though these dimensions have not stood up to the achievement made by Singapore. On the other hand, it must be understood that the above radar chart represents a visual reflection of the selected cities at 'first instance' which is without considering the functions and prevalent conditions that have shaped the cities in the past. The greater national agenda of city may have an influence over the purpose and functions of a city when it was developed. In this case, Singapore was supported by its status as a city-nation whereby as both a city and country, there was a substantial motivation for it to be as 'smart' as possible bearing its limited resources and small size.

7.0 CONCLUSION

Smart City has been said to be one of the city development concept that has promotes sustainable city management through the use of ICT. From the review of the various models that have been introduced for Smart City, Giffenger's (2007) model has described as a smart city that encompass the three (3) pillars of sustainable development and portrayed six characteristics through the development of a transparent and easy hierarchic structure, where each level is described by the results of the level below. The six 'smart' characteristics that had been identified are: economy, people, governance, mobility, environment and living. It is widely accepted that there are three (3) major dimensions of sustainable development which are economy, environment and social which has been recognised for the adoption of the Giffenger's model by Iskandar Malaysia. Taking into consideration of this framework and other smart city models, this study has adapted six (6) dimensions of Smart Economy, Smart People, Smart Living, Smart Mobility, Smart Governance and Smart Environment.

When comparative review was made on the Smart City initiatives in Singapore and Seoul, it is revealed that these two cities have achieved the advanced level of implementation in terms of smartness. The functions of the city and the city's prevalent institutional structure play an important role in shaping the smartness of the city. Singapore led as the smartest city, whereby results from the comparative analysis indicated the highest score in all of its Smart City dimensions. It is submitted that Singapore had no choice but to employ the smart agenda to ensure its survival as a city state. Thus, its highest place in the ranking was assured by its full commitment in using ICT to improve all facets of city development.

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