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A New Tool for Land Value Analysis and Scenario Planning

Abstract: In the digital era of big data, data analytics and smart cities, a new generation of planning support systems (PSS) is emerging. The Rapid Analytics Interactive Scenario Explorer (RAISE) is a novel PSS developed to help planners and policy-makers determine the likely land value uplift associated with the provision of new city infrastructure.

The RAISE toolkit was developed following a user-centred research approach including iterative design, prototyping and evaluation. Tool development was informed by user inputs obtained through a series of co-design workshops with two end-user groups: land valuers and urban planners. The paper outlines the underlying technical architecture of the tool, which has the ability to perform rapid calculations and visualise the results, for the end users, through an online mapping interface.

The toolkit incorporates an ensemble of hedonic pricing models to calculate and visualise value uplift and so enable the user to explore *what if?* scenarios. The toolkit has been validated through an iterative case study approach. Use cases were related to two policy areas: property and land valuation processes (for land taxation purposes) and value uplift scenarios (for value capture purposes). The cases tested were in Western Sydney, Australia

The paper reports on the results of the ordinary least square linear regressions – used to explore the impacts of hedonic attributes on property value at the global level – and geographically weighted regressions – developed to provide local estimates and explore the varying spatial relationships between attributes and house price across the study area. Building upon the hedonic modelling, the paper also reports the value uplift functionality of the RAISE tool that enables users to drag and drop new train stations and rapidly calculate expected property prices under a range of future transport scenarios. The RAISE toolkit is believed to be the first of its kind to provide this specific functionality. As it is problem and policy specific, it can be considered an example of the next generation of data driven PSS.

Keywords: What-if scenarios, Planning support system, Big data, Value uplift, Land economics

1 Introduction

In this research, we developed a data-driven planning support system (PSS) that specifically addresses a clear planning policy – land value capture. In many parts of the world, cities are growing rapidly and the concept of value capture has received renewed interest as an instrument for funding large infrastructure projects. Value capture can be defined as "*a way to distribute the costs and benefits of publicly funded infrastructure to facilitate a project that may not otherwise occur*." (Australian Government, 2016 p19).

Within this context, this paper presents a novel PSS called the Rapid Analytics Interactive Scenario Explorer (RAISE) tool. The PSS has been built to support planners and policy-makers to rapidly explore anticipated value uplift scenarios around new train stations. The users can access a number of property valuation models built into the tool and also use drag and drop functionality to create future scenarios and rapidly calculate the likely property value increase attributable to the new train stations. The outputs can be visualised through a map window.

This paper presents an overview of the RAISE tool in the context of a case study in Western Sydney, Australia. Section 2 introduces the research background, which draws from the field of planning support science, as well as building upon theories of housing economics; specifically property valuation modelling with a focus on the concept of value capture.

Section 3 presents the methods used for developing the tool, including co-design workshops, with prospective users, for creating the tool and an overview of the Western Sydney case study. Section 4 outlines the system architecture of the tool and its required data inputs. Section 5 provides an in-depth examination of the mathematical rationale of the property and land valuation models behind the tool. Section 6 describes two use cases for the RAISE tool and discusses its application for rapid exploration of value uplift scenarios. Section 7 concludes the paper through a reflection on the current strengths of the RAISE toolkit and outlines future directions for its development and application

2 Background

2.1 Data-driven Planning Support Science

Advancements in both hardware and software, coupled with globally accelerating urbanisation, have contributed to growth in urban modelling (Batty, 1976). Initially, the sources of urban data were limited in quantity, accuracy, and frequency. Now we live in an era of open 'big' data, and high-performance computing. Such data and technology can be harnessed to create powerful digital planning tools commonly referred to as planning support systems (PSS) (Pettit et al, 2018). PSS can be defined as instruments which "*collectively support all or some part of a unique planning task […], using a suite of theories, data, information, knowledge, methods and tools*" (Geertman and Stillwell, 2012, p.5-7). Over the last 20 years, the body of literature on PSS has matured to give rise to the emerging field of Planning Support Science (Geertman et al. 2017). Over this period a number of PSS tools have been developed, applied in practice and critically evaluated, as reported in the literature; particularly in the PSS book series edited by Geertman and Stillwell (2012) and Geertman et al. (2017, 2019). One of the key features of PSS tools is their ability to support planners and decision-makers in exploring *what if?* scenarios. Klosterman (1999) created the first *What if?* PSS, which enabled users to rapidly explore different future city scenarios by changing key assumptions such as population projections, housing density, zoning plans etc. The *What if?* PSS has since been applied in over 100 countries: for example, Australia (Pettit et al, 2015) and Pakistan (Hussnain et al, 2020). In this paper, a new *What if?* PSS tool is presented: the Rapid Analytics Interactive Scenario Explorer (RAISE). RAISE is unique in that it focuses on rapid calculation and visualisation of new train station scenarios and the economic value (uplift) associated with such infrastructure. To the authors' knowledge there is no other such tool available which enables users to rapidly explore and dynamically calculate value uplift around train stations for various rail network configurations. The RAISE tool is data driven and made possible by the vast amount of land sales and valuation data available, at a land parcel level, across Metropolitan Sydney. This data is sometimes referred to as big data and presents its own challenges in urban modelling (Batty, 2013).

2.2 Value Capture Analysis

There is renewed interest in 'value capture' funding for infrastructure in Australian metropolitan planning (Greater Sydney Commission, 2018), and indeed globally: for example, the Cross-City Rail project in the United Kingdom (Transport for London & Greater London Authority, 2017). New and improved transport – including new stations, faster trips, more frequent trips, upgraded services or higher volume services – can connect residents to jobs and services and also connect businesses to labour, supplier and customer markets(McIntosh, Trubka, & Newman, 2015). As such, there is an expectation that residents and businesses will pay a premium for property serviced by this infrastructure. Infrastructure investment will boost residential and commercial property values through an increased willingness to pay for improved service, and this is capitalised into nearby property prices. The nexus of infrastructure and increased property values has long been a justification for a taxation structure that taps into the latter to fund the former. In the current era of tighter government budgets, this source of funds has become increasingly appealing (Lieske, van den Nouwelant, Han, & Pettit, 2018, 2019).

The anticipated increase in property value associated with transport infrastructure is called 'value uplift'. Government appropriation of a portion of that value uplift to fund current or future transportation infrastructure projects, is called 'value capture' (or 'value sharing'). Value capture is, in essence, a tax on the increase in land values associated with new or upgraded infrastructure and these taxes are used to justify funding of the project (Terrill & Emslie, 2017). Typical value capture mechanisms include: Tax Increment Financing (TIF), land taxes and betterment taxes. Quantifying value uplift is a key step in evaluating the feasibility of value capture (Mulley, 2014).

2.3 Data-driven Value Uplift Modelling and Analysis

The RAISE toolkit was developed in response to specific policy drivers for value capture, including the national Smart Cities Plan (Australian Government, 2016) and the Greater Metropolitan Sydney Planning Strategy (Greater Sydney Commission, 2018). The toolkit is based on data-driven hedonic price models augmented with a user interface and additional functionality, co-designed with the end users, as outlined in the next section.

3 Methods

3.1 Co-Design Approach

Co-design has its roots in the Scandinavian tradition of Participatory Design (Robertson & Simonsen; 2012). More recently, co-design has been used as a framework to better connect people's needs with technically feasible solutions in developing GIS-based decision support systems (e.g., Goodspeed et al. 2016). Trubka, Glackin, Lade, and Pettit (2016) defined co-design as a "process of product development that focuses on a strong developer–stakeholder interaction throughout the development timeframe for ensuring that a project delivers on expectations" (page 177). PSS including the Envision Planning Tool (Trubka et al. 2016), have been developed using such a co-design approach. This addresses the common problem of mismatch between PSS functionality with end-user expectations (Russo et al, 2018 and Vonk et al. 2005).

We employed an iterative co-design process to develop the RAISE tool. A series of six co-design workshops, each with a different focus, were held between July 2016 and January 2018 (Figure 1). The workshops covered, in order: the core use case and functionality; data inputs, models and scenario formulation; interface features; workflow optimisation; and reflection on initial tool. The co-design process was driven by two distinct user groups: state government-based valuers and local government urban planners. The development process involved the creation of a series of rapid prototypes that explored specific feature sets and extended base functionality, model and data integration, data visualisation and collaborative features through a series of iterations. The workshops enabled partner and end-user feedback and direction throughout prototyping.

< Insert Figure 1: Co-design workshops, and their core focus, for RAISE tool development and participants of workshop 5 exploring the tool's workflow and user experience (March 2017) >>

Core partners were invited to participate in all workshops, and other likely end-users were invited depending on individual workshop focus. Invitees were requested to complete a brief pre-workshop survey about their expectations and levels of expertise in various aspects of the program (geo-spatial, economic, financing, policy, etc.). At the end of each workshop, participants were asked to fill in a post-workshop survey about functionalities explored, fulfilment assessment, strongest/best feature, frustrating experiences and recommendations.

Each workshop took about four hours and followed a common format of: Learn, Use, Review and Explore. This structure (a) broke up the workshop into sessions; (b) provided opportunities for users to experience the toolkit and present ideas and feedback both individually and collectively, and; (c) gave ample opportunity for the development team to observe the tool in use and gather detailed directions from users. The co-design workshops, which actively engaged end users, ran similarly to participatory planning studies in Australia by Houghton et al. (2012) and to the mediated planning support approach developed and used in The Netherlands by Brömmelstroet & Schrijnen (2010).

3.2 Use Case Approach

The RAISE tool was developed and tested using a real-word case study. This enabled the tool to be demonstrated to end-users through two policy-related use cases: (i) Property and land valuation processes (for land taxation purposes); and (ii) value uplift scenarios (for value capture purposes). As both use cases have similar foundations in property assessment and land valuation, we drew upon standard functionality built on hedonic price modelling (HPM) – a form of multi-variable regression that uses a market indicator (i.e. sale price) as the dependent variable and quantifiable measures of property characteristics as the independent variables (Lieske, et al. 2019).

The study encompassed four local government areas: Paramatta, Blacktown, Penrith, and the Hills Shire Councils in Western Sydney (Figure 2). Both use cases drew on a large number of datasets, including property attributes (lot area, number of bedrooms, etc.), locational attributes (distance to train station, to industrial area, to library, etc.) and neighbourhood attributes (local demographics, crime rates, etc.). These attributes were collated in the RAISE database for around 600,000 properties across the case study area.

<Insert Figure 2: Case study with outline of the four Local Government Areas in Western Sydney>

4 System Design

RAISE was built on an open, cloud-based architecture. The application workflow was realised by front-end technologies and applications for the user interface and back-end technologies which connect with the server and databases (Figure 3). Whilst the software has been built using predominantly open source software components, the software is licensed to one of the commercial partners of the project – Omnilink. Additionally, given the commercial nature of some of the data inputs, the software cannot be made available as a free and open source project.

<Insert Figure 3: Technical architecture>

4.1 Front-end Architecture

The user interface was developed through a combination of existing open source JavaScript framework libraries (JQuery, JQueryUI, ChartJS, Cesium, SocketIO, NodeJS) and custom JavaScript modules for the user interface, data processing, collaborative tools and client to server communications. The application has a traditional 'thin' design, using a single HTML page for the entire interface.

The front-end application supports both mouse and touch interactions and has been tested on a "touch table" for collaborative use purposes. The interactions within the map are custom JavaScript modules built to extend the Cesium open source 3D mapping application and allowing for exploration and development of data visualization and interactions in novel ways.

The client application is served from Django, which allows for tighter coupling of server environment variables with the front end, while handling caching for improved performance. The collaborative toolset relies on high-frequency data communications with NodeJS on the server to synchronize user instances in near real-time. Data sets, scenario creation and retrieval, 3D buildings and geo-spatial layers are retrieved from a GeoServer instance using specially crafted queries over REST and HTTP API Endpoints.

The RAISE tool's front-end is accessed through a web browser on a mid-range or higher computer, using Google Chrome, preferably, to align with the development and testing environments. High performance tablets have been tested and work with the application, although this is not the recommended user experience due performance limitations and smaller screen size.

The core of the interface is the mapping framework, Cesium, which is an open-source 3D globe and mapping engine. This is a constantly evolving and improving project, with scheduled releases each month. It should be noted that at the time of development, native 3D tiles support (glTF format) had not been released; this would have significantly improved the rendering of the 3D buildings (based on their footprints) within the application. In the toolkit, buildings are rendered based on viewport boundaries, with REST queries to GeoServer returning the building footprints, which are then iteratively rendered based on building-height metadata (Figure 4).

<Insert Figure 4: Scenario explorer interface with 3D mode enabled, showing heat map query results applied to the surfaces of building models>

The RAISE tool includes a collaborative user engagement model which allows the view states of multiple instances to be synchronized across the network. Thus, multiple users, in diverse locations, can be engaged in efficient comparison and analysis of shared scenarios and data sets.

The tool uses a highly scalable software communication channel which is only limited by the allocated server and network capacities. This software stack, based on socket.io and NodeJS technologies, allows an instance of the toolkit to broadcast to as many other instances as required, synchronizing, for all sessions that are linked to the controlling instance, the map co-ordinates and viewport.

All user interfacing, data requests and collaboration interactions are performed through asynchronous scripting technologies, allowing a responsive application that continues to process requests behind the scenes, whilst the user is exploring other functionalities via the user interface.

4.2 Back-end Architecture

A set of python-based loading functions were created using GeoDjango libraries in the back-end of the tool for spatial queries. These functions load data from different sources, with different formats, to the PostGIS database (Figure 4). Currently these functions can load data from ESRI Shape files & CSV. Once the data is loaded, a second set of functions link the datasets with each other - for example linking 'analyzed sales' data with 'spatial property' data. These functions are tightly related within the RAISE dataset structure. Therefore, provided the structure of the source datasets is not changed, the functions can be re-used to load datasets for different geographical boundaries. Using Geoserver the processed data can then be used to create layers that can be consumed instantly through a number of OGC standard web services such as WMS and WFS. Other non-OGC standard output formats such as TopoJson and Mapbox Vector Tiles can also be provided.

An open source framework (Django REST Services framework) was used to provide interoperability between computer systems on the web. Django REST Framework offers the capability of creating/updating new features as well as querying data in standard REST format. For example, a geographical feature, such as a train station, can be created through a REST POST call to the corresponding REST service endpoint.

Celery is used to distribute heavy loading tasks such as on-the-fly property value calculations, based on a scenario, to multiple processes. It can distribute tasks equal to the number of CPU cores available on the server machine.

4.3 Data Stack

RAISE links and embeds diverse open geospatial and property data from trusted government databases and industry partners, to provide a platform for visualisation, modelling and interactive scenario exploration. As such it is a data-heavy system designed to support valuation modelling. This included data from Australian Property Monitors and NSW Land and Property Information, partners in the project, and various other government data sources, such as Transport for NSW, NSW Education, NSW Bureau of Crime Statistics and Research.

The property sales data was provided by Australian Property Monitors, sourced from domain.com.au: one of the largest online property sales advertising portals in Australia. Details of property transactions include transaction price, property type (house or apartments, etc.), the number of bedrooms and bathrooms, and the presence of other features listed in the advertisement, such as walk-in robes, courtyard, heating, ensuite, study, rumpus room, sunroom, garage, swimming pool, laundry, air conditioner, barbeque facility or spa and also the latitude and longitude of the property. The case study properties were geocoded using their coordinate information allowing distances to train stations, schools, libraries, public swimming pools, parks, shopping centres, and electric transmission lines to be determined and coded as the accessibility characteristics of each property relative to transport and amenities.

5 Valuation Modelling

5.1 Model Summary

The RAISE tool uses HPM to quantify the impact of transport infrastructure on residential property prices and rapidly estimate changes in property values during the exploration of different hypothetical scenarios of new infrastructure provision. Conceptually, HPM follows the idea that the value of residential properties is determined by a bundle of hedonic attributes, this includes (Costello & Watkins, 2002):

- Structural attributes such as the building's quality, age and size;
- Neighbourhood attributes such as crime levels and socio-economic profile; and
- Accessibility attributes such as the nearest transport connections, jobs centres and services

Empirically, HPM is a form of multivariate regression which uses a market indicator (e.g. sale price) as the dependent variable and some quantifiable measure of each attribute as the independent variables. This enables the development of a formula that best estimates prices for properties by determining the weightings for the set of attributes across the set of sold properties based on the model coefficients. The formula can be used to estimate the value for other properties, even in the absence of a market indicator, based on those coefficients and the known attributes of those properties. By identifying the marginal effect of each attribute, HPM also allows an estimate of the expected difference in property value if an attribute value changes. This is exploited in the RAISE tool, which, by introducing hypothetical train stations, changes the 'distance to nearest train station' attribute in the formula. In addition to the Ordinary Least Square (OLS) model which provides the global contribution of the significant hedonic attributes, a Geographic Weighted Regression (GWR) was implemented in the RAISE Tool to capture local parameter estimates and spatial variations in relationships (Du & Mulley, 2006; Fotheringham, Brundson, & Charlton, 2002).

Property and land valuation models were developed and tested using the sales records of 25,741 residential properties within the four councils in the case study area. The descriptive statistics for variables included in the property valuation models are provided in Table 1. These variables were chosen for a number of reasons including: (i) they have an anticipated contribution to property price variance having been found to be statistically significant in other Sydney land valuation studies – (Mulley et al 2015; Lieske et al. 2018, 2019); (ii) they were suggested by stakeholders during the model co-design e.g. NAPLAN school results; and, (iii) they are potentially controllable. (iiii) they are not associated with serious multicollinearity issues.

<Insert Table 1: Descriptive statistics for the dependent and independent variables (n= 25,471)>

5.2 Modelling Results

All the explanatory variables in the final OLS model were significant and most of them presented an expected relationship with the dependent variable as consistent with previous studies (Mulley, Ma, Clifton, Yen, & Burke, 2016; Mulley, Tsai, & Ma, 2015; Tsai, Mulley, Burke, & Yen, 2015).
Detached property prices are higher than attached property prices, and properties with a study room or a swimming pool are valued 4.2% and 2.6% higher than those without, respectively.

As suggested by the stakeholders from the co-design workshops, school quality indicators were considered in the modelling. Those properties in the catchment of schools performing well as measured by the NAPLAN results were found valued higher. This is also consistent with past studies on the studying the effects on schools catchments on property prices (Gibbons & Machin, 2008; Ries & Somerville, 2010). Properties are valued higher in a neighbourhood with higher incomes, a greater percentage of senior-aged residents and a lower percentage of residents from overseas.

Every 100 m distance from the CBD was shown to decrease the expected selling price of a residential property by 0.139% (equivalent to $AUD 1184 at the mean of the data). As hypothesised, proximity to a train station had a positive relationship with property value, with an increase of 0.129% (equivalent to $AUD 1099 at the mean of the data) for each 100 m closer. Although minor or no effect of transmission lines on property values has been found (Bond & Hopkins, 2000; Jackson & Pitts, 2010), our research suggests that property prices are negatively affected by proximity to high voltage transmission lines.

Moran's I test was used to detect the presence of heteroskedasticity and spatial dependence in model residuals. As seen in Table 2, the GWR model is better at controlling for spatial autocorrelation, as demonstrated by the smaller Moran's I statistics (0.12 for GWR and 0.47 for OLS). The model fit parameters showed that GWR improved the OLS model, having a higher adjusted-R^2 (0.85 as compared to 0.79) and a lower AIC (-13787 as compared to -9423). In the GWR, the mean of coefficients of all variables have the same signs as the coefficients estimated by the global model, with slight changes in their magnitudes. Generally, it was found that areas that have better accessibility to train stations are positively capitalised in their property values, noticeable along the northern train lines and northwest areas continuing out toward the Hills Shire where the new northwest train stations (opened in 2019) are located.

<Insert Table 2: OLS and GWR Model Estimates of RAISE Property Valuation (n=25,471)>

6 Use Cases – Application in Sydney

6.1 Property Valuation

The use case for valuation sought to improve the current processes for calculating and validating land and property values. These processes are supported by automated valuation models, also known as mass appraisal valuation models, two of which have been developed for RAISE using the HPM methodology described in the previous section. Both OLS and GWR HPM methods with good model fit were adopted. The use case was to apply the RAISE tool so that government valuers could quickly check existing diagnostics related to land and property valuation via the intuitive visual interface. The RAISE tool incorporated existing datasets used by Property NSW as part of their valuations (e.g., recent nearby sales, and the geographical boundaries of groups of properties that are expected to have similar changes in value over time). It also incorporated the automated valuations produced by the HPMs reported above. The valuers could access the RAISE tool via a simple online mapping dashboard to conduct visual inspection of both neighbourhood and property structure/physical attributes associated with the property or land valuation. More importantly, the HPM coefficients could be examined to identify the marginal effect or weight of each attribute on the property valuation, as illustrated in Figure 5. In this example it can be seen that the selected property is 343 m from the nearest high voltage transmission line, which is $8,086 more than if the line was 100 m closer. Conversely, the distance to Beecroft train station is 246 m, and the property value is $1,206 less than if the station were 100 m closer.

<Insert Figure 5: RAISE Tool providing transparency to the marginal effect or weight of each attribute on property valuation>

6.2 Value Capture

The use case for value capture sought to improve the current processes for predicting value uplift attributable to new transport infrastructure. The use case was for a new commuter rail connection in parts of Western Sydney. Currently, in the initial stages of exploration of potential suburban train routes, specialist consultants have been engaged to estimate changes in property values, an expensive and time-consuming exercise. Consequently, fewer options are typically explored by planners, and effective value capture mechanisms are seldom employed in Australian infrastructure planning. The use case was for council (or other planning agency) staff to collaboratively explore alternative route scenarios, and to rapidly estimate the potential uplift created by each proposal. A 1-km buffer around new infrastructure focused analysis to likely areas of influence and reduced computational load. The implemented use case allows users to drag and drop new railway stations to candidate locations and immediately calculate the value uplift (as seen in Figure 6).

<Insert Figure 6: RAISE tool use case – value uplift from a new drag and drop train station>

In both use cases, an important component was to improve users' appreciation of the drivers of property values. As such, a requirement of the user experience, and the tool design, was an ability to explore the effects of different independent variables in the HPMs. This meant that the users could see what effect different variables had on property value – how it would change if one variable changed while all others were held constant, and which variables had a greater impact on property values. In turn, the RAISE tool provided users with a greater level of access to complex land and property valuation models and the ability to create and explore *what if?* scenarios for calculating the likely value uplift around potential train stations. The PSS has been used to evaluate a range of *what if?* scenarios for new rail networks across Western Sydney. Initial performance testing of the RAISE tool showed that a value uplift scenario for 20 stations, with 28, surrounding 743 parcels, could be calculated in less than two minutes.

7 Conclusions

This research investigated whether a rapid analytic scenario planning approach can be encapsulated in a tool that supports data-driven planning and decision-making based on land economics, with a specific focus on property valuation and value capture. A PSS centred upon land economics and the exploration of *what if?* future city scenarios was developed and tested to achieve two purposes. Firstly, to support government land valuers in understanding changes in land and property dynamics. Secondly, to support urban planners and policy-makers in exploring the potential value uplift from new public transport infrastructure (train stations) in *what if?* scenarios for Western Sydney, Australia. The RAISE tool was co-designed with end-users through a series of workshops to ensure the usability and utility requirement of users were sufficiently accommodated. The importance of usability and usefulness of such PSS have been noted in previous research (Russo, Lanzilotti, Costabile, & Pettit, 2018; Vonk, Geertman, & Schot, 2005) and can be a significant barrier to adoption of such PSS in practice.

In this paper, we described the development and application of the RAISE tool in the context of a Western Sydney case study. The HPMs underpinning the tool have resulted in statistically robust results, with the GWR model performing best with an adjusted-R^2 of 0.85. A high level of explanation of property value variation is important if the results are to be useful to government valuers. The functioning PSS version can already be used by planners and policy-makers to rapidly explore data driven value uplift capture scenarios.

The RAISE tool's key strength is its data-driven and visualisation-based approach to scenario exploration. Being built on models and algorithms supporting fast, interactive scenario exploration improves practitioner understanding of land economics, in particular the influence infrastructure provision plays in land values. While the co-design workshops have provided positive end-user feedback, the tool is still the early stages of development, requiring further refinement through comprehensive user evaluation by end users, including land valuers, city planners, and policy-makers. Until then, it is too early to assess the extent to which such a use-case led PSS will shape practices in the land valuation and value capture fields.

Further development of the RAISE tool will include additional models that can estimate the value uplift attributable to rezoning of land parcels, particularly those in close proximity to transformational infrastructure, such as train stations. A public-facing version of the RAISE tool based on open data sources will also be explored to enhance community engagement in valuation and urban planning processes. Community access to such a PSS can ultimately improve the transparency and accountability of government planning decision making and has been among the long-time visions for such tools as advocated by Klosterman (2001) and others. However, this is more of a challenge from the perspective of city governance.

In conclusion, this paper introduces the RAISE toolkit, a PSS which has been designed specifically to address land valuation related city management and planning related decisions. The RAISE toolkit provides a suite of functionality to support the exploration of property valuation scenarios with unique functionality that enables to the user to rapidly create value uplift scenarios around proposed new train stations. The RAISE toolkit is the first of its kind providing this specific functionality and, being problem and policy specific, it can be considered an example of the next generation of data driven PSS.

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