Urban Pinboard

Development of a platform to access open source data to optimise urban planning performance

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In this paper we present our research to design and develop ‘Urban Pinboard’, a platform to optimise urban planning process and performance. We argue that second machine age general purpose technologies can now be accessed for city modelling. Based on the observation that: GIS does offer a depository that can display urban data; data sets exist but often stored at different locations; there is a discrepancy of access to planning information; and the data often are not accessible to private / public sector and the general public on one location, Urban Pinboard aims to address these problems as an integrated digital platform that enables the public, private and community sectors to connect by contributing ideas, comments and proposals on all planning issues in a single platform. The paper outlines the background research, methodology and introduces the Urban Pinboard's features to create a single source of truth for planning data.

Keywords: Software development, web-based GIS platform, Urban Planning, planning data

INTRODUCTION AND BACKGROUND
The maturation of the Internet has made possible the confluence of powerful technologies in which freely accessible software libraries automate many tasks (Brynjolfsson, McAfee, 2014). Low cost database technologies, storage, transmission and replication mean that massive data sets can now be accessed for city modelling. At present GIS does offer a depository that can display urban data; government agencies and others provide websites that store i.e. planning data, but often datasets are not on one and the same site and a user has to search at different locations to get all information; further there is a discrepancy of access to planning information; and finally data such as the private and public sector and the general public are not able to access the same information on one location leading to miscommunication and potential delays in planning processes hence there is no single source of truth.

Planning
The built environment is arguably designed and constructed by multiple, diverse entities that span academia, government, industry and the community. Whilst successful outcomes rely on effective collaboration between these entities, such collaboration is hard. Different paradigms and competing
goals mean that many planning decisions are politically contested. Exacerbating the political challenge is the difficulty of describing the built environment comprehensively. It is a complex physical entity, but cannot be understood as that only. The legal reality of a city needs to be described and represented, as do its economic and demographic aspects. The organization, manipulation and visualization of spatial data is not a novel problem and an enormous amount of work has been done in this field under the umbrella term GIS (Davis, 2001).

Full featured GIS
GIS is a mature technology with an evolved ecosystem of products and technologies. Despite the promise of GIS to present data cleanly and comprehensively, GIS has largely remained the domain of technical experts. This is driven by a number of factors such as: Open source solutions - PostGIS, Qgis despite their active, welcoming and helpful communities are technically difficult, limiting their uptake; and proprietary software like Esri, CityEngine are both technically difficult and also expensive.

Light weight web GIS
More recently GIS has become more accessible to a community of non-experts. Google Maps provided a digital map designed for the masses in 2005. This is a lightweight geographical information system which exposes some algorithms - distance and way-finding - as well as the overlaying abstract information on the base map - such as traffic speed. The success of this product has lead to a greater market understanding of key GIS interactions and concepts (such as layers). This has lead to a virtuous circle where web GIS apps are able to assume a more technically literate market and thus increase the complexity of their offer. The visualizations shown on platforms like Mapbox are evidence of this. Crucially graphics and browser technology has evolved to the point where almost any device can display convincing 3D environments.

Community Interaction
At the same time the way community interact with each other and with institutions has changed rapidly with the advent of social media. The cost of interaction - both direct and diffuse - and of information - has fallen rapidly. Facebook, Twitter and other social media platforms host more than just individuals. They are platform for a wide variety of interactions between multiple sectors. Governments, professions and businesses are able to seek feedback on their activities and policies far more cheaply and rapidly.

The opportunity and the need
These two trends (1) a mass knowledge and technology ecosystem that makes public consumption of complex spatial data feasible and (2) an understanding of social media and rapid, de-siloed communication - provide an opportunity to change the way city planning is performed. Better GIS tools are able to provide clearer, more instantaneous evidence and information about problems, and social media platforms enable deep community engagement in the design process.

OBSERVATIONS AND RESEARCH QUESTION
Based on the above listed background the paper makes the following observations:

- GIS platforms and their commercial licences are costly, hence they are mainly used within the AEC profession and consequently are not necessarily openly available to the general public.
- Still there are developments to address this issue and offer open source free GIS platforms such as the websites ‘Mapbox’ or ‘Esri’ to name but two, but these platforms are as well professional focused but not towards use of the general public.
- Further the above mentioned website platforms focus on purely technical problems but not on problems of governance, design and consensus.
On the other hand of the spectrum websites like ‘Social Pinpoint’ are providing community engagement via a software solution but they often lack the data richness of GIS platforms like ‘Mapbox’ or ‘Esri’.

Yet one can argue that web technology has matured and one can get de facto standardisation of formats hence data transfer between different organizations (community vs. GIS) is cheap and feasible.

At the same time web users of the general public are familiar with navigating maps on the internet through an exposure to Google Maps and others and therefore able to utilize GIS like tools.

Further web browser allows complex information to be displayed visually and in 3D, here Kelly and Donegan (2015) deftly make the argument that: “Three-dimensional visualisation tools are much more effective at conveying what proposed new housing will actually be like. [As] one Australian state government official said that: this tool is moving us from year-long to hour-long negotiations”.

Yet if the use of GIS offers potentials one can notice that even architects and designers that are proficient in CAD make limited use of City data and web technologies in their design process due to the difficulties of accessing GIS data.

Lastly built form data transfer has improved (through platforms like flux.io), however the potential for designers create, share and market algorithms has not been realized. Direct model to API communication happens within design firms, but not across design firms.

When reviewing and analysing these observations the researchers concluded that, speaking here general, two main types of data depositories exist: Data rich and interface poor or Data poor and interface rich (advanced), meaning they either have a large amount of data and these with a high level of accuracy - but with a user unfriendly interface; or the other way around, the interface has a higher level of quality and could be used by the general public - but the data stored at the backend are from a lower quality. A further disadvantage is that most platforms present data and the built environment in 2D as a map but not as a 3D model. Hence the research proposes two questions:

- Can one use currently available web technologies to source and combine disparate, disconnected, high quality data and provide a single, 3D user interface to that data which is legible to the public, design professionals and government users?
- Could such a shared platform enable a new business model for architects and consultants where they provide their services as API calls across a network?

Consequently the paper provides background into the multiplicity of available urban data and urban data platforms in order evaluate what exists at presents, and based on these findings propose and develop a platform of one's own meeting the objectives listed in the observations.

**METHODOLOGY**

The research project employed a three-folded methodology.

Firstly, the team conducted a review of existing platforms such as ‘Esri ArcGis’, ‘Qgis’, ‘Nicta National Map’, ‘F4 maps’, ‘Mapbox’, ‘Leaflet’ and ‘Postgis’, to name but the most commonly known platforms in order to gain a broad understanding of the state of play in the field. This was supported through an extensive literature review in GIS, Big Data, urban planning tools and similar outlined in greater detail in the final paper. Through evaluating and reviewing the above and other platforms the researchers could classify them in taxonomy to identify a need for a platform to access open source data and algorithm to optimise urban planning performance. Classification criteria were items such as maximising the chance of community engagement the tool needed to be
browser based and not require complex installation; establishing that the tool supported 3D, as the built environment is three dimensional and to seek community engagement this needed to be recognised; or that social media integration was a critical item. Through this taxonomy we could establish that full featured platforms like Qgis or ArcGis were not solutions. Further Google maps, Leaflet, Mapbox and Esri provided browser based mapping services which could be integrated with social media technologies but Google maps and Leaflet did not offer a 3D environment to extend the project need. Mapbox and Esri provided aspects of 3D mapping, with Esri’s being the most comprehensive.

Secondly, the team conducted a survey and interviewed ~ 100 potential users from the private sector (architecture, planning, developers), the public sector (state government, local councils) and the general public (community groups) in order to understand and evaluate how these three target groups planned to use the proposed ‘Urban Pinboard’ platform. The private and public sectors were asked about their technology workflows, their data collection and storage methods and the integration of this data into their work, their understanding of ‘open data’ and the ‘collaborative economy’, and the integration of API’s and other shared platforms into their work. This component of the surveys revealed that many firms in the private sector and some Local Councils are moving towards more open and integrated processes and platforms in their everyday workflows, and that there is a need for more authoritative and centralised data sources. Other topics covered in the survey included the public consultation process, in particular the time, costs and processes associated with engagement from the private sector to the Government and the community. As well as the communities expectations for consultation, and barriers to true consultation and feedback throughout the life of a proposal. The findings confirmed the need for more expressive communication of built form in the consultation process to the general public, lower costs and time allowances for consultation from the private sector to the community sector, as well as more opportunity for direct feedback in a timely and targeted manner from the community.

Thirdly, findings of the team were peer-reviewed and evaluated through weekly meetings by an advisory team comprising developers and urban planners. The advisory board evaluated and tested in these meetings whether ‘Urban Pinboard’ could lead to better design outcomes by facilitating collaborative, evidence based design processes. The conclusions of the advisory team indicated that more direct and comprehensive consultation with a larger segment of the community through an online 3D platform was likely to lead to more targeted feedback on the design of spaces and buildings, and would encourage a collaborative solution. Additionally, they identified that the opportunity for the community to interrogate the context of a proposal through the data layers provided on Urban Pinboard was likely to lead to greater understanding of the proposal, and would also encourage the private sector to deliver more evidence based planning and design.

Based on the three-fold methodology the team started developing the ‘Urban Pinboard’ platform using agile software development principles (Collier, 2011). This was motivated through the mixed nature of the project development team comprising a mixture of: architects, urban designers and computational designers working in a practice; academics from computational design; a software development team with a quantity surveying background; and a national urban development institute as client. Hence ‘Urban Pinboard’ needed to evolve through the collaborative effort of this diverse, self-organized and cross-functional team mixture.

**URBAN PINBOARD**

Urban Pinboard (urbanpinboard.com/app) is an integrated digital platform that enables the public, private and community sectors to connect by contributing ideas, comments and proposals on all planning issues in a single platform. Urban Pinboard is the product of City Live Labs, a national innovation competi-
tion hosted by Urban Development Institute of Australia NSW Chapter, with the architecture / urban design firm Cox Architecture, Sydney and the academic partner University of New South Wales / Computational Design as winner of the competition (City Live Labs, 2016). Urban Pinboard was developed by the AAM group, a Geospatial Services company with offices in Australasia specialising in the collection, analysis, presentation and delivery of geospatial information.

The research team took as premised that planning issues may be physical, visual, acoustic, strategic and political and they could be local or regional. Further they may be quantitative and/or qualitative. Hence Urban Pinboard was developed to be a data and knowledge rich resource that has the ability to raise the urban IQ of the city and as a result, produce more informed decision making and smart city transformation. Further Urban Pinboard is founded on open urban data, with the latest qualitative and quantitative urban data constantly being inputted by all sectors to become a universal resource and collaboration platform. Examples of urban data that may be harnessed and integrated within Urban Pinboard may include:

- Community Input: local knowledge and insight that already exists but is normally locked away. i.e. lack of amenities in a certain area; lack of performance of certain infrastructure; ideas for new developments or programs; public perspective on policies or infrastructure investment;
- Professional Input: Research or studies prepared for a particular area by professionals. i.e. flooding studies; site survey information, traffic studies; ideas for new developments, improvements, collaborations.
- Other Urban Data: Big Data of Cities - Theory and Politics surrounding data;
- Policy-making urban data: land use and ge-ophographic data, Census & demographic data, traffic - mobility & flow data; Other types of urban data from social media and twitter to noise, urban lights and urban heat; Public and Open Data (or commercialised data).

The development team sees Urban Pinboard as an urban data marketplace, where commercialised data could be exchanged or purchased through plug-in applications integrated with the platform. Once on Urban Pinboard, data and ideas can be responded to or elaborated on by others from any sector, providing equal opportunities to be connected (See also Figures below).

The digital platform enables participants to respond by sharing their own views on the data they see, regardless of their physical proximity to the matter being proposed or addressed.
Participants can share their ideas and responses via connected platforms such as social media, in order for those ideas to gain momentum and reach wider audiences. Urban Pinboard has sophisticated voting and ranking systems to allow popular ideas and data to be brought forward to gain more momentum and become a project or action. Still it also could function as a tool used by a development or developer team. In listing some, but not all, features and functions Urban Pinboard can / is:

- **User login with user specific interfaces.** Urban Pinboard caters for different users ranging, as listed above from the private and public sector to the general public. Naturally each group has different expectations and skills they will bring to Urban Pinboard. To give an example, a community member might only want to see projects that are under DA (Design Approval) and alter the shadows to see if the new development overshadows his/her site, but do not want to engage into further tools such as uploading a DA, as an architect might like to do, or do a query for suitable sites, as a developer might do. Hence each user group has specific tools available to their individual needs. Users can login via registering an account or via using their Facebook or Twitter credentials (See Figure 1).

- **A browser based 3D representation of the physical city, including buildings and terrain.** Urban Pinboard is able to render 3D buildings in real-time as well as the terrain (See Figure 2) This 3D map is frequently updated by the geo surveyors at AAM, the back end developer of Urban Pinboard to assure that 3D map is up to date. Users can choose different base maps such as Streets, Satellite, hybrid or topography. Again, this gives specific user groups the opportunity to engage in a preferred way with Urban Pinboard and to allow general public users to navigate via a map system they are comfortable with through their use of Google Maps.

- **Multiple layers of data.** It includes multiple layers of data that are pulled from a variety of sources including planning controls, demographic and/or transport data (See Figure 3). These data are displayed in a variety of ways, and overlay on the 3D representation of the cities or councils of interest. For the council used in beta version (Parramatta City Council in NSW, Australia) this results into ~ 800 layer sets with several sub layers underneath. The data were grouped into main fields of interest with sublayers, as well different users will get access to some or all data depending on their login credentials.

- **Filter, search and layer tools.** Filters, search and layer tools to easily navigate and control the display of data. These tools are widely used in web GIS and need little introduction. Urban Pinboard has more numerous data layers than something like Google Maps and so layers are organized into subcategories. An interesting feature for users from the public sector in particular developers is the ‘query’ function. (See Figure 4) Here a developer can search for sites that meets certain requirements i.e regulations such as no heritage, a particular FSR, etc. in combination with soil and ground information in order to assess and evaluate potential costs to develop the site.

Figure 3
Screen capture showing the data layer function on the right side of the user interface © Industry&Co
• **Uploading proposed buildings by designers or developers.** A developer or architect can use Urban Pinboard to upload a proposed building which would then be visible to the public, in 3D, in its context (See Figure 5). Urban Pinboard also allows developers to upload text and images and create a panel to display their project in a traditional manner. Further, the multiple built form options per project can be uploaded which increases the value of engagement. The potential to upload proposals prior to a DA submission offers an interesting option for a developer to engage with the community. A proposal can be tested upon the response from the community, i.e does the community care less about if the building is taller than the planning regulation allow because it offers extra public space. This feedback can be collected and evaluated via the browse, comment and vote function outlined below.

• **Understand buildings in their ‘data context’.** All users can turn on data layers to understand buildings in its ‘data context’ - all the physical and nonphysical information that is meaningful to evaluating the project’s suitability. Some of the data layers - particularly those representing legal zoning constraints - are hosted by the relevant custodian and pulled at time of use. This ensures data integrity.

• **Browse, comment and vote on proposals.** Ability for the public to browse proposals, and comment and vote on them, providing feedback to the developer as well as the government directly through the platform. The comments are organized in threads according to each project option.

• **Showcase 3rd party apps on Urban Pinboard.** Developers and government users can use Urban Pinboard to run analysis via 3rd party apps to develop a deeper understanding of the building. (See Figure 6) This serves two functions. First it allows focused specialized uses of the Urban Pinboard platform which increases the number of experts contributing to the platform. Secondly it provides the possibility for consultants to derive income from Urban Pinboard which creates an incentive to engage.

• **Urban Pinboard as a marketplace.** 3rd party data vendors can use Urban Pinboard as a marketplace to sell their data, these could
be static but also real-time data. A benefit of a web-based platform is that Urban Pinboard can consume a wide variety of spatial data formats, and so is well placed to display data collected and stored elsewhere from the private sector, as shown on the example Kinesis (See Figure 6) as well as public sector like universities such as UNSW’s City Data (www.citydata.be.unsw.edu.au) or others.

- Community orientated functions. Reservations against neighbouring new developments are often associated with the question of overshadowing. Where as planning permission often only require a proof on the summer and winter solstice Urban Pinboard offers a feedback for any day of the year at any site. Thus members of the community can easily evaluate if their property is overshadowed at any day and time during the year. (See Figure 7)

Figure 7
Shadow function to enable community members to assess overshadowing of the property. © Industry&Co

EVALUATION AND NEXT STEPS
At present Urban Pinboard exists as a beta version with one council, Parramatta in New South Wales, Australia, represented through its spatial, economic and social data. Over the next months we are planning to cover most of Greater Sydney to then extend Urban Pinboard further to the state of New South Wales and finally Australia, with the potential to extend the project to Australasia. Where as 3D building information can be provided by our partner AAM , the collection and access to data for all proposed regions will remain the main challenge of this project. Initiatives like National Map in Australia (www.nationalmap.gov.au) are a step in the right direction to better access data for planning and APIs can feed data from the platform directly into Urban Pinboard and updates can happen instantly. Still to often data is scattered over several platforms and we hope that Urban Pinboard can play a role in collecting and visualising data from different sources to make them available to a wider community. This is where we see the greatest strength of Urban Pinboard as we understand and see it as an interface to access data but not a data storage. When reflecting on the observations and the research question and evaluate the result we argue that Urban Pinboard has provided a single,3D user interface to that data which is legible to the public, design professionals and government users as well as that it has the potential to become a shared platform that enables new business model for architects and consultants. Further we see the following benefits for the private, community and public sector.

Private Sector Benefits
Urban Pinboard will provide local insight and knowledge to developers, as well as all professionals and consultants. These inputs can be considered and incorporated into their proposals or professional outputs which are more likely to be favoured by both public sector and community sector through the collaborative process. As a result, the timing required to undertake formal community engagement processes and for development applications to be assessed has the potential to be significantly reduced.

Community Sector Benefits
Urban Pinboard will provide easy access to essential data and knowledge of areas where communities live or are interested in, allowing them to be more educated and more ‘intelligent’ in addressing urban challenges. Communities will be encouraged in several stages to interact with Government and the private sector on service solutions and to improve outcome
for their areas, creating attractive communities as a result.

Public Sector Benefits
Urban Pinboard can become the main tool for all government agencies to engage and communicate with the other sectors. The nature of it being digital, legible and accessible, allows them to communicate much more efficiently than ever before, hence providing them with significant economic, as well as social benefits.

Yet to definitely answer and argue for these benefits with confidence Urban Pinboard needs to be applied and tested on case studies in each of the three sectors.

Next Steps - Community Engagement 4.0
Before rolling out Urban Pinboard to further councils and thus a state-wide platform the team aims to conduct tests. This first test concentrates on how Urban Pinboard performs for community and the general public. There is evidence that in periods of rapid growth large projects often face opposition from community. Here research suggests that opposition often arises due to a lack of trust and limited understanding of the development process. As argued in the background chapter of this paper legally planning documents are available to the public during the consultation phase and ultimately, a community or individuals may decide to oppose a project, not because they disagree with the proposal, but because they simply do not understand it. To address this significant challenge, Community Engagement 4.0, the first test project funded by Urban Growth NSW, a large developer proposes the following research questions: “Can Cities 4.0 principles (Web 2.0, social media, open data and computational design) technologies help better communicate planning concepts to the public through a digital representation of planning data using Urban Pinboard?” The project aims to add emerging technologies to Urban Pinboard as they present engagement opportunities to government that can demonstrate public sector innovation through collaboration with key stakeholders. This is relevant as research argues that Cities 4.0 principles (Web 2.0, social media, open data, computational design) can harness “digital disruptive trends of automation, internet of things (IoT), cloud computing, virtual reality, 3D modelling, and other cyber-physical systems” to “fundamentally change city planning, design, construction, governance, financing and operations” (Cities 4.0 Summit, 2017). These emerging concepts offer new opportunities for cost effective, customised and engaging ways to communicate development projects to the community. The full scope and potential of Cities 4.0 concepts is not yet sufficiently understood when focussing on community engagement. To conclude next steps aims to achieve:

• Identification of efficient ways for collecting, analysing and storing social media data and digitised information on community engagement;
• Using virtual reality or 3D modelling via the UrbanPinboard platform to assist in explaining planning concepts to the public; and
• Forecasting community behaviour through machine learning.

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