A planning support system to optimize approval of private housing development projects

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Abstract. Out of 182 million population of Pakistan, 38% reside in urban areas having an average growth rate of 1.6%, raising the urban housing demand significantly. Poor state response to fulfil the housing needs has resulted in a mushroom growth of private housing schemes (PHS) over the years. Consequently, only in five major cities of Punjab, there are 383 legal and 150 illegal private housing development projects against 120 public sector housing schemes. A major factor behind the cancerous growth of unapproved PHS is the prolonged and delayed approval process in concerned approval authorities requiring 13 months on average. Currently, manual and paper-based approaches are used for vetting and for granting the permission which is highly subjective and non-transparent. This study aims to design a flexible planning support system (PSS) to optimize the vetting process of PHS projects under any development authority in Pakistan by reducing time and cost required for site and documents investigations. Relying on the review of regulatory documents and interviews with professional planners and land developers, this study describes the structure of a PSS developed using open-source geo-spatial tools such as OpenGeo Suite, PHP, and PostgreSQL. It highlights the development of a Knowledge Module (based on regulatory documents) containing equations related to scheme type, size (area), location, access road, components of layout plan, planning standards and other related approval checks. Furthermore, it presents the architecture of the database module and system data requirements categorized as base datasets (built-in part of PSS) and input datasets (related to the housing project under approval). It is practically demonstrated that developing a customized PSS to optimize PHS approval process in Pakistan is achievable with geospatial technology. With the provision of such a system, the approval process for private housing schemes not only becomes quicker and user-friendly but also transparent.

1. Introduction

Housing is a basic human need. With the average growth rate of 1.6%, population in Pakistan has reached to 185 million out of which 38% reside in urban areas [1]. In 2009, total housing demand was 8 million which will grow to 13 million by 2025 with an annual incremental need of 1.1 million [2]. In the absence of adequate public sector response, there has been a mushroom growth of private housing development projects. As compared to 120 public sector housing schemes (covering 9,462

acres) in five major urban areas of Punjab (largest province of Pakistan), there has been 383 private housing development projects (covering 21,987 acres) [3]. Additionally, over 150 illegal private housing schemes exist within jurisdictions of development authorities. It is estimated for Lahore that 75% of residential land development is done by informal/unplanned sector.

A major factor behind the cancerous growth of unapproved private housing schemes is the delays in the approval process. While the hindrances in the approval process include lack of awareness in developers about planning regulations, confusion about jurisdictions of development authorities (DAs') and lack of coordination among planning agencies. The approval of PHS or land subdivision is governed by zoning regulations and private housing scheme rules of particular development control authorities. According to the officials, the average time taken for approval has been 13 months which affects the whole project in terms of cost and development.

The approval of PHS is governed under a set of rules/regulations of concerned development control authorities or Town Municipal Administration (TMA). Applicable regulations for private housing development project vary from one area to another with the change in number and weightage of factors under consideration. On the other hand, in the case of Islamabad (the capital), they vary for various development zones while in the case of Lahore (capital of Punjab province); they differ on the basis of area of housing project. In most of the cases, any private housing development project has to be in line with the latest development plan, zoning regulations and housing scheme rules for that particular area. Currently, a manual and paper based approach is used for vetting and for granting the permission which is highly subjective and non-transparent [4], [5].

This study explains the structure of a PSS which has been developed using open source set of tools (OpenGeo Suite[1], PHP, and PostgreSQL) to improve the efficiency of PHS approval process by reducing time and cost required for site and documents investigations. The system development follows the ideas advocated by an earlier school of thought [6]–[8]. It is believed that the developed PSS will provide answers to the following questions to speed up the decision process:

- Under which authority's jurisdiction, the housing project location falls?
- Are there any zoning regulations for this location? If yes, in which zone this project falls?
- Based on location and size (area), what are the applicable zoning regulations and housing scheme rules?
- Analyze the housing scheme layout plan and provide the following information:
  - percentage of various land uses
  - Schedule of plots
  - Schedule of street widths
- Whether the division of land uses, plot sizes and street widths are in line with permissible rules? If not, identify problematic areas.

The remainder of the paper is organized as follows; Section 2 outlines the scope of the research project while the related literature is presented in Section 3. The detailed legislations and the local government rules are described in Section 4 while Section 5 explains the data requirements, system flow diagram and the implementation details of the prototype. Finally, conclusions and directions to future work are given in Section 6.

2. Scope

In terms of scope, the knowledge module of PSS will be based on the review of documents from all development authorities of Punjab and Islamabad Capital Territory. It will make it geographically usable for the whole of Punjab (most populated province of Pakistan accommodating 56% of total population) as well as for capital territory. Furthermore, the system has been designed such that user will be able to add/ define the parameters for any other part of the country to use it elsewhere.

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[1] http://boundlessgeo.com/solutions/opengeo-suite

The first stage in the formulation of this PSS included the development of knowledge module by extracting rules from regulatory documents. It contained equations related to scheme type, size (area), location, access road, components of layout plan, planning standards and other related approval checks. At the second stage, the architecture of database module was designed where data requirements were enlisted and categorized as base datasets (built in part of PSS) and input datasets (related to the housing project under approval). The *base datasets* included jurisdiction boundaries of DAs, zonal limits, existing regional road network and future roads proposed in approved development plan while the *input datasets* comprised of the boundary of the housing project, plots distribution, road network within proposed project and location of proposed civic facilities. Each of the input datasets possessed a predefined set of attributes. Figure 1 illustrates the generalized flow chart, placement, and interaction between the developed PSS components.

3. Related work

Deciding about the approval of a private housing project is very subjective and relatively complex in nature. Owing to the uniqueness of location, design, physical surroundings, designer vision, relevant regulatory body etc., each approval case requires dealing with a considerable level of uncertainty. Around the globe, planning support systems have been frequently used in such circumstances to aid planners by combining GIS, urban models, and visualization tools [9]–[14]

Anjum [3], Larkham [15] and Yaakup et al. [16] have acknowledged the complexity of procedures undertaken by planning authorities during planning approval process. They highlighted that the process of analysing the suitability of planning applications involves many stages of decision-making which faces delays, inconsistent decision making owing to personal judgment, and lack of transparency.

In 2007, Yaakup et al. proposed a planning support system for local authorities in Malaysia to facilitate development plan implementation, improved service delivery, and enhanced planning approval process [16]. From the review of literature from advanced world, it was concluded that a spatial decision support tailored to the Pakistani context will serve the purpose.

Ballatore et al. (2011) have articulated a comprehensive comparison of open source geospatial technologies for web mapping where they have reflected good marks for PostGIS, OpenLayers and ExtJS [17]. Additionally, in another similar study, an open source web architecture is discussed which is built on PostgreSQL, OpenStreetMap and MapServer[18]. We use above mentioned open source geospatial technologies which are widely used and tested in various applications.

4. Understanding private housing schemes approval process

4.1. Review of relevant regulation

To develop the desired PSS, it was important to review relevant rules and regulations from an operational perspective. Following documents have been reviewed to extract rules governing approval of private housing schemes.

- Punjab Private Housing Schemes and Land Subdivision Rules 2010
- LDA Private Housing Schemes Rules 2014
- Islamabad Capital Territory Zoning Regulations 2005
- Capital Development Authority (CDA) Housing Scheme Regulation for Zone, 2, 4 and 5

Table 1 provides a summary of key attribute areas and corresponding rules contributing to the approval of private housing scheme in above-mentioned areas [19]–[21].

Table 1. Rules governing approval of private housing schemes in Pakistan.

Attribute	Rule Definition
Type	- Land subdivision (up to 100 kanal) - Farm housing scheme - Private housing scheme (more than 100 kanal)

Size	For LDA; Area <40 kanal
	40 – 99 kanal
	100- 300 kanals
	300- 500 kanals
	>500 kanals
	For RDA; Min area is 100 kanal
Access Road	Have frontage on Access Road, RDA needs min 60 ft
Location	Not in Flood zone
	Not notified for acquisition by government
	Fall in area marked as residential in approved development plan
Layout Plan	*Compulsory components:*
	Scale of scheme plan is 1:1200 to 1:2400
	Scale of location plan is 1:4800
	Size and dimensions of each plot
	Plot number
	Corner plots should be chamfered; up to 1 kanal by 5X5 and >1 kanal by 10X10
	Right of way of roads
	Dimensions of scheme boundary
	Boundary of the mouzas or a revenue estate
	Number and boundary of each Khasra in a mouza
	Land use breakup in area and percentage for

- Residential
- Commercial (Com)
- Open Spaces (OS)
- Roads
- Graveyard (GY)
- Public buildings (PB)
- Other land uses

Schedule of plots with area and size
Area of existing graveyard, if any
Location of pumping station, overhead water tank, and tube well if any
Aggregate of various categories of plots to be mortgaged

Planning standards	Land use	Land subdivision		Farm housing scheme	Private housing scheme		
		< 40k	*40-99 k*		*<300 k*	*300-500 k*	*>500 k*
	OS	-	Min 5%	Min5%	Min7%	Min 7%	>=7%
	GY	-	-	Min2%	Min2%	Min 2%	Min 2%
	Com	-	Max 1%	Max5%	Max5%	Max5%	Max10%
	PB	-	Min2%	Min2%	2-10%	3-10%	4-10%
	Plot size	2k max	2k max	4k min	2k max	2k max	2k max
	Street	Min 30ft	Min 30ft	Min30ft	Min30ft	Min30ft	Min30ft
	Solid waste mgmt.	-	Min5m	Min10m for every 500 kanal	Min10m for every 500 kanal	Min10m for every 500 kanal	Min10m for every 500 kanal
	Major Road	Min40ft	Min40ft	Min40ft up to 300k and 60ft above 300k	Min 100ft	Min 100ft	Min 150ft
	Society Office	-	Min 5m	Min 10m	Min 10m	Min 10m	Min 1k

Other Checks	If the project site intersects any road proposed in approved development plan, then accommodate in plan
	If the project site intersects a high tension electricity line, provide green strip
	10% of the plots shall be allocated for 3-5 marla
	10% of the remaining plots shall be allocated for multistory flats or apartments

*4.2. Semi-structured interviews with professionals and developers*
Considering the importance of stakeholders in the approval process of a private housing scheme, views of both professional planners and developers have been noted by means of semi-structured interviews. This helped in understanding current practices and ground realities, and identifying loopholes and time-consuming stages. It has been ensured that their comments and suggestions are also incorporated in the design of the system architecture.

5. PSS system description
In terms of data requirements, the system requires seven different vector layers including jurisdiction boundaries of DAs, land-use zones, regional road network, the boundary of the project site, plot subdivisions, street network within proposed project and location of proposed civic facilities. Table 2 provides detailed characteristics of each of the data layer containing layer type (polygon, polyline or point) and associated attributes. Additionally, comments have been added for further explanation.

Table 2. Data requirements in the proposed PSS.

	Dataset	Type	Attribute	Comments
1	Jurisdiction boundaries of Development Authorities		Name of authority	Polygonal demarcation of jurisdictions of development control authorities
2	Zones		Zone number/ names	Zonal polygons obtained from land-use zoning map
3	Regional road network		Road class, width, name	Network of Existing roads + road proposed in approved future development plan of the area
4	Location of housing project		Size	Shapefile containing boundary of the project site
5	Plot distribution		Plot size, land use, height, address	Shapefile containing land subdivided into plots such that each polygon of plot contains its attributes
6	Road network within proposed project		Width, Type (major road, internal road etc.), name	Centre line road network of the proposed project
7	Location of proposed civic facilities		Use, Name	Shapefile containing point location of proposed civic facilities including schools, health facilities, parks, commercial center etc.

Overall workflow and interaction of components in proposed PSS is given in Figure 1. The system uses four data layers as base datasets. These layers (control area of DA, zoning plan and both existing and proposed regional road network) have been made built-in part of the system. Four other layers are needed as input datasets and these are related to the PHS under consideration. Rules derived from regulations have been made part of knowledge module in the form of built-in equations.
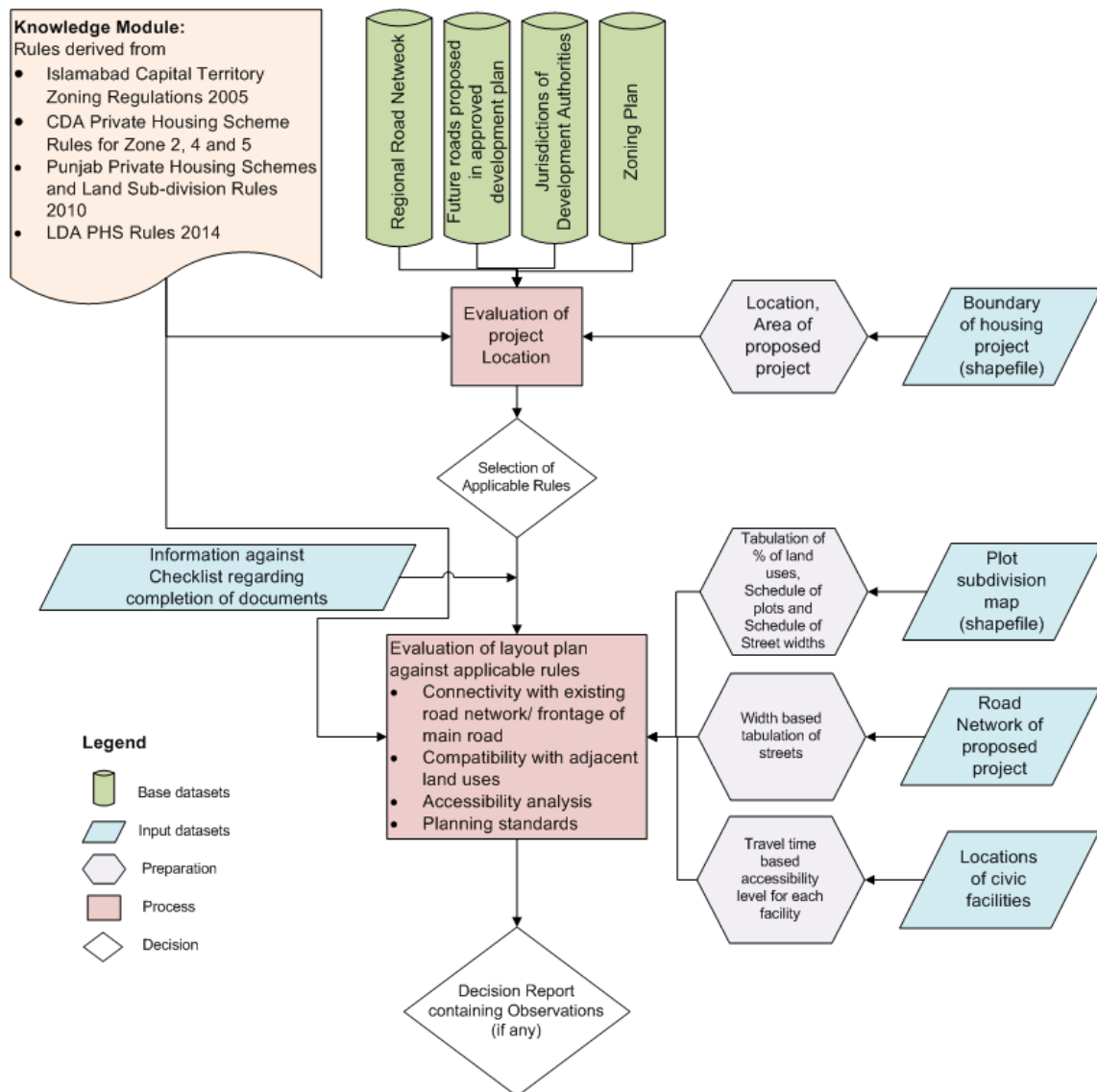
Figure 1. Generalized workflow and interaction between PSS components.

In terms of user interface, a combination of OpenLayers, GeoExt and ExtJS has been used. ExJS is a JavaScript framework for building cross-platform web applications leveraging HTML5 features while GeoExt provides a bridge between OpenLayers and ExtJS. Figure 2 reflects the arrangement of various tools, layer tree, map window and legend panel of the system which is currently displaying the control area of DA, alignment of proposed roads and location of the project site. Figure 3 illustrates the land-use breakup analysis of a loaded PHS layout map while Figure 4 shows the information on key decision indicators for the PHS project under consideration based on its location.
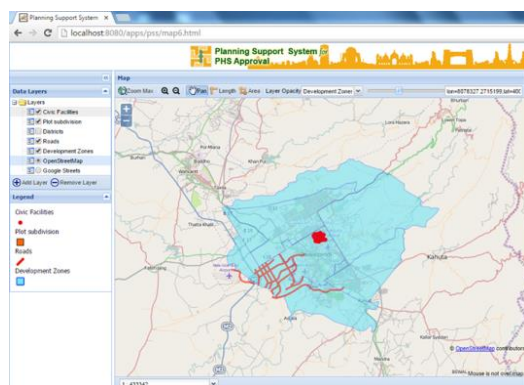
Figure 2. Screenshot of PSS showing the jurisdiction of development control authority and future planned roads.
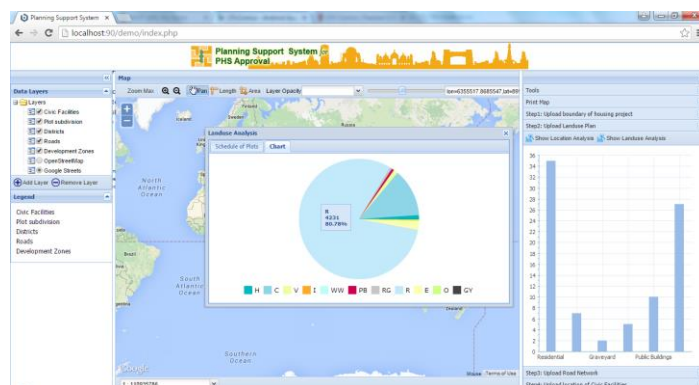

Figure 3. Snapshot reflecting land-use breakup of the proposed PHS derived from attributes of loaded Shapefile.
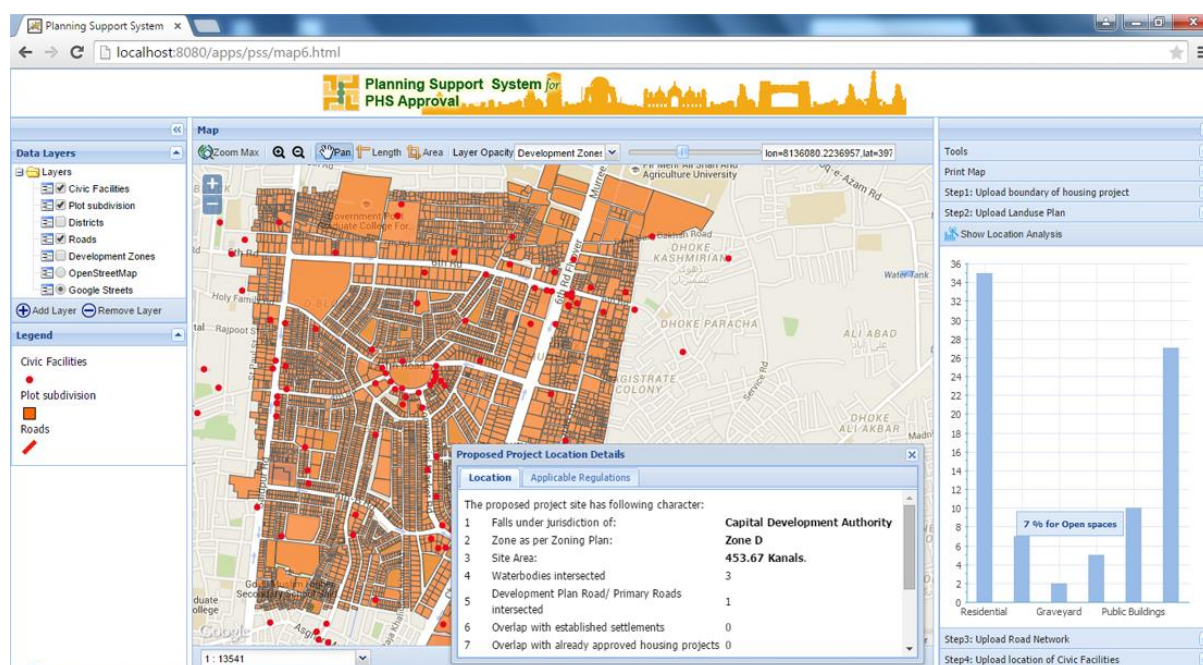

Figure 4. Once plot subdivision map is loaded, PSS provides location analysis including information about associated development authority, zone, site area, intersection with existing water bodies, overlap with already approved PHS etc.

6. Conclusions and future work

This study proves that developing a customized planning support system to achieve time and cost efficiency in private housing schemes approval process in Pakistan is very much achievable with open source tools. In doing so, the approval process for private housing schemes not only becomes quicker and user-friendly but also becomes transparent. However, availability of adequate human resources and existing institutional setup are few of the biggest challenge in the implementation of such PSS in concerned development authorities and TMA's. Wider utilization of the system is recommended, however, awareness and capacity building is direly needed to remove the reluctance of professional planners working in development authorities in Pakistan.

Since the PHS regulations are subject to changes based on area and time, the knowledge module of the PSS has to be updated. Further work is needed to develop and configure graphical user interfaces to add/update equations in knowledge module. Similarly, work can be done to enhance

reporting module so that advisory reports containing suggestions for improvements in PHS layout can be produced.

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