

User-centred approach for developing PPGIS.

Khitam Shraim

School of Environment & Development,
University of Manchester, England, M1 3 9PL

khitam.shraim@postgrad.manchester.ac.uk

khshraim@hotmail.com

1. Introduction

Web-based mapping interactive tools such as public participation geographic information systems (PPGIS) have substantial promise to enhance public participation in the planning process and to serve as a communication bridge between stakeholders (Seiber, 2006). The effectiveness of such tools, however, is constrained by fundamental issues such as usability and acceptability. Thus, in order to design these ‘means’ to successfully achieve the desired ‘ends’, the development of PPGIS applications as social and technical objects should be based on a user-centred approach that focuses on “intended users and their environment and how technology can best be deployed and designed to support them” (Preece et al., 1994, p 7).

Users of web-based GIS applications notably encounter more difficulties than users of other online systems such as e-commerce (Warren and Bonaguro, 2003; Steinmann et al., 2004). It is believed that these difficulties are due to the inherent complexity of web GIS applications in terms of the specialized functionality that supports online GIS, the amount of content available and the skills required to interpret this content (ibid). This complexity can present a major impediment to public use of these applications. Generally, the call is to develop “a comprehensive user-centered design approach to geovisualization usability” (Maceachren and Kraak, 2001).

This paper aims at informing the importance of adopting user-centred approach for identifying users’ needs and requirements in developing a usable and acceptable PPGIS application. So, utilizing technology to develop PPGIS is a social construct (Feenberg, 1999) that integrates the participants’ interest into the design process. A case study is carried out, where soft system methodology (SSM), usability engineering (UE) and acceptance of the new technology models (TA) are integrated in developing a prototype PPGIS for empowering public participation in educational planning in Palestine to meet the challenge of the Millennium Development Goals. The proposed methodology provides opportunity for researchers to take an interdisciplinary perspective in developing PPGIS and merge different methods and techniques.

2. Methodology Framework

This research explores the possibility of using Web Information Systems Development Methodology (WISDM) developed for e-business (Vidgen et al., 2002) for generating a framework to develop the PPGIS tool. This framework (Figure 1) consists of two-dimension socio-technical aspects and concentrates on organizational analysis, technical design, and HCI design. In these successive stages, issues concerning users and their environment are central to the design process (Preece et al., 1994). The

organizational analysis is based on human activity, with a seven-stage of SSM developed by Checkland (1999) with the intention of stimulating a debate about defining changes that are ‘systematically desirable’ and ‘culturally feasible’. Results from organizational analysis identify both the technical and social requirements of the new system (Avison et al., 2003). The technical design is concerned with how to integrate the stakeholders’ needs and requirements into the structure and functionality of the system (Preece et al., 1994), while the HCI design focuses on the usability and acceptability of the new application.

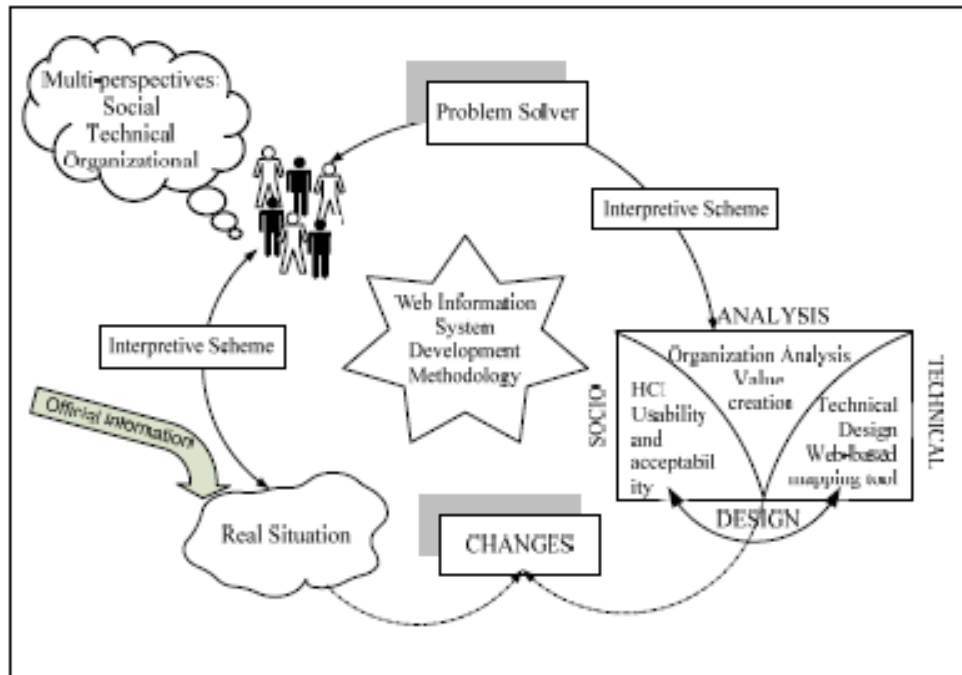


Figure 1: WISDM for EP-PPGIS (adapted from Vidgen et al., 2002)

3. Methods

Phase 1: SSM

In developing a website like PPGIS, considerable attention are given to the issue of putting people first and capture a holistic view from them. This is starting with organization analysis or human activity with the seven-stage techniques of SSM (Figure 2).

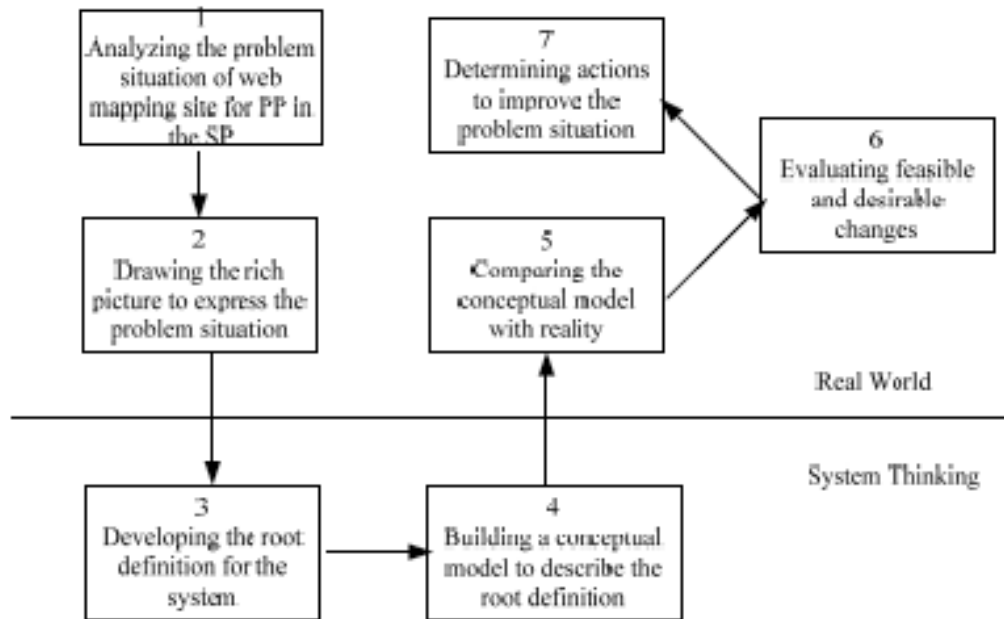


Figure 2: SSM model (adapted from Checkland and Scholes, 1990)

The techniques used to explore variations in the perspectives of stakeholders were discussion groups and in-depth semi-structured interviews with key players responsible for and interested in developing the education system which were conducted between 15th June, 2006 and 15th September 2006 in Palestine and Jordan.

Phase 2: Technical Design

Like any system, PPGIS designers are required to know the intended users and involve them early and continuously (Andrienko et al., 2002). Throughout the system development lifecycle, frequent discussions with intended users were carried out to ensure that the interface of the website designed meets their needs and is usable.

Phase3: HCI design

The recent evolution of user-centred design methods means that ‘ISO-backed’ usability standards are considered a crucial part of the software engineering lifecycle which must be extended to user acceptance of new IT applications (Dillon, 2000). Therefore, the process of designing the new system should take account of HCI factors and be extended to include both the usability and acceptability of the PPGIS website.

Usability framework

The main aim of usability testing is to identify difficulties and shortcomings potentially affecting an end user in using the PPGIS tool. Two methods were used to evaluate the usability of PPGIS version 1; usability testing with 10 participants and discussion with 7 individuals. The criteria used were the so-called 4 Es: Efficacy, Efficiency, Effectiveness and Elegance.

Acceptability framework

The main aim was to examine how users come to accept and use a new technology such as PPGIS. In this research, five determinants of adoption of PPGIS version 2 were chosen from different technology acceptance models (Davis, 1989; Venkatesh et al. 2003). These determinates are information quality, functionality and interactivity quality, perceived ease of use map-based interface, perceived usefulness and social influence. A 30-question online questionnaire was adapted from these models and tailored to be more specific to the PPGIS application based on literature related to the PPGIS context.

4. Results

Phase 1: SSM process

Stage 1: The starting point is to identify the ‘problem situation’ to be addressed by PPGIS. In the context of this research, the top-down concern of the problem owner, the Ministry of Education (MEHE), is that there is a problem in the SP process due to the ongoing crisis in Palestine and thus a need to work with local communities to improve the planning process. On the other hand, the push of bottom-up technologies from the Internet and web GIS provides an opportunity to empower the public to participate in the spatial planning process (Carig et al., 2002; Sieber, 2006).

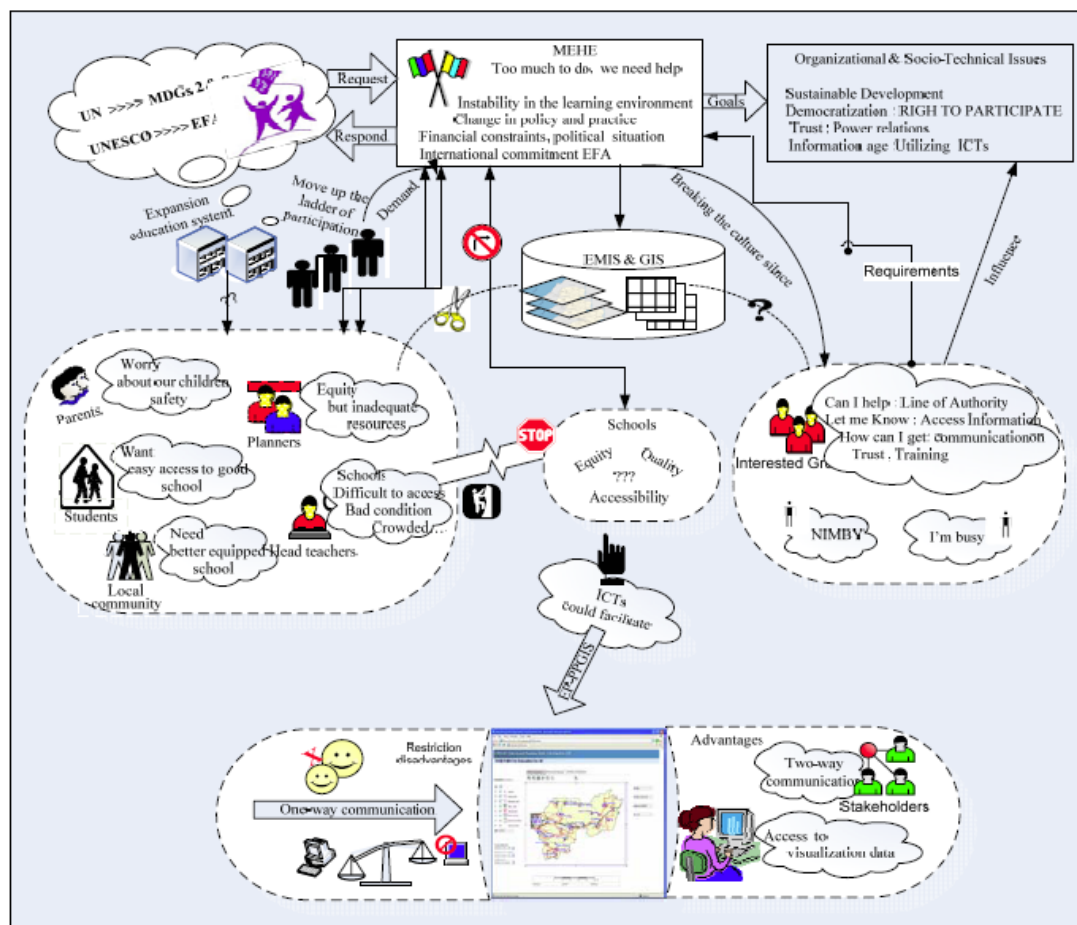


Figure 3: The RP of the SP in Palestine.

Stage 3 is the development of a Root Definition (RD), whose aim is to express some purposeful human activity system. The RD does not exist in the real world, but is concerned with the system thinking, which is more or less relevant to the problem situation. The transformation process (change), which is the core of the RD, is based on the X-Y-Z structure: *Do X by Y in order to achieve Z*, which tell us what the system will do (X), how (Y) and why it needs to be done (Z) (Checkland, *ibid*). Generally, various participants' perspectives assembled into an overall RD for participatory approach as follows:

The Ministry of Education and Higher Education in Palestine is responsible for the SP, looking to improve PP in the SP (X) by the introduction of web mapping tool, PPGIS, (Y), taking into consideration the technical and institutional aspects, and the willingness of the public to participate, in order to improve spatial planning issues (accessibility, quality equity) and then to achieve the EFA initiative (Z). The RD is formulated as follows **CATWOE**:

Customer	Stakeholders, interested groups, all public.
Actor	Decision makers, educational planners and developers.
Transformation	Need to improve PP in the SP----- public participation improved via PPGIS website.
Worldview	Believe that utilizing ICT could empower the public to involve in the SP and then to improve the accessibility, equity and quality of school in order to achieve the EFA initiative.
Owner	Ministry of Education and Higher Education, Palestine.
Environment constraints	The willingness of the public to participate and technical and institutional aspects such as physical accessibility to the Internet, trust, digital divide.

Table1: CATWOE for PPGIS in SP in Palestine.

Stage 4:

Figure 4 represents the overall Conceptual model (CM) which includes the minimum number of necessary activities expressed through verbs to meet the requirements of the RDs described in the above section.

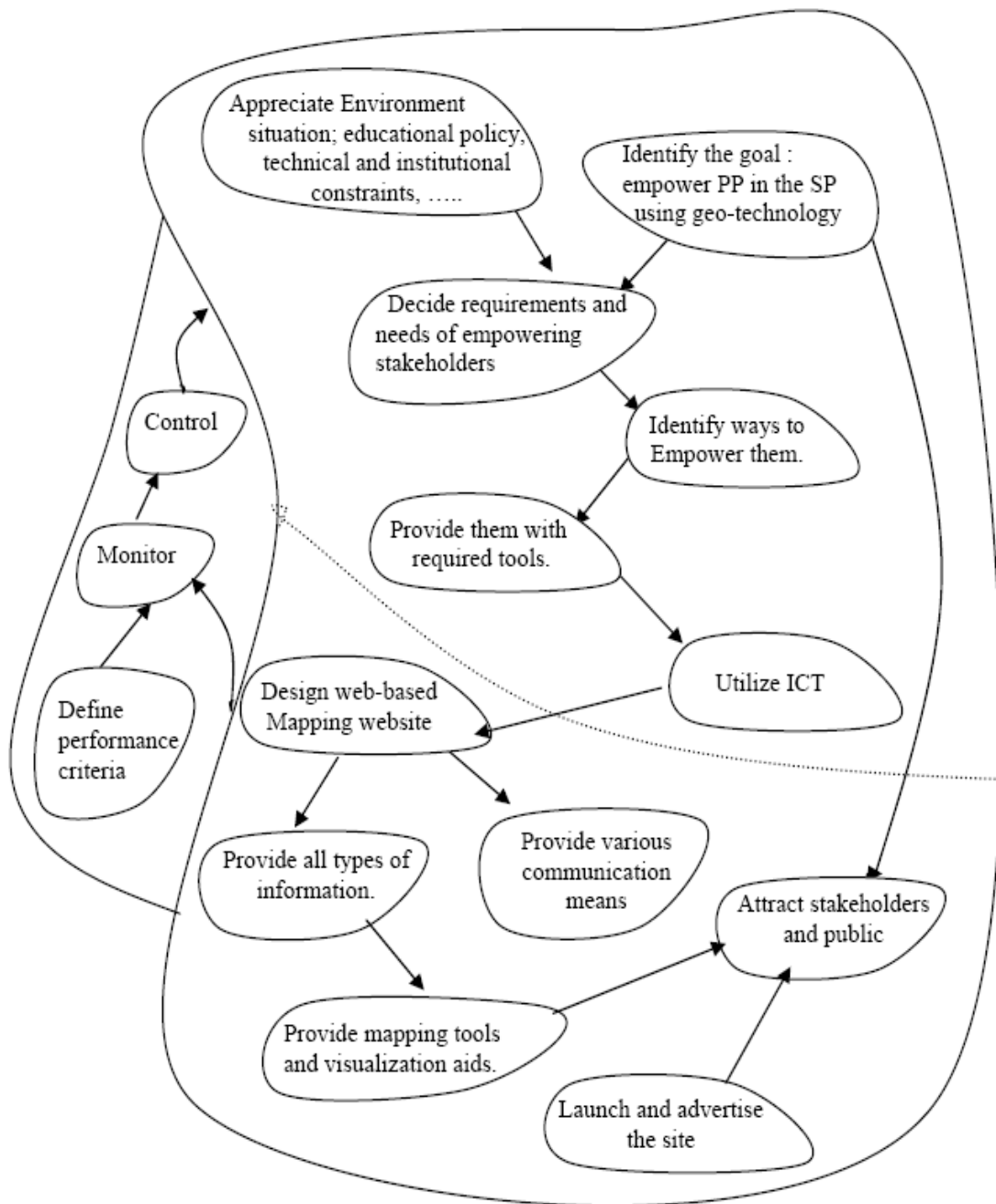


Figure 4: CM of PPGIS

Stage 5 compare the CM developed at stage four with the problem situation expressed at stage two. Given that the PPGIS tool is new to Palestine, the general comparison was based on ‘what’s and how’s questions (Coupri, et al., 1997). ‘What is the current situation of public participation in educational planning in Palestine’ and ‘what form should it take’ were debated by decision makers at the MEHE who came to accept that ICT-based participatory approach within educational planning should be regarded

as imperative and receive more attention. Changes of attitude at the national level pave the way for necessary structural and procedural modifications in order to facilitate a high degree of public involvement (Flood and Jackson, 1991).

Stage 6: During the semi-structured interviews and discussion group, the participants highlighted the essential requirements that have to be taken into consideration to achieve the structural and procedural changes desired.

Stage 7: The final stage is to make recommendations to address the problem situation, not actually to implement specific solutions (Checkland, *ibid*). The MEHE has already recommended setting up the required procedures such as improving technological infrastructure, raising awareness, advertising the websites and controlling the process and building trust.

Phase 2: Technical Design

The PPGIS website Figure 5 is currently being developed as a pilot application with a technical platform based on Open Source Software (OSS) using Open Geospatial Consortium (OGC) compliant Web Map Server (WMS) technology, MySQL for the database and PHP scripting language.



Figure 5 The EPPGIS website interface

Phase 3 : HCI Design

Usability

The result of usability testing indicates that the website partially met its objectives by providing sufficient information. Although, it provides several communication channels that meet the needs of different groups, yet does not take into consideration the geo-referencing and restrictions of users contributions seriously. Participants were generally satisfied with the map-based interface and found that visual representation is more effective to attract them. Feedback was used immediately to improve the functionality and interface design of the prototype.

Acceptability

Since PPGIS application has been introduced recently and individuals have no or limited experience in the early stage, several workshops were conducted to the participants prior filling the questionnaire. The survey was conducted from 5th of November 2007 through 10th January 2008. A total of 163 different cases responded to the survey. Seven of the received responses were dropped because they were incomplete. This was an extremely complex task considering the political situation in Palestine.

The regression analysis revealed that functionality perceived usefulness and social influence would be influential in the Palestinian decision to adopt the PPGIS in the future while perceived information and perceived ease of use interface would not.

The open comments of respondents were also analyzed alongside the quantitative analysis. The assessment confirmed that there were a number of issues that would need to be addressed, the most significant being related to institutional (organizational) and procedural (logistics) considerations.

5. Conclusion

In this paper three methods; SSM, UE and AT are integrated to identify needs and requirements for and responses to ICT-based development activities for effective design and to determine a set of variables that have a significant influence on Palestinian intention to adopt new technology such as PPGIS. This outlined framework to support user-centred design approach for PPGIS applications and offered researchers and practitioners a valuable framework upon which a more complete understanding of user needs and response to new technology can be built.

6. References

Checkland, P. (1999). *Soft Systems Methodology. a 30-years retrospective*. Chichester, UK : Wiley.

Craig, W., Harris, T. and Weiner, D. (2002). *Community Participation and Geographic Information Systems*. London: Taylor & Francis.

Davis, F.D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 3 19-340.

Feenberg, A. (1999) *Questioning Technology*, Routledge, New York.

Haklay, M. and Tobon, C. (2003). Usability evaluation and PPGIS : towards a user-centred design approach, *International Journal of Geographical Information Science*, 17(6), 577-592.

Peng, Z.R. (2001). Internet GIS for Public Participation, *Environment and Planning B. Planning and Design*, 28(6), 889 - 905.

Preece, J. Rogers, Y. Sharp, H. Benyon, D. Holland, S. and Carey, T. (1994). *Human Computer Interaction*. Harlow : Addison-Wesley.

Rattray, N. (2006). A User-Centred Model for Community-based Web-GIS, *URISA Journal*, 18 (2), 25-34.

Seiber, R.(2006). Public Participation Geographic Information Systems: A Literature Review and Framework. *Annals of the Association of American Geographers*, 96(3), 491-507.

Steinmann, R., et al. (2004). Analysis of Online Public Participatory GIS Application Applications With respect To the Differences Between The US and Europe. [http://www.iapad.org/publications/ppgis/udms%20paper 2004 last.pdf](http://www.iapad.org/publications/ppgis/udms%20paper%202004%20last.pdf)

Vidgen, R., Avison, D., Wood, B.and Wood-Harper, T. (2002). *Developing Web Information Systems*. Elsevier.

Warren, D. and J. Bonaguro. (2003). "Usability Testing of Community Data and Mapping Systems. <http://www.gnocdc.org/usability/usabilitytesting.html>