Modelling and Matching: A Methodology for ePlanning System Development to Address the Requirements of Multiple User Groups

Yun Chen[1], Maria Kutar[2], and Andy Hamilton[1]

[1] Rearch Institute for the Built and Human Environment, University of Salford. Room 10, Technology House, Lissadel Street, Manchester, M6 6AP, U.K
[2] Salford Business School, University of Salford. Room 505c, Maxwell Building, 43 The Cresent, Manchetser, M5 4WT, U.K
Y.Chen1@pgr.salford.ac.uk , A.Hamilton@salford.ac.uk, M.Kutar@salford.ac.uk

Abstract. In this paper the authors present the Modelling and Matching methodology (M&M), developed to ensure that ePlanning systems meet the needs of their users. Designed to address the requirements of multiple and diverse user groups, the methodology intends to offer an operational guidance to ePlanning system developers. M&M combines elements of UML, Soft Systems Methodology, Object-Oriented Methodology and Rapid Development Methodology, and embeds them into a five-step process to reflect a human-centred approach. The methodology will be elucidated further in the paper together with its application and evaluation in a multi-partner, geographically distributed ePlanning system development project, called Virtual Environment Planning System (VEPs) project. The reflection of this application will be discussed at last, in terms of the learning recorded with respect to the methodology (i.e. M&M) itself and the effects it caused.

Keywords: ePlanning Systems, Information System Development Methodologies (ISDMs), Multiple User Groups, Modelling and Matching (M&M).

1 Introduction

The strategic goal for 2010 set for Europe is 'to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion. [1] ' This new style of society is defined as the 'Information Society', in which low-cost information and Information Communication Technologies (ICTs) are in general use. eGovernment has been defined as one of the most important goals in achieving the Information Society, which intends to provide the public with the services of government [2]. As one of the most important services to be provided by the eGovernment, ePlanning is about using ICTs to facilitate the urban planning process [3]. With varying levels of knowledge, experience and computer literacy, different stakeholders may use the ePlanning system in a large number of application areas. For instance, a local authority could use the

D. Schuler (Ed.): Online Communities and Social Comput., HCII 2007, LNCS 4564, pp. 41–49, 2007.

ePlanning system to disseminate planning information and thus promote transparency of activities and public awareness of planning and sustainability issues [4]; citizens could comment on local and strategic urban planning to participate in the process via the ePlanning system [5]; the ePlanning system could also facilitate professionals to create different planning alternatives and to forecast their outcomes [6]. Accommodating such a wide spectrum of needs and the effective use of technologies to facilitate the interaction of various stakeholders is a challenge. As a result, a well-understood and feasible development methodology is needed to bridge this gap.

The work of this research is focused on the design of a methodology to facilitate the development of complex ePlanning systems so that they can be fitted to the expectation of users, whilst still being suitable to facilitate the urban planning process. This paper firstly focuses on the preliminary investigation of ePlanning systems and Information System Development Methodologies (ISDMs). Based on the findings of the preliminary investigation, the core work of this research is implemented during the development and evaluation of a proposed methodology for ePlanning system development in a project called Virtual Environmental Planning Systems (VEPs) [7]. This development methodology is called 'Modelling and Matching' (M&M). The M&M development methodology offers a roadmap for ePlanning system developers to transform the initial planning scenario to the final system solution. This methodology together with its application and reflection are discussed in the subsequent sections of this paper.

2 Background

2.1 ePlanning Systems

In Europe, many local governments have employed new ICTs to provide eGovernment services. ICTs offer many opportunities to improve the quality of the built environment through new forms of better planning, urban and building design tools as well as through improved planning processes [8]. ePlanning, as an important part of eGovernment, can enable easy access to high quality information, guidance and services that support and assist planning applicants and streamlined means of sharing and exchanging information amongst key players. With the emergence of the ePlanning concept, the information system is used to realise the concept, namely the ePlanning system. The ePlanning system is a new product of the information age to facilitate the urban planning process, based on a range of ideas and technologies. The point of an ePlanning system is to make the urban planning process more effective and efficient with appropriate ICTs. It intends to offer considerable opportunity for enhancing public participation, with an emphasis on electronic delivery [9]. In addition, the ePlanning system has specific positive effects on social inclusion, allowing people to become more effectively involved in the planning process. It consists of the data of electronic information and is hosted on the Internet. The main body of an ePlanning system includes one base and two centres – infrastructure and spatial data as base; government information centre and public information centre.

Implementing ePlanning systems requires high-level vision supported by 'What' and 'How' strategies to ensure continuous sustainable improvements in service delivery [3]. In order to get a clear picture of ePlanning systems, '*characteristics of ePlanning system*' and '*criteria for an effective ePlanning system'* are summarised as below:

Characteristics of ePlanning Systems. As a special product emerged during last few years, evidence indicates that the ePlanning system has its own characteristics distinguishing itself from other information system, summarised as below:

- From the process perspective, ePlanning system development is a complex and iterative process, which has a gap between initial development stage and final system specification.
- From the social perspective, ePlanning systems have a wide range of stakeholders involving complicated interaction. Its target users tend to have a diverse range of computer literacy, worldviews, cultural backgrounds, knowledge and preferences. In addition, their interests and benefits may be in conflict.
- From the technical perspective, producing an ePlanning system is normally based on a historical 'technique heritage', especially including geo-spatial technologies In addition, the development of ePlanning system is restricted to certain physical development standards.

Criteria for an Effective ePlanning System. An effective ePlanning system should facilitate the urban planning process to enhance public participation and social inclusion via proper technologies. In Figure 1 below the assertions (A) to (D) concern the basic technical development of ePlanning systems, which can be assessed in the short term. The realisation of these assertions can support higher levels in the 'assertion pyramid'. The assertions (E) to (G) describe more concrete criteria related to an effective ePlanning system. The assertions (H) and (I) illustrate the positive social influences an effective ePlanning system should make.

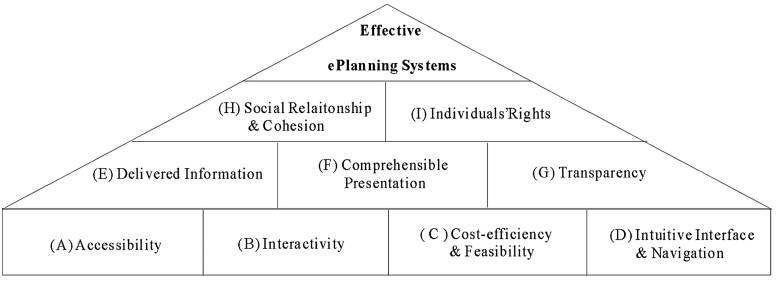

Fig. 1. Effective ePlanning systems assertions

2.2 ISDMs

ISDM is a rapidly developing area of research. In the1960s, IS were largely developed depending on individual programmers' experience and expertise, without explicit or formalized development methodologies [10]. But many different ISDMs can now be found in the literature. Avison and Fitzgerald (2006) [11] refer to it as "the methodology jungle."

There is no widely accepted framework for studying ISDMs. They can be categorised by their underpinning paradigms and approaches, ranging from the 'hard' rationalistic ones that have a technical development focus to 'soft' hermeneutic ones with a social and human focus. However, as developers face increasing uncertainty

and complexity in IS development situations and diverse problem situations, they found that they could not be served by an either single 'soft' or 'hard' methodology (e.g. [12]; [13]). Hence, researchers started to think about combining both 'hard' and 'soft' methodologies into a multi-methodology, which is a new product in post-methodology era [13] [14]. Mingers (1997) [15] argues that 'Multi-methodology' is not the name of a single methodology, or of a specific way of combining methodologies. Rather, it refers in general to utilizing a plurality of methodologies or techniques, both qualitative and quantitative, within a real-world intervention. The purpose is to generate a richer and more effective way of handling the problem situation.

We argue that to develop complex systems like ePlanning systems, the multi-methodology is the most appropriate approach. There are two arguments to support this statement: First, all real-world problems existing in the complex urban planning process have personal, social and technical dimensions. Combining methodologies to deal with all these characteristics should therefore be more effective. Second, a typical IS development passes through several stages, from an initial exploration and appreciation of the situation, through analysis and assessment, to implementation and action. Individual methodologies and techniques have their strengths and weakness with regard to these various stages.

3 The M&M Framework and Methodology

3.1 Requirements and Challenges of ePlanning System Development

As discussed above, in order to make the most effective contribution in dealing with the richness of ePlanning systems development, it is desirable to go beyond using a single methodology to generally combining several methodologies, in whole or in part, and possibly from different paradigms. There are three kinds of requirements and challenges faced in the development of ISDM for ePlanning systems.

To Fit Characteristics of ePlanning Systems. Most existing development methodologies pursue a general approach, which is intended to work in virtually any given domain. Due to this general approach these methodologies, however, lack specialisation for some aspects that are crucial to the ePlanning system development domain. In particular there is commonly no adjustment to aspects of 'incremental and complex development process', 'involvement of multiple user groups' and 'interoperability of applications'.

To Ensure Assertions of Effective ePlanning Systems. A set of nine assertions for effective ePlanning systems are identified in Figure 1. The desired development methodology should facilitate produced ePlanning systems to meet these criteria, so that the quality of 'methodology delivery' can be ensures.

To Address Multi-Methodology Combination Issues. It is undoubted that the multi-methodology involving both 'soft' paradigm and 'hard' paradigm is desirable and feasible for ePlanning systems. However, mixing methodologies, particularly from different paradigms, does present some problems need to be addressed, such as philosophically in terms of paradigm incommensurability, theoretically in terms of

effectively fitting methodologies together, and practically in terms of the wide range of knowledge, skills and flexibility required of practitioners [15].

3.2 The Theoretical Framework of M&M

Based on the peculiarities of ePlanning system development, the authors consider that the possible approaches to ePlanning systems development can be conducted through four processes: *Modelling Process, Matching Process, Iterative Process* and *Evaluation Process*. In theory these processes are proposed in terms of specific characteristics of ePlanning systems, and thus have significant implications for the effective ePlanning system development. The four-process framework is underpinned by both objectivist ('hard') viewpoints and interpretivism ('soft') viewpoints to ensure that social context, stakeholders, activities and technologies are all covered during the whole development process. The following figure illustrates the general layout of the framework:

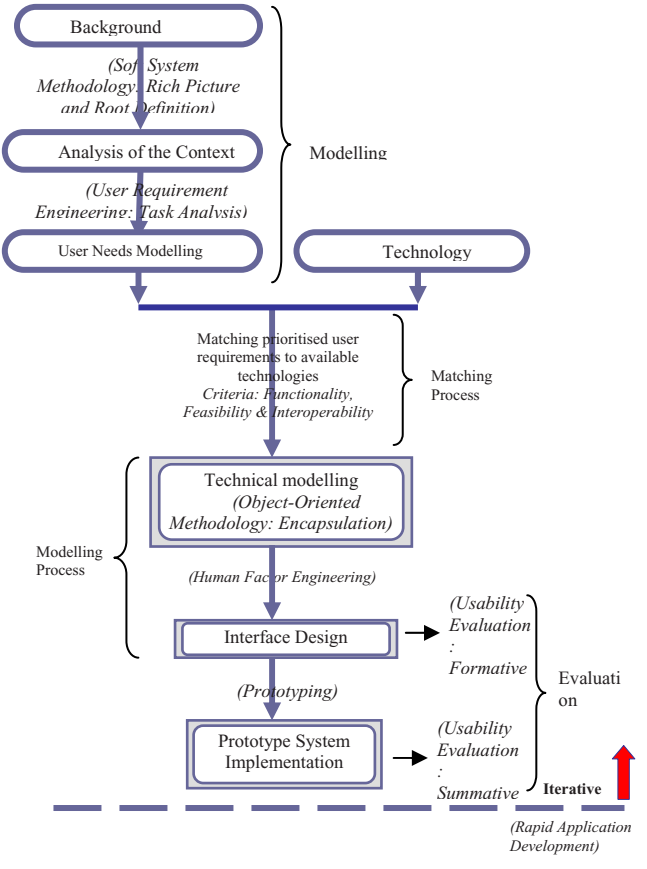

Fig. 2. The Theoretical Framework of M&M

As illustrated in Figure 2, the first modelling process is to model its context and user needs. Second way of using models in the framework is to model technologies for reuse, which happens after the matching between available technologies and user models in terms of *functionality, feasibility* and *interoperability*. The modelling and matching processes take place in the iterative cycle together with evaluation. In summary, the main concept of this framework is the separation of requirement elicitation and system modelling into views reflecting the peculiarities of the ePlanning system. This results in models of sub-problems, which are then matched and combined to an overall model of the system. As a result, modelling and matching processes are two main processes in the proposed framework, complemented by iterative and evaluation processes.

3.3 The Practical Methodology of M&M

To enhance the practical effectiveness of M&M, experiences have been extracted from a participatory case study involving ePlanning systems development named IntelCities [16]. To be an practically effective methodology, M&M has distinct procedures for action and addresses practical issues identified from the real case study, such as 'cooperation and communication among development partners', 'results presentation and sharing', 'combination between user requirements and technical development', 'evolved requirements 'and 'system test' etc. The methodology is elucidated succinctly below.

There are five stages in the 'M&M' methodology for modelling and matching process, shown in Figure 3 below.

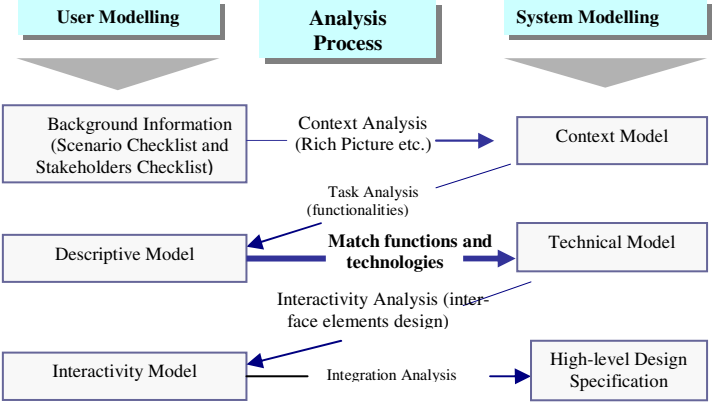

Fig. 3. Modelling and Matching Process of M&M

As shown in Figure 3, the essence of stage one of the process is to find out what the problem is utilising rich pictures and CATWOE analysis [17]. That is summarised in the *Context Model*, which expresses the features of the situation and its stakeholders. Stage two undertakes task analysis. Although it similarly concerned with system definition as stage one, it is driven by the needs of external stakeholders rather than any inherent purpose of the ePlanning system development project. The

outcomes from stage two are presented in the *Descriptive Model*, which tends to focus inwardly on use cases and stakeholders interacting with the system. It is hoped that the combination of *Context Model* and *Descriptive Model* can yield a more balanced view of system definition and provide a systematic development path from high-level context analysis down into an object-oriented implementation. In stage three, the matching process occurs which facilitates the establishment of a feasible and interoperable development solution against the system functionality identified in previous stages. The solution is 'elucidated' by the object-oriented language (i.e. Unified Modelling Language) in the *Technical Model*, which needs to be handed over to technical developers for realisation. Stage four concerns the interface design issues based on proposed technologies. The interface elements and their arrangement are presented in the *Interactivity Model* by storyboards. The final stage of M&M (i.e. Stage five) is an integration process to construe the high-level design specification based on outcomes produced from above four stages, as another 'methodology delivery' besides established ePlanning system. Although the stages described above show the similarity with ones in Multiview model [13], they are distinguishing with regards to several points. Basically speaking, Multiview is an organization-oriented ISDM, which attempts to address business-related questions such as' what do we hope to achieve for the company as a result of installing a computer?'. While M&M is a public-sector-oriented ISDM, which has different concerns such as accessibility and interoperability. In addition, M&M is intended to offer a more operational methodology, rather than a general 'framework' like Multiview which 'gives insufficient guidance in certain situations' [18].

Besides the process, evaluation is another integral part of the M&M methodology. There are two evaluation activities occurring during M&M. One is call 'design evaluation' when the interactive model is produced. Cognitive walk-through [19] is applied in this evaluation step for usability assessment. The second evaluation activity is 'prototype evaluation' which will use questionnaires and empirical evaluation to check whether functional and non-functional requirements grasped in the early stage are met in the final prototype system. The context and descriptive model serve as the criteria for system functionality evaluation.

4 Application of M&M

M&M has been applied in an EU-funded project, called Virtual Environmental Planning Systems (VEPs), a collaborative project which has eight academic and industry partners located across Europe alongside associated planning authorities [7]. It aims to improve the knowledge base on the potential of ICTs for territorial development in the North West European (NWE) region specifically on the use of ICT for ePlanning, consultation and communication of citizens' views on planning issues. Under the guidance of M&M, two prototypes were developed for interactive participation concerning urban regeneration in Rosensteinviertel (Germany), the location of one of the demonstration projets in VEPs. These are the *Commenting System* and the *Discussion Forum.* Two techniques were adopted to evaluate the 'methodology use' and 'methodology delivery' after the development of these prototypes, namely questionnaires to end users and interviews with project partners.

In the evaluation using the questionnaire, the test website (i.e. www.vp.salford.ac.uk/testpage) was distributed to twenty citizens in UK. In addition, ten pairs of questionnaires (for Commenting System and Discussion Forum separately) were brought to attendees in the workshop at Urban Data Management System International Conference 2006 (UDMS2006) held in Aalborg. 21 were returned out of 30 (70 % response rate). The results of questionnaires illustrate the positive argument that first rapid prototype for Rosensteinviertel demonstration project is effective as an ePlanning system. Simultaneously, the evaluation indicates two weaknesses of the development. The first is the geo-spatial interface design and the second is the long-term effective evaluation regarding the social inclusion and selflessness issues. Further empirical fieldwork and evaluation needs to be carried out to assess how satisfactory the geo-spatial interface is for novices and how useful the system is in enabling the social inclusion and selflessness.

In the evaluation using the interview technique, two interviews were conducted with team members in the Rosensteinviertel project. The highlights in using the methodology observed in the interview include:

- The methodology presents a very precise ideas and development plans for project cooperation
- The methodology provides profound structure and control for development process.
- The methodology documents back-up cognitions of stakeholders' profiles, stakeholder requests and technical must-bes.
- The methodology encourages the good communication among partners.
- The methodology is effective in combining 'hard' issues with 'soft' issues during development process to avoid technique bias.
- The methodology integrates the evaluation plan into the process to facilitate the rapid prototyping, which does help for iterative development process.

The lowlights in using the methodology reported in the interview include:

- Letting all project partners follow an agreed methodology is a challenge because every methodology needs some time to be learned, M&M is the same.
- It is difficult to involve target users into the interface design. This methodology did not show the concrete idea about how to achieve this aim.
- Integrating with existing prototypes which was developed by other partners is not easy. A common system interface needs to be developed to realize the integration.

5 Conclusion

In this paper, we have illustrated that ePlanning systems present a number of challenges for IS development and have proposed a methodology (i.e. M&M) to enable effective ePlanning system development. The design of the M&M methodology focuses on multiple user groups, the wide variety of user needs and the complexity in urban planning process. Initial evaluation of the methodology following its application in the VEPs indicates that it facilitates the documentation and analysis of user profiles and request together with technical must-bes, and encourages the good

communication among partners in the real development project. The evaluation also suggests that some areas of work remain, such as the involvement of users into the interface design and the integration with existing prototypes. Future work will focus on more extensive application and evaluation of the methodology following adjustments to address the issues raised in the initial evaluation.

References

1. European Commission, i2010: A comprehensive strategy for the information society 2005 –2010 (2005a) available at: http://europa.eu.int/information_society/eeurope/i2010/introduction/index_en.htm
2. European Commission, eGovernment Research & Development (2005b) available at: http://ec.europa.eu/information_society/activities/egovernment_research/index_en.htm
3. I-documentsystems, Implementing E-Planning in England and Wales (2002) available at http://www.i-documentsystems.com/idox/downloads/whitepapers/Implementing%20E-Planning%20in%20England%20and%20Wales.pdf
4. Haklay, M.E.: Public access to environmental information: past, present and future. Computers, Environment and Urban Systems 27, 163–180 (2003)
5. Song, Y., Hamilton, A., Trodd, N., Zhang, X.: Public participation in urban planning facilitated by an Internet based Geographic Visual Information System. In: The Proceedings of the 3rd International Postgraduate Research Conference in the Built and Human Environment. 3rd – 4th Apr 2003, ESAI, Lisbon, pp. 797–805 (2003)
6. Laurini, R.: Information Systems for Urban Planning: A hypermedia co-operative approach. Taylor & Francis, New York (2001)
7. VEPs (2006) VEPs Project Home Page, available at: http://www.veps3d.org
8. IntelCity (2003) IntelCity Project Home Page, available at: http:// ndmodelling.scpm.salford.ac.uk/intelcity/
9. The Planning Service (2004) Electronic Planning (ePlanning), available at: http:// www.planningni.gov.uk/Corporate_Services/PlanningToDeliver/eplanning/eplanning.htm
10. Avison, D., Fitzgerald, G.: Where Now for Development Methodologies? Communications of the ACM 46(1), 79–82 (2003)
11. Avison, D., Fitzgerald, G.: Information System Development: Methodologies, Techniques and Tools, 4th edn. The McGraw-Hill Companies, Inc., New York (2006)
12. Miles, R.: Combining 'Soft' and 'Hard' Systems Practice: Grafting or Embedding? Journal of Applied System Analysis 15, 55–66 (1988)
13. Avison, D., Wood-Harper, T.: Multiview methodology. Blackwell Scientific Publishers, Oxford (1990)
14. Bell, S., Wood-Harper, T.: How to Set Up Information Systems: a non-specialist's guide to the Multiview approach, Earthscan Publications Ltd (2003)
15. Mingers, J., Brocklesby, J.: Multimethodology: for Mixing Towards a Framework Methodologies. Omega (Elsevier Science Ltd.) 25(5), 489–509 (1997)
16. IntelCities (2004) IntelCities Project Home Page, available at: ttp://www.Intelcitiesproject.com
17. Checkland, P.: Soft Systems Methodology in Action – includes a 30-year retrospective. John Wiley & Sons, Ltd, UK (1999)
18. Stowell, F.: Information Systems Provision: The Contribution of Soft Systems Methodology. McGraw-Hill International Ltd., UK (1995)
19. Nielsen, J.: Usability Engineering. Morgan Kaufmann, San Diego, CA (1993)