An Advanced User-Construction Requirement Within the EFD for the Development of Large-scale Information Systems

Won-Seok Choi and Man-Gon Park

ABSTRACT

This research focuses on an approach for the building of a requirements model for the development of large-scale information systems. It will suggest a set of requirements engineering processes as a procedure of the implementation for building the requirements model. It will also emphasise the evaluation requirements model aimed to refine and complete the requirements model by the different user groups as a cross reference. This paper provides an advanced user-construction requirements within the Event Flow Diagram as a set of requirements engineering process.

Key words: User-Centred Design, User-Construction Requirement, Requirements Engineering, Event Flow Diagrams, Stakeholders

1. INTRODUCTION

The development of information systems has been faced with problems since the 1960s, when the project of this development was delayed and over budget. The most serious problem was that the product as an information system often could not satisfy what users really wanted.

In 1979, the US General Accounting Office produced a report which revealed that more than 50% of delivered systems were not successfully used[19]. It has been reported[11] that 10 billion pounds is spent per year by the UK companies in the information technology area. 40% of that is due to the failure of systems to meet their related business requirements.

This failure is concerned with the "requirements

* Won-Seok Choi and Man-Gon Park are with the Dept. of Computer Science, Graduate School, PuKyong National Univ. 599-1 Daeyeon-Dong, Nam-Gu, Busan, Rep. of Korea. E-mail: wschoi88@lycos.co.kr
* Man-Gon Park is the director of the Colombo Plan Staff College (Intergovernmental International Organization), Meralco Ave., Pasig City, Metro Manila, Philippines.
E-mail: mpark@pknu.ac.kr

crisis[17]" which is caused by the need to set system requirements before the design and implementation phases.

It has been thought that information systems requirements should be captured from clear, complete, and agreed-upon description in terms that both users and developers understand for developing information systems.

The user-centred design (UCD) in the early stage of the Information Systems development is generally believed to be the successful approach [18]. It is said that user-centred design and development is a process that begins and ends with a deep understanding of, and response to, the users of products and their needs and goals[2]. The emphasis of the user-centred system design is on people, rather than technology[16].

The User-Construction of Requirements (UCR) approach is a user-centred approach for building a requirements model[7]. The UCR approach involves a tool which is called the Event Flow Diagram (EFD) and has been developed by Flynn and Jazi(1996) at the department of Computation in UMIST.

The main aim of the UCR is to address prob-

lems, i.e., the user-developer culture gap and the neglect of the social nature of organisations. The UCR provides a users training stage which teaches users how to use the EFD. However, the question has emerged as to whether the UCR is suitable for a large-scale information system in a big organisation.

This paper focuses on an approach for the building of a requirements model for the development of the large-scale information system. It will suggest a set of requirements engineering processes as a procedure of the implementation for building the requirements model.

Chapter 2 will provide more detailed information about the user-centred design concerned with building the requirements model. It will draw attention to the user-construction of requirements(UCD) approach as a user-centred design method, which is discussed in Chapter 3. This chapter will also introduce the event flow diagrams(EFD) and present some questions concerned with how the UCR is suitable for a large information system.

Chapter 4 will show an advanced UCR which may address questions from the previous chapter and suggest a set of requirements engineering processes. The final chapter will provide a conclusion for this report and mention further areas of research.

2. THE USER-CENTRED METHOD IN THE DEVELOPMENT OF INFORMATION SYSTEMS

There are many criticisms of information systems which do not meet their users needs[1]. It is believed that one of the main reasons for this has been caused by the 'technology-centred' or 'data-centred' design and development of information systems.

In order for the successful design of information systems an understanding of the technology, the person, and their mutual interaction is required. The information system should be thought of not only from the perspective of its technology but also from the experience of the user. This users view can influence with the task, the person, and the design of the information system.

It is also noted that success or failure of new information systems is frequently determined not only by technical matters but also is often affected by the user and organisational acceptance.

Allen(1996) suggests that user-centred design might produce usable, effective information systems when it is possible and applied to information systems. He insisted that user-centred design focuses on information-as-process, particularly on the way that information systems meet the information needs of users.

There are many definitions of the user-centred design and many approaches which have relied on each researcher's cases in the development project. In this chapter, the definitions and aims of the user-centred design approach are presented by the different researchers, and some approaches will be introduced.

2.1. Aims of the User-Centred Method

There are a lot of approaches which seek to address one or more problems in the requirements engineering area.

Jazi(1996) highlights some of the commonly stated problems in requirements engineering: changing requirements, which occurs frequently and has a widespread influence on the whole period of system development; user-developer communication gap, which is caused by the breakdown of communication between them; capturing the wrong requirements which resulted from user-developer communication gaps; neglect of human/organisational factors which requirements engineers have argued is only a management issue; and the need for maintaining traceability of changing requirements.

Barnum(2000) said that User-Centred Design means building products that match the needs,

wants, and desires of users.

The User-Centred Approach focuses on the user at the centre of the design process, and includes techniques and procedures for designing usable systems[14]. The argument here is that the communication gap between users and developers will be closed if users and developers work together.

Smith(1997) believes that the user-centred method is able to ensure effectiveness, efficiency, and satisfaction for the usability and success of the information systems development.

Therefore, the user-centred method is applied to contain a high degree of user-computer interaction by emphasising the end-users role as an expert in their own systems or organisation. It is a solution of the communication gap between users and developers by working together through the whole information systems development stages.

2.2 What is the User-Centred Method in the IS Development?

It is generally accepted that the user-centred design is one of the successful design methods in the development of information systems. It has seen important developments in the way in which information systems are designed.

The question 'what is the definition of a user?' now needs to be addressed. In this area, a user means any manager, employee or customer of an organisation who will be directly or indirectly affected by, or influence, an information system [18]. They may be experts in their own work or business, and have a good knowledge about their work environment[5].

In the user-centred design, most users will play some role in the planning and implementation of the new information system. They are likely to analyse, design and deliver information systems with the specialists who provide technical advisers. Smith(1997) proposed definitions of user-centred design:

A fully user-centred information systems development approach is one where all potential users of the proposed information system have the opportunity of being actively involved, either directly or indirectly, in the whole anaylsis, design and implementation process.

A user-centred information systems development approach is one in which all types of user needs(functional, physical and aspirational) are addressed so that usability(effectiveness, efficiency and satisfaction) is maximised in the end product.

Eason(1988) has provided a comparison between three levels of user-centredness(table 2.1).

Therefore, the user-centred method will ensure to production of a high level of usability if all these concepts are appropriate to the problem in the IS development.

Table 2.1 Three levels of user-centredness (Eason, 1988; in Smith, 1997)

| Level | Design option | Contribution made by: | |
		Technical specialists	Users
1	Technical – Centred	Analyse, design and deliver	Commission and accept are informed, consulted and trained
2	Joins User-Specialist	Analyse, design and deliver co-designers	Are represented in all stages of design Informed decision makers
3	User-centred	Provide a technical sevice to users	All users contribute to design

3. CURRENT APPROACH FOR REQUIREMENTS ENGINEERING UNDER THE UCD METHOD

User-centred approaches have been applied to the whole development stage of information systems. In particular, they have been applied to requirements engineering areas for building a requirements model[8,13].

In this chapter, two approaches based on the user-centred method are introduced, namely, the user-construction of requirements[7] and co-operation requirements capture[12]. The user-construction requirements method involves a tool of requirements engineering which is called the Event Flow Diagram(EFD).

3.1 The User-Construction of Requirements with the Event Flow Diagram

The user-construction of requirements(UCR) approach has been proposed based on the user-centred method by Flynn and Jazi(1996). The UCR approach takes into account not only those aspects of an organisation but also the wider, social aspects of the organisation. The UCR approach involves a tool, called the event flow diagram, supporting users for building a requirements model themselves.

3.1.1. User-Construction of Requirements

As already mentioned, the user-construction of requirements(UCR) approach was suggested by Flynn and Jazi(1996). The UCR approach addresses two problems: the user-developer culture gap[21] and the neglect of the social nature of organizations[9].

It is asserted that "the main aim of the UCR is to assist users in formulating requirements for future work practice that will bring improvements to their working environment and to the organization[7]".

The UCR approach is shown in Fig. 3.1 in the form of a spiral. The approach consists of three consequent and iterative rounds.

The first stage is the user training round where users are trained in order to obtain the knowledge and skills necessary for building the requirements model by the developer. The user can acquire the required knowledge, such as how to use the EFD through the training stage. The developer gathers a general knowledge of a user's work, and produces
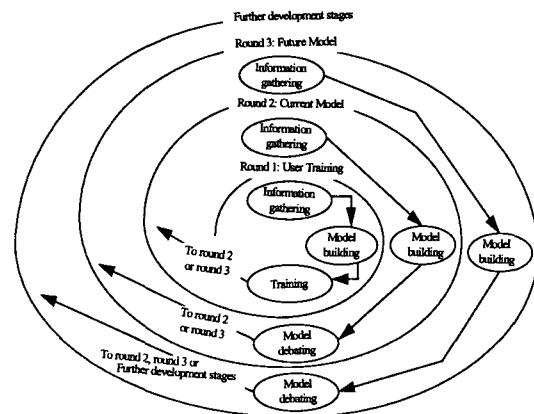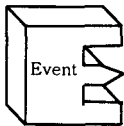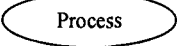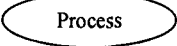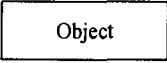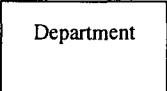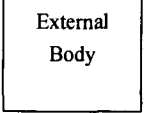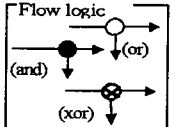

Fig. 3.1 UCR Activities(Flynn and Jazi, 1996)

an EFD model based on the knowledge obtained. The training activity is performed in which the developer explains the concept and diagrammatic symbols of the EFD, and the user practices with the EFD in a given assignment. In short, each user performs the activity individually with the developer.

In the second round, users build the current domain using the EFD, which is a preparation for the next round. Understanding and assessing current systems may be helpful for building a new system. This round consists of information gathering, the model building activity, and the debating of the model. Users seek information about their own or related work from their colleagues. Sometimes, required information is collected from existing documents in their organisation. The user builds current models from their own perspective by themself. After that, the developer facilitates group sessions where users discuss and debate their own models in order to reach an agreement for building a single current model.

After analysing of the current model, the users construct the future, desired model in round 3. The users requirements are gathered, based on the current model. The activities of round 3 are similar with those of the previous round in terms of information gathering, model building, and model debating. It is suggested that iteration between

Table 3.1 Definition of EFD Symbols(Flynn and Jazi, 1996)

Construct	Description	Symbol
Event	An event initiates a flow of information or material within the organisation.	Event
Process	Any manual or automatic activity carried out in the organisation is termed a process. Processes are initiated by an event or by another process.	Role/Actor Process
Object	An object is a thing, for example a book, or data representing a thing, for example a book record, which is used by processes. Within the organisation objects are used by processes and collections of objects are kept in the form of, for example files(data) or stored in physical locations(material).	Location Object
Department	A department is an organisational structure.	Department
External body	An external body is an organisation or an actor which communicates with the organisation by exchanging information/material.	External Body
Flow	Information/material flows between components are represented by arrows labelled with a sequence number. Multiple flows may be specified with and, or and exclusive or flow logic.	Flow logic (and) (or) (xor)

round 2 and round 3 is possible, should it be necessary. Additionally, each round, between round 2 and 3, can be carry out repeatedly.

Therefore, the UCR method enables the users to build the requirements model themselves with a tool such as the EFD method. It is supported by the user training stage which ensures the satisfactory performance of the requirements model. Its main advantage is that the user-developer culture gap is circumvented.

3.1.2. Event Flow Diagrams

In the requirements engineering area, many authors suggest different types of formal representation. With respect to the developer, a formal language method is easy to define and maintain requirements models. Despite their advantages, these methods are difficult for users to understand and they demand that the users posses knowledge

of the formal language used.

The event flow diagram (EFD) model has been designed in order to address problems in requirements engineering[7], for example, the culture gap between users-developers[21] and the neglect of social issues[9], both of which are commonly acknowledged.

The event flow has been informally defined as "the flow of information or material initiated by the occurrence of an event together with its related organisational and environmental components"[7].

When an EFD model of a domain is built, the event flow is the key concept which is used for grouping representation of domain components. In other words, the event flow connects activities in the organisation, considering the sequence of activities, together with their related components.

There is a common sense that an organisation

is naturally structured into smaller infrastructures such as a department or a division. The EFD model divides the organisation into existing departments, which is a familiar organisational structure to users.

The EFD method combines the two concepts of grouping activities in the organisation and partitioning the organisation into departments, thus giving it an advantage in reducing the complexity of the organisational model.

The components of the EFD model are related not only to a computer system such as processes, objects, information/material flows and events, but also a social nature such as departments, manual processes, roles/actors, managers, teams and external bodies. The symbols of the EFD model are defined and shown in Table 3.1. It is in graphical form and uses the same components names in the EFD method.

The EFD model has three different levels, those being the Departmental Event Flow Diagram (DEFD), Organisational Event Flow Diagram (OEFD), and Overall Departmental Flow Diagram (ODFD).

The DEFD is the lowest and most detailed of these levels. A set of DEFDs is modelled for each department. There are two types of DEFD: a single department event flow, starting and finishing in one department with no relationship to other departments; and a multiple department event flow which extends across several departments and is modelled over several DEFDs.

The OEFD contains the middle level of detail and focuses on the event flow in the organisation. In the OEFD, each event flow shows departments, external bodies, events, and objects without process.

The ODFD is the highest level of the EFD model and provides an overview of the whole EFD model. It shows only department, external bodies and flows. There is only one ODFD in an organisation and separate event flows are not distinguished.

The EFD model provides the flow description

table in each event flow separately from the main diagram. The reading and understanding of these diagrams is helped by the fact that the table is described in natural language and involves flow sequence numbers and a flow type, for example, D(document) or V(vocal).

The EFD is based on a bottom-up process[20] from the DEFD to the ODFD. It is allowed the lower-level designs with the DEFD. The complexity is estimated by the OEFD and the ODFD.

The EFD method provides concepts and a language for users to build the requirements model.

3.1.3. Problems

The UCR approach is based on a bottom-up process which may be appropriate to a small or medium size information system. There is doubt as to whether the UCR approach is suited for large size information systems in business organisations. Some questions which have emerged from the UCR approach are presented below.

- *How to make users co-operate?*
- *How to constitute user group?*
- *Is the current UCR suitable for Information Systems in a large organisation?*
- *How to evaluate the EFD model which is built by the user group?*
- *How to address conflicts between stakeholders?*

3.2 Cooperative Requirements Capture

The Cooperative Requirements Capture(CRC) has been developed by Macaulay(1993). Macaulay defined the CRC as being "a group session approach that the role of participants and the role of the facilitator are clearly defined". In this approach, participants are not only users and developers but also those with a stake in the information systems.

The CRC approach to addressing this problem makes use of two components as a team and a structure[12]. The discussion of the team en-

courages the sharing of views and concerns of the stakeholders. The structure is needed in order to make the team capture all the important issues and produce all the required outputs.

Macaulay(1994) defined the CRC as "an approach to early requirements capture which has two components: first an approach to facilitation of co-operation between the stakeholders; and second, a methods of requirements capture which includes techniques multiparty interaction".

The CRC method follows six stages[14], these being:

1. *identify the problem*
2. *formulate the team*
3. *group session 1: explore the user environment*
4. *validate with users*
5. *group session 2: identify the scope of the proposed system*
6. *validate with stakeholders.*

When the initial requirements document is agreed and documented by all the relevant stakeholders, the detailed plan of the proposed system can be evolved and start to be carried out.

Macaulay(1996) suggests that each group session consists of many steps: for example, the business case, workgroups, users, tasks, objects, interactions, and consolidation. These steps follow an introduction, brainstorming, prioritisation and generation of agreed descriptions, and the use of checklists.

In the CRC method, it is necessary for a trained facilitator to be at the meeting. This facilitator should not be a stakeholder but external to the group. The facilitator is expert at applying the method and managing the interaction of stakeholders. The facilitator's role is very important in that they guide the team through the main steps and encourage all the stakeholder's participation. However, the facilitator is not necessarily an expert at the stakeholder's task[15,17].

4. AN ADVANCED UCR FOR A LARGE INFORMATION SYSTEM

It has been thought that the UCR method based on a bottom-up process may not be suitable for a large-scale information system. It is commonly known that a large organisation such as a business company or government, has many departments, divisions, and branches. It also has a significant number of relationships with external organisations. These large organisations provide a number of activities concerned with their own business.

When a large organisation needs to develop a new information system, or upgrade existing information systems, it should determine any new requirements of those users in the organisation. If an organisation starts to build the requirements model with the detailed business activities as the bottom-up process, it will ensure the model becomes complicated and confusing. As a result, it will be difficult to achieve both the building of requirements models and the designing of a new target system.

Consequently, there may be many conflicts between stakeholders which should be resolved during the requirements engineering stage. The UCR provides 'the model debating' session, but it is thought that this activity has to be emphasised and expanded more than it had been previously by the evaluation and feedback session, as a kind of decision process.

Further arguments are that the UCR has not mentioned how to make users cooperate and how to constitute a user group. For these arguments, a pre-stage is necessary to spread mind for the IS project.

Thus, it is thought that the need of an advanced UCR method, based on top-down process, as a guide is essential for huge information systems.

4.1 An Advanced UCR Approach

This section provides an advanced UCR ap-

proach for a large-scale information system considering four main factors: pre-activities for spreading minds for the information system; the specialised user group, related to the constitution of a project team; building the requirements model by the EFD; and evaluation and feedback by the user evaluation groups for completing the requirements model.

4.1.1. Pre-Activities to spread minds for the IS

Before implementing an information system project, some activities are essential for spreading minds for information systems. It is believed that people may know about the benefits of information systems in terms of a common sense. However, they will still have doubts about the convenience or even inconvenience for their job, how easy the new system is to use, and what they can do with these information systems. Stress can be induced because of the need for advanced knowledge to utilise new technology and systems.

As a result, sometimes, the user hesitates not only about using new information systems and technology but also in their cooperating with the developer of information systems. This situation may lead to the problem of user unwillingness.

This paper suggests pre-activities before starting any stage of the IS development which aim to encourage stakeholders encountering challenging new information systems. Firstly, the campaign will inform stakeholders about new information technology and systems, and focus on its necessity for their affairs. It may introduce a plan or practice for using information technology and systems in a competitive or similar organisation. It will influence all stakeholders, in particular, the managers.

Secondly, workshops and conferences provide further detailed information related to the IS project. During the workshops and conferences, the system related to the project will be shown and demonstrated to present how useful and easy it is to use.

The IS project should be supported by all stakeholders in order to determine their requirements accurately and successively. These activities are suggested to be performed not only before requirements stages but also throughout the whole of the project stages, continuously and iteratively.

4.1.2. The Specialised User Group Approach

In the previous chapter, the need for user-centred methods was explained. This section will discuss how to organise the project team within the user-centred method. 'The specialised user group' approach is provided in this chapter. In other words, this topic is concerned with who will, or should, be involved in the project team and how many users are needed at least for the large information systems.

It must be known and suggested how to 'design' the project team for the success of the IS project. There have been many methods put forward, but in this report the focus is on multiple user groups called the specialised user group'. The user group is divided by three different purposes. It is illustrated in Fig. 4.1.

The first user group, which is called the user design group, aims to build a requirements model and a target system with the developers. They, that is the 'key-persons', participate in the design team as a user representative of each department
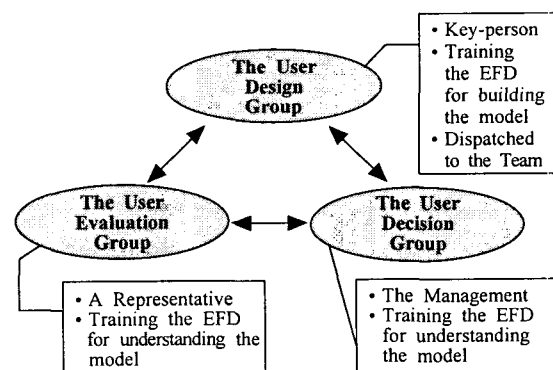

Fig. 4.1 The Specialised User Group

in the organisation. A key-person is defined as one who is an expert about all the affairs in their department and has significant experience within their business. It is preferable that they have good IT knowledge, but it is not essential.

The main aim of the second group is to evaluate the production from the design team. This group, called the user evaluation group, will analyse and approve requirement models. They, as representatives of each department, will not stay in the project team, but will be involved in the team only during the evaluation stages. It is possible that evaluation by a different group, with the design group as the cross reference, will prove more reliable. The last group decides to accept the requirements model approved by the evaluation user group. This user decision group consists of the management, and senior managers in particular.

All users in the three groups participate in a training course for learning the EFD. The design group users should handle the EFD tool and build the EFD model. The others are expected to at least understand the EFD model.

The specialisation of the user group approach aims to plan who is to be involved in the design team and the responsibilities which they must undertake in the process.

4.1.3. Building the Requirements Model

This report states that a top-down process will be more suitable than a bottom-up process for the large information system development. The top-down process may provide a good guide and clarify the requirements model of the information system development project within the a organisation.

Higginbottom(1990) states that "a top-down approach quickly provides overview documentation of the system which is reusable, levelled down and self scoping, as application are as are addressed in detail".

In this section, the top-down process is applied

to the UCR within the EFD method. The user design group build three EFD models utilising a top-down method. This approach is shown in Fig. 4.2.

Firstly, the Overall Departmental Flow Diagram(ODFD) is built as the highest level of the EFD. The ODFD will apparently show the entire business activities of the organisation. Cooperation between key-persons is required for building the ODFD, because of the ODFDs function as an overview of the whole system.

The next stage is to build the Organisational Event Flow Diagram(OEFD) as the middle level of the EFD. The OEFD may provide more detailed information about the organisation activities than the ODFD. In this level of requirements models, the key-person can ask and reference their department users ideas for building it.

Finally, the Departmental Event Flow Diagram(DEFD) will be built by the key-person with their fellows in each department. In this stage, the key-persons may go back to their original place and discuss and build the DEFD model with their companies. This will be individual work in their department, far from the project team.
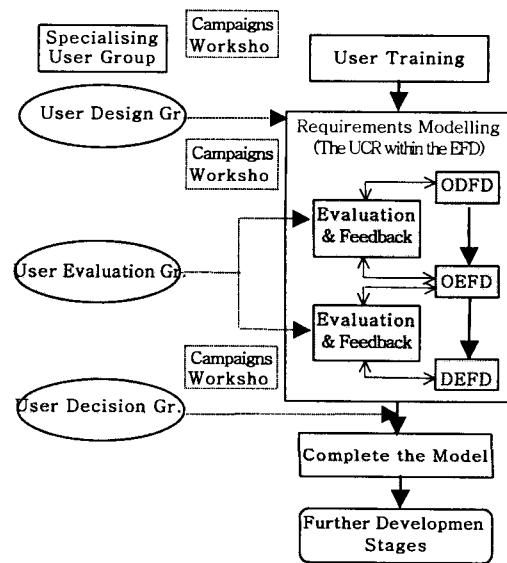

Fig. 4.2 The Advanced UCR Method

The key-person can organise a meeting to discuss building the OEFD or the DEFD in their own department, if it is needed.

In the UCR method, when the design user group build the current or future EFD models, the user evaluation group reviews the relevant models.

4.1.4. Evaulation and Feedback

Evaluation should not be thought of as a single phase in the design process. An ideal evaluation should occur throughout the development life cycle, with the results of the evaluation feeding back into modifications to the design. It may be much easier to change a design in the early stages of development than in the later stages.

The user-centred design involves evaluation and shares a number of techniques with it. User-centred evaluation is iterative: the approach is subject to evaluation and revision at each stage.

Evaluation has three main goals: to assess the extent of the system's functionality, to assess the effect of the interface on the user, and to identify any specific problems with the system.

This paper has suggested to prepare a users evaluation group which should include people not involved in the user design team. The user evaluation group will assess whether the provided requirement model is correct. The evaluation can be carried out after building either the whole EFD model or each of its levels: the ODFD, the OEFD and the DEFD.

In particular, the level of the OEFD and the DEFD can be evaluated in each department where there are related models. The representative of each department can discuss and debate with their colleagues in the department.

The results of evaluation should provide feedback to the design team for the adjustment and refinement of the requirements model. These activities will be iterative.

This evaluation method may provide more reliable results by using a specialised group as a cross reference.

4.2 Methodology for Solving Conflicts between Stakeholders

There are some problems arising from the conflict between stakeholders who were involved in the IS project for design, evaluation, implementation, and maintenance.

The stakeholders are involved in the project as a representative of each infrastructure, consequently, they bring many ideas and arguments based on the view of each particular department. They will often insist on some arguments for the sake of their department and not the whole organisation.

Here, two factors are considered that the priority of requirements and the main department as a signpost are considered as two factors to help solve any conflicts between stakeholders. This technique requires knowledge of business behaviour and co-operation with the user decision group.

4.2.1. The Prioritising of Requirements

It is suggested that the priority of requirements must be provided by the user decision group during the requirements modelling stage. The prioritising of requirements depends on the strategy and the policy of the organisation.

For example, in the bank, both security and real-time requirements are important components for a bank's information system. However, the management of the bank emphasises the security needs more than the real-time demands. The emphasis on the security of the bank as the most important requirement in their business means that services are always considered next.

When conflicts emerge, they are normally negotiated, but sometimes it may not be possible for the management to find a solution themselves. In this case, the reasons for the conflict are presented to the user decision group, who then make a final decision with their policy.

4.2.2. Main Departments

Each department of the organisation cooperates

and is cooperated under the main business or the main target. This is related to the strategy and the policy of the organisation and depends in turn on the particular view of the management.

According to the main policy of the organisation, all infrastructures are essential for their affairs, but there are some main departments in the organisation. This view may affect the whole information system's development stages. It will also influence the prioritising of the requirements described in 4.2.1.

5. CONCLUSION

Earlier in this report, the concept of requirements engineering was introduced and why it is needed. The research presented in chapter 2 was in the form of a literature survey. The user-centred method has been focused on through this study in terms of the successful design of the information system. The UCR method[7] and the CRC[12] method were introduced as example of a user-centred method.

The UCR method with the EFD tool has been mainly designed to overcome the problem of a user-developer communication gap. Its major features are partitioning the organisation by departments and grouping processes by events. The EFD provides three levels of the models: the ODFD, the OEFD and the DEFD.

However, the weakness of the UCR approach was also pointed out, such as the bottom-up process within the large information system development. Consequently, the UCR did not provide a further methodology for user willingness and constituent user groups. It mentioned 'the model debating' session, but did not explain how to solve conflicts between stakeholders.

In order to address this weakness, this paper provides an advanced UCR for the large information system. This approach is based on the top-down method which starts with the highest

EFD level, i.e. the ODFD in order to build a requirements model.

The approach provides the pre-activity stage including the campaign, the workshop and the conferences. This activity aims to spread minds for the information system. It attempts to ensure the user's willingness as well as to address the user's hesitation.

The user group is specialised as the design group, the evaluation group, and the decision group. The divided groups provide more reliable design and evaluation by specialising users for the building requirements model. This specialised user group will be helpful to further stages of the information system's development.

This approach suggests two signposts for solving conflicts between stakeholders: the priority of requirements and the main department. The user decision group will provide these components based on the strategy and the policy of the organisation.

It is expected and believed that this approach is suitable for the development of Information Systems within the large business organisation. However, this approach is an on-going area of research and has yet to be proved. Future research will comprise a case study and the approach being put into practice.

6. REFERENCES

[1] Allen B L(1996) *Information Tasks: Toward a User-Centered Approach to Information Systems*, Academic Press, San Diego, California.

[2] Ames A L(2001) *Users Fisrt! An Introduction to Usability and User-Centred Design and Development for Technical Information and Products*, Professional Communication Conferences(IPCC 2001), 135-140.

[3] Barnum C M(2000) *Building a Team for User-Centered Design*, Proceedings of Tech-

nology & Teamwork, 325-332.

[4] de Bruin H and van Vliet H(2002) *Top-Down Composition of Software Architectures*, Proceedings of the 9th Annual IEEE International Conference and Workshop o the Engineering of Computer-Based Systems(ECBS'02), 147-156.

[5] Dobson J and Strens R(1994) *Organisational requirement definition for information technology systems*, ICRE '94, Colorado Springs, Colorado, 18-22 April, 158-165.

[6] Eason K(1988) *Information Technology and Organisational Change*, Taylor & Francis, London, UK.

[7] Flynn D J and Jazi M D(1996) *Constructing User Requirements: a Social Process for a Social Context*, the Department of Computation, UMIST.

[8] Higginbottom A(1990) *A Maintenance Methodology*, Software Management Magazine, March.

[9] Hughes J, O'brien J, Rodden T, Rouncefield M and Sommerville I(1995) *Presenting Ethnography in the Requirements Process*, RE '95, York, England, 27-29 March, 27-34.

[10] Jazi M D(1996) *Event Flow Diagrams: a User-Centred Method for Requirements Engineering*, a Ph.D. Thesis, UMIST.

[11] Lissoni C(1992) *Business Mapping as the Route to Better Business Systems, Internal Paper*, IBM UK Ltd., Portsmouth.

[12] Macaulay L A(1993) *Requirements as a Cooperative Activity*, RE '93, San Diego, CA,

4-6 January.

[13] Macaulay L(1994) *Cooperative Requirements Capture: Control Room 2000*, in Requirements Engineering: Social and Technical Issues, Jirotka M and Goguen J, Academic Press, London, UK, 67-85

[14] Macaulay L A(1996) *Requirements Engineering with 80 figures*, Springer-Verlag, East Sussex, UK.

[15] Mathieu R G(2002) *Top-Down Approach to Computing*, Computer, vol. 35, 138-139.

[16] Minocha S(1999) *Requirements Development in User-Centred System Design*, Making User-Centred Design Work in Software Development, IEE colloquium, 7/1-7/4.

[17] Opdahl A L(1994) *Requirements Engineering for Software*, REFSQ '94, Utrecht, Netherland, 6-7 June, 16-32.

[18] Smith A(1997) *Human Computer Factors: a Study of Users and Information Systems*, Mcgraw Hill, Berkshire, England.

[19] Sommerville I, Bentley R, Rodden T and Sawyer P(1994) *Cooperative System Design*, The Computer Journal, vol. 37, no. 5, 357-366.

[20] Takeda N, Shiomi A, Kawai K and Ohiwa H(1993) *Requirement Analysis by the KJ Editor*, RE '93, San Diego, California, 4-6 January, 98-101.

[21] Wood D P, Christel M G and Stevens S M(1994) *A Multimedia approach to requirements capture and modelling*, ICRE '94, Colorado Springs, Colorado, 18-22 April, 53-56.
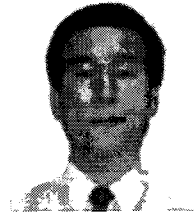
Won-Seok Choi

1991 B.S, Dept. of Computer Science, PuKyong National University (PKNU)
1996 M.S, Dept. of Computer Science, PKNU
2001 Completion of a Ph.D Course, Dept. of Computer Science, PKNU
2000~2001 Chief of the Planning Team, ShinWon Information Technology Co. Ltd.
2002 Chief of the Bureau, e-Business Industrial, Educational & Research Institutional Cooperation Association (eBIERA)
Research Interests : Software Requierment Engineering, Software Reliability, Component Based Development, Function Point Analysis & Design, Methodology of Information System Development, Availibility of Multimedia Information System

Man-Gon Park

1976 B.S, Dept. of Mathematics Education, KyungPook National University
1980 M.S, Dept. of Computing Science & Education, KyungPook National Univ.
1987 Ph.D, Dept. of Computing Science & Education, KyungPook National Univ.
1992~1993 Post Doctoral Course in Computer Engineering, Dept. of Electrical & Computer Engineering, Univ. of Kansas, Lawrence, USA
1979~1981 Professor, Dept. of Computer Science, KyoungNam Technical College
1987~1990 Director of Central Computer Center/ Vice Dean of Nature Science College, PuKyong National University (PKNU)
1988~1997 Chairman of Dept. of Computer Science (Undergraduate & Graduagte Courses), PKNU
1997~2002 Faculty Consultant, Div. of Information Technology & Communication, Colombo Plan Staff College, Manila, Philippines
1981~Present Professor, Dept. of Computer Science, PKNU
1997~Present Advisory Professor for International Information Technology, ADB/ UN ESCAP/ ILO APSDEP/ KOICA/ JICA
2002~Present Director, Colombo Plan Staff College (Intergovernmental International Organization), Manila, Philippines
Research Interests : Software Reliability & Safety Engineering, Software Quality Engineering, Software Metrics, Software Reusability & Reengineering, Software Testing & Inspection, Fault-Tolerant Software System, Methodology of Information System Development, Internet, BPR, GIS, and Multimedia Information Processing Techinques

For information of this article, please send e-mail to: wschoi88@lycos.co.kr(Won-Seok Choi)