

User-Website Interactive Communication Analysis in Web-Based Information System Development

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Abstract - *Web-based information systems (WBIS) include the website part and the system part, and easy-to-use website is particular critical to the success of WBIS. This paper argues that the easy-to-use website can only be developed based on the need of use in the user perspective and such need must be captured and modelled as communicational requirements in WBIS analysis. However current analysis and modelling techniques do not enable modelling of communicational requirements in WBIS development. This chapter addresses this problem and proposes a new modelling technique (dialogue act modelling technique) for modelling of communicational requirements by user-website interactive communication analysis. It shows that the user-website interactive communication model built for the website part of WBIS by the analysis is also useful in modelling of the system part of WBIS with object orientation. It concludes that user-website interactive communication analysis is significant in developing WBIS towards easy to use and interaction.*

Keywords: website, communicational requirements, dialogue, dialogue act.

1 Introduction

E-business is changing the life style of people and helping customers and companies to demand and supply business information and services cross the world by internet without face-to-face meeting. However, like traditional business, the success of an e-shop or e-business depends on how easy and fast customers can successfully find and buy things that they want online by interactively communicating with the website of web-based information systems (WBIS) as shown in Figure 1. A well-accepted WBIS should allow the user to control the communication procedure and to decide how to interact with the website of WBIS. To make WBIS easy-to-use and well-accepted, the website of WBIS must provide an interactive communication procedure that the user prefers to go through for achieving their business goal. Experiences have proven that easy-to-use website must be produced based on understanding of user needs for the website of WBIS and in the user perspective. This requires the developer to develop the website of WBIS according to the user's opinion on easy to use rather than the developer's opinion on easy to implementation of the website. Understanding of the user's opinion and need is critical to developing successful website of WBIS because the user need has impact on usability of the website of WBIS including user interface, navigation structures and web pages. Some of e-business websites have failed completely and been shut down because of poor usability [1].

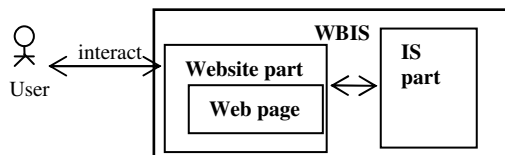


Figure 1 WBIS

Understanding of the user need for software systems is an analysis issue and a task of system analysis in Software Engineering [2] in system development. However a lot of books and articles such as Cato [3] only emphasised how important understanding of the user need is in design of the “user-centred” user interface in WBIS design but ignored how to find and describe the user need towards “user-centred” in WBIS analysis. Also WBIS are different from traditional IS and they have their own specific characteristics such as website and web pages [1, 4, 5, 6]. These differences make WBIS development more difficult than traditional IS development. Lazar et al [7] have indicated that the problem of WBIS development is no longer how to construct the technical infrastructure of the system, but is how to create a good website that is easy to use and meets the needs of the

user. Therefore it is necessary and important to start development of website from analysis instead of design in the process of WBIS development. Analysis and modelling of the website is a new issue in WBIS development because the modelling techniques and approaches available did not address it before. This paper will address this issue and recommend to add user-website interactive communication analysis to the WBIS analysis. It proposes a new modelling technique “dialogue act modelling” for capture and modelling of the user need for the website of WBIS in the analysis.

2 User-Website Interactive Communication Analysis

User-website interactive communication analysis aims to capture and modelling of the user need for the website of WBIS. It is to build a user-website interactive communication model for recording the need in terms of dialogue act modelling technique (see Figure 2).

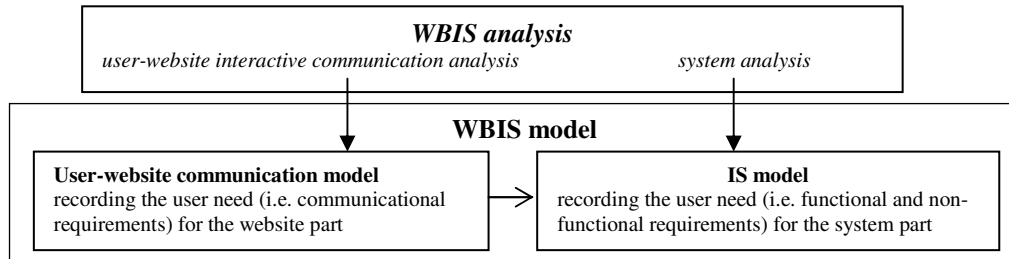


Figure 2 User-website interactive communication analysis

2.1 User Role

WBIS have varied users because they can be used by anybody in the world [4]. The users can play different roles in use of the system for different purposes. For example, a user plays a “buyer” when using the system to buy things online and plays a “seller” when using the system to sell things online. Users playing different roles will have different needs in interactive communication with the website of WBIS. They will not purchase things from a website that is complicated and frustrating to use [7]. Therefore capture and understanding of user roles and needs is critical to the success of the website and important to successful WBIS development. Traditional IS without web can control where a user can go but users of WBIS want to be active when they are on the web and they even can take paths that were never thought or intended by the developer [8]. They will intend to control the paths towards the goal of their tasks and want to complete their tasks in a minimum amount of time with a minimal amount of frustration. Thus developing the website with consultation with customers is vital in WBIS development and, ideally, customers are consulted repeatedly in order to understand their needs over time [5]. User roles can be recognised within business contexts of a business system by user-website interactive communication analysis. Understanding of the user role helps capture the user need from right people and helps understand the reason and background of the need in the analysis.

2.2 Communicational Requirements

User requirements for traditional IS without web are often classified into *functional requirements* about what a system needs to do and *non-functional requirements* about constraints such as performance and security in traditional IS development [2]. They only mean the user need for the system part of WBIS but not the user need for the website part of WBIS in WBIS development. For example, the user need for the website can be what they want to see on the computer screen and how they want to communicate with the website interactively. This kind of user needs is named *communicational requirements* in this paper because they do not mean functional or non-functional requirements in normal WBIS analysis. User-website interactive communication analysis is to capture communicational requirements for the website of WBIS and to build a use-website interactive communication model for recording them in WBIS analysis. Experience on WBIS development has proven that system changes are inevitable if communicational requirements are not understood and focused by the developer. Users often are unhappy with the way that the developer provides to display the information on computer screen or to communicate with the system in the end of development and they want to change this developer’s way of use the system into their way of use of the system. *Communicational requirements* [9, 10] include the following:

- **Business contexts:** These are what users of WBIS want to see on the computer screen for overview of the business information and services supported by the system. A business context is a business activity or a business index in business. Business contexts may be overlapped to suit varied users. Overlapped parts normally mean common obligations of the system.
- **Dialogues:** These are what users want to talk to the website of WBIS interactively within a business context.
- **Dialogue acts:** These are what users need to do (responsibilities/commitments) or what the system needs to do (obligations) in responses to the dialogues in a business context.

2.3 Business Contexts and User Roles Analysis

The role of users of WBIS can be decided according to the business contexts of a business system because a user usually performs a specific business task in a business context and this decides the role of the user in that business context. A user can play different roles in different business contexts of the same business system. For example, in a car business system, a customer can play a “car buyer” in the business context “Car for sale”, and a “car hirer” in the business context “Car for hire”. Stakeholders of a business system are usually considered as the user of WBIS. For example, car buyers and car manufacturers are stakeholders of the car business system and they will be the users of the web-based car information system. Stakeholders can choose “Car search”, “Car for sale” and “Car for hire” as the business contexts of the car business system because they want to find, buy and hire cars. Their roles are decided based on the chosen business contexts. That is, they are car seeker in “car search”, car buyers in “Car for sale” and car hirers in “Car for hire”. Understanding of business contexts and user roles should focus on “what kind of business information and services that stakeholders/users want WBIS to provide” and “what roles these stakeholders/users play in obtaining the information and services from WBIS (different roles imply different criteria and needs of business)”. A *business context map* [9, 10] was created to represent the business contexts of a business system and roles of users in the business contexts that were identified by this analysis. Figure 3 is an example of the map for the car business system. The business contexts are shown in rectangle boxes and the users and their roles are shown using figures. The business context and its stakeholder(s)/user(s) are connected using solid lines.

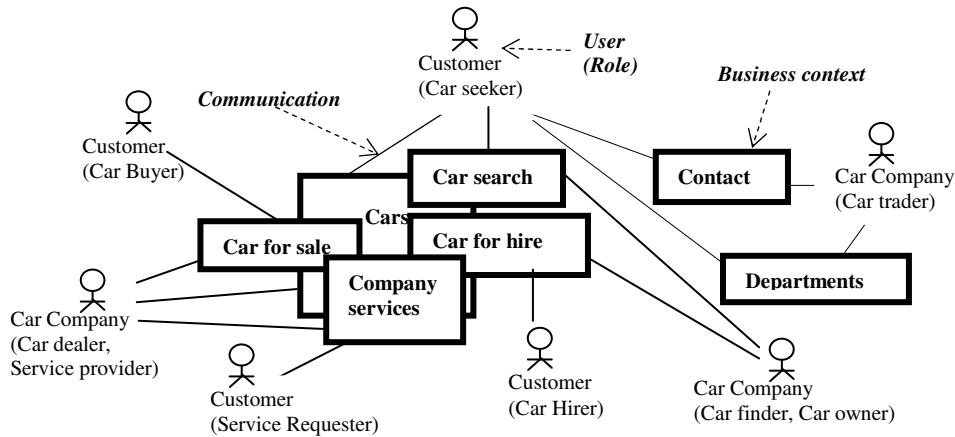


Figure 3 Business context map

2.4 Dialogues and Dialogue Acts Analysis

Analysis and modelling of business contexts and user roles in a business system provides a basis for capturing and understanding the dialogues that are needed by users to communicate with the website of WBIS interactively in the paths towards the goals of their business tasks, and dialogue acts that are the responses of users or the system to the dialogues in business contexts. The Speech Act Theory [11] in the social science was adopted in the dialogues and dialogue acts analysis by the dialogue act modelling technique because ‘communication’ between the user and the website in an e-society means ‘speech to act’ in the reality. This theory was defined to describe the phenomenon in a social society that people use speech to act, e.g., demanding/promising something. Searle [12] later defined a speech act with four sub-acts: *utterance acts* with uttering words; *prepositional acts* with referring and predicating; *illocutionary acts* with stating, questioning, commanding, promising; and *perlocutionary acts* with causing an effect on hearers. This theory explained how people in a society use a language for talking about events in the external world as observers, and for communication act within the world as actors in the society [13]. In IS society, IS were even defined as language systems in general used to perform communication acts [14] and the theory has been successfully used in traditional IS analysis [15, 16, 17, 18, 19].

Speech Act Theory can be also used in WBIS analysis because WBIS use a web language for user-website interactive communication (i.e. dialogues) and other things such as demanding and promising things (i.e., dialogue act). In user-website interactive communication analysis, in terms of the speech act theory, users and the system are considered speakers or hearers of dialogues, performers of dialogue acts, seekers of business data, and consumers of resources in the user-website interactive communication model for the website part of WBIS. A *dialogue* is interactive communication between a speaker and hearer(s). A *dialogue act* is a hearer’s response to the dialogue and a business activity performed by the system or a responsibility committed to the user. A flow of dialogues means an interactive communication procedure towards a goal of a user’s task in a business context. A dialogue act to the present dialogue is a precondition of the next dialogue in the flow. It has been noticed that dialogues between users and WBIS are more complicate than data flows between users and traditional IS

because they can deliver *information* (e.g., car list)/*organization units* (e.g., car sales department)/*service* (e.g., buy car) and can cause different types of responses. In the user-website interactive communication model, we define a dialogue act with four sub-dialogue acts in terms of the Searle's definition [12]:

- (a) The utterance act is production and communication of physical written message shown on the computer screen or printed on the paper such as *buy car*.
- (b) The propositional act is performed by an object such as a *car* and its attributes.
- (c) The illocutionary act is performed by a business service (activity) such as *sell car*.
- (d) The perlocutionary act is performed by the hearer such as *buy car*. It has the effect on the business context.

Dialogues and dialogue acts captured by this analysis are described using a dialogue act diagram [9, 10]. Figure 4 gives an example of the diagram that described dialogues and dialogue acts within the business context "Cars" in Figure 3. Users and WBIS are shown as the speakers/hearers of the dialogues in the diagram.

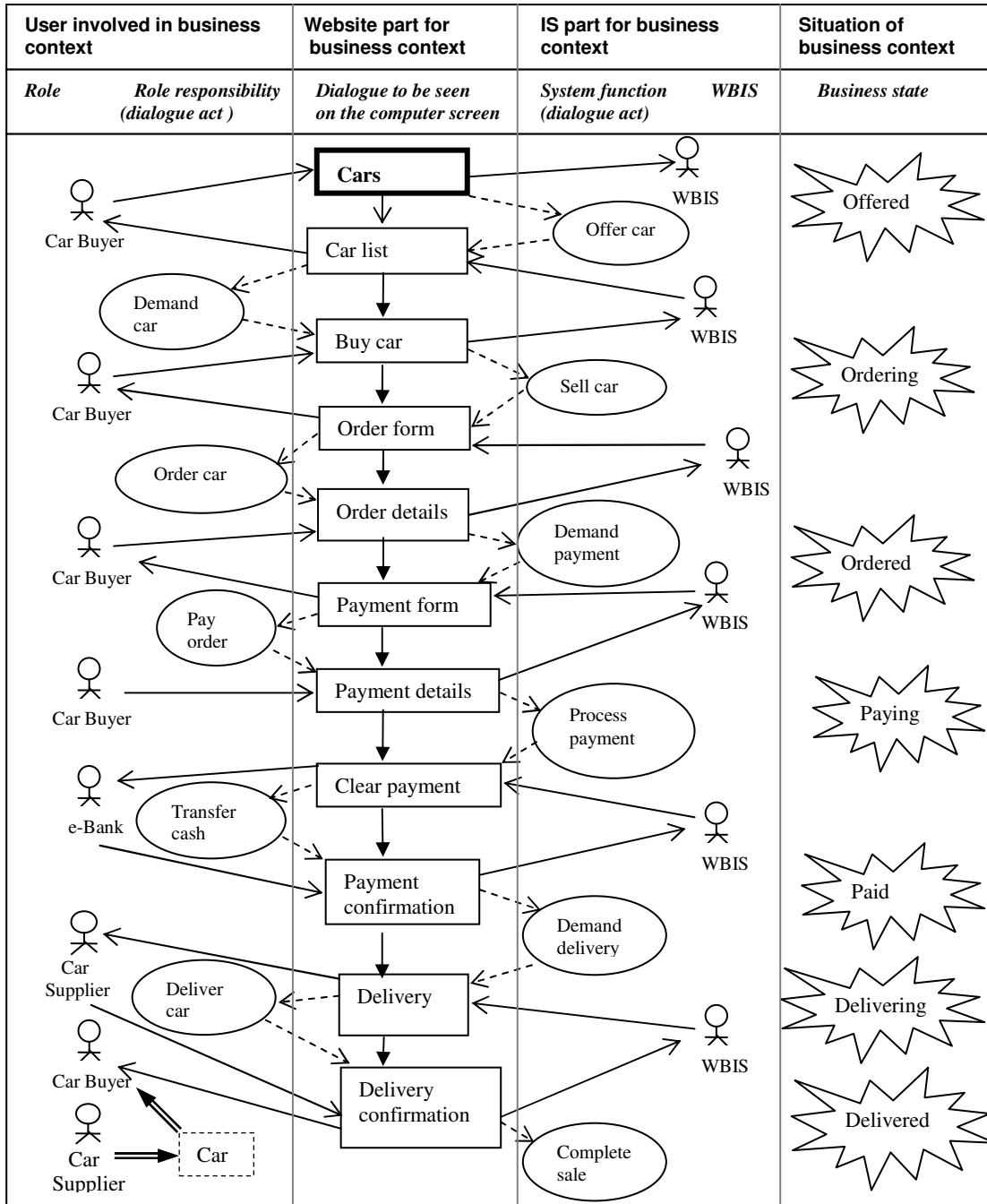


Figure 4 Dialogue act diagram for the business context "Cars"

Capture of dialogues has to involve users in order to find out "what things/terms/phrases users want to see on the website", "what conversations users wish make with the system", "what feedbacks users expect the

system to return”, “what users like and dislike about the way they are work at present”, and “what are users’ preferred ways of working towards the goal of their tasks on internet”. Users playing different roles in WBIS have different needs on dialogues. Dialogue acts are captured by asking users “what problems they want the system to solve”, “what feedback they expect to receive from the system when they make a dialogue with the system”, and “what actions they will take when receiving the feedback”. Hearers of dialogues are the performers of these dialogue acts. The performance of the dialogue acts has impact on states of the business context.

3 Advantages of User-Website Interactive Communication Analysis in WBIS Development

User-website interactive communication analysis enables to capture communicational requirements from the user for the website part of WBIS and use a user-website interactive communication model to record for developing the website with easy to use. It has the following advantages in WBIS development:

- *Provide a technical tool for modelling the user role and need for the website of WBIS in WBIS analysis*

Understanding of the user need for the website of WBIS should be an essential task in WBIS analysis in order to develop the easy-to-use and interactive website. However this task is ignored in WBIS analysis because the website is regarded as a design issue in current WBIS development [1, 7, 20, 21, 22]. The ignorance has damaged the development of easy-to-use website in fact. To emphasise the task, user-website interactive communication analysis promotes the website as an analysis issue and provides a technical tool (i.e. dialogue act modelling with diagrams such as dialogue act diagram) for carrying out the task so that the website can be designed and implemented according to the user need rather than the development need in WBIS development. The user-website interactive communication model built using the tool enriches communication between the user and the developer about the website in WBIS analysis.

- *Support the IS part analysis towards easy-to-use and interactive WBIS*

Ease-to-use website needs to be supported by the IS part of WBIS in implementation because the dialogue acts performed by WBIS in the user-website interactive communication model for the website part of WBIS are supposed to be the functions of the IS part of the system. Therefore if the IS part analysis takes the dialogues and dialogue acts in this model as input to modelling of the IS part, the IS part modelled based on them will make the whole system easy to use and interactive in the user perspective.

Currently, the IS part of WBIS is analysed and modelled using object-oriented technology in WBIS analysis [4]. The user-website interactive communication model built by user-website interactive communication analysis can be used to analyse and model the IS part with object orientation in the IS part analysis. The analysis will transfer the user-website interactive communication model into the object model that shows the static structure of WBIS and the behaviour model that shows the dynamic behaviour of WBIS, in terms of existing object modelling techniques such as UML [23] and statechart [24], as illustrated by Figure 5. The examples of building these two models through this way can be found in the other papers of the author [9, 10]. The significance of building the object model and the behaviour model for the IS part of WBIS by this analysis is that the user role can be identified from the business contexts of a business system instead of from the functions of a computerised system so that it the role of the user is closer to the reality and acceptable to the user.

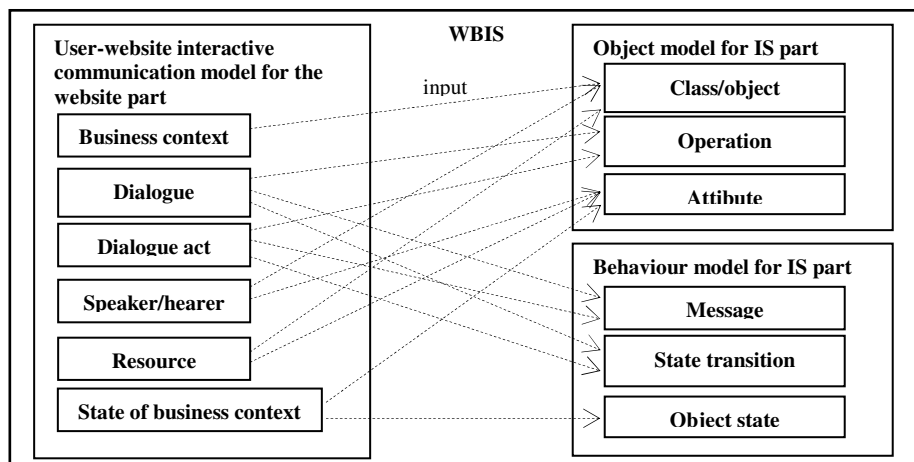


Figure 5 Models of WBIS built by WBIS analysis

- *Enable to design website in the user perspective*

The user-website interactive communication model contains the communicational requirements for the website of WBIS so that the website can be designed towards easy to use and interaction in the user perspective. The system boundary of WBIS can be decided based on the business contexts in the model. For example, Table 1 shows the system boundary of the Cars business context that was conducted from Figure 4. The dialogues in a business context can be nested in a *user-website structure tree* (see Figure 6) that provides the website layout of interactive communication for designing user interface, navigation structures and web pages in WBIS development. It can be the guide to use of the website of WBIS if WBIS displays it on the computer screen. In particular, it shows user responsibilities and commitments along with the dialogues, and the WBIS designer can consider to display them on the computer screen for notifying the user what they are supposed to do while making the dialogues with the website of WBIS.

Table 1 System boundary of the business context “Cars”

<i>OUTSIDE SYSTEM</i>		<i>INSIDE SYSTEM</i>		
<i>User role</i>	<i>Actor responsibility & commitment</i>	<i>Dialogue displayed on computer screen (direction)</i>	<i>System function (obligation)</i>	<i>Entity involved</i>
Car Buyer		Cars (→)	Offer car	Car
		Car catalogue (←)		
	Demand car	Buy car (→)	Sell car	Car
		Order form (←)		
	Order car	Order details (→)	Demand payment	Car, Order, Customer
Payment form (←)				
Pay order		Payment details (→)	Process payment	Order, Payment
		Clear payment (←)		
e-Bank	Transfer cash	Payment confirmation (→)	Demand delivery	Order
		Delivery (←)		
Car Supplier	Deliver car	Delivery confirmation (→)	Complete sale	

User responsibility/commitment

- Car buyer wants to find a car
- Car buyer wants to buy a car
- Car buyer orders a car
- Car buyer pays order, e-bank transfers cash, car supplier deliver car

Dialogue hierarchy in the Cars business context

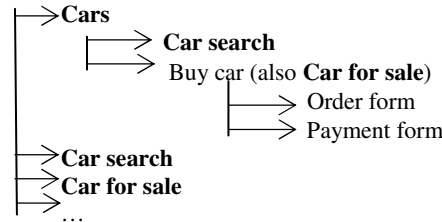


Figure 6 User-website structure tree

4 Conclusions

WBIS consists of a website part and a IS part and uses the website part to display business information and services and the IS part to provide information and services. The website part is the communication medium for WBIS to communicate with the user in the process of achieving a business goal. The user often regards the website part as whole of WBIS because it is the part visible to the user. Easy-to-use website can encourage the user to use the system and reduce their frustration and anxiety. The user prefers to control the communication procedure rather than be controlled and they want to be aware of what is going inside the system during communication with the system. They have their own opinions on communication with the website of WBIS what should be displayed on the computer screen and how communication should be taken towards the goals of their business tasks. Both of users and the system will act to the dialogue heard by them because communication means talk to act, as explained by the Speech Act Theory [11]. The user need for the website part of WBIS is classified into *communicational requirements* in this paper for differentiating them from other types of user requirements (i.e. functional and non-functional requirements captured and modelled by analysis of traditional IS without web). The website part of WBIS must satisfy the communicational requirements when it is handed in to the user.

Communicational requirements should be captured and modelled by WBIS analysis in the process of WBIS development so that the design of the website part can focus on the user concerns about usability of the website rather than focus on the developer concerns about implementation of the website in WBIS design. However, there is lack of analysis and modelling technique for capture and modelling of such kind of requirements in current WBIS development. Thus this paper addressed this problem and proposed the user-website interactive

communication analysis for capture and modelling of communicational requirements in WBIS development. It provided a dialogue act modelling technique with business context map, dialogue act diagram, and user-website structure tree for description of the requirements in a user-website interactive communication model through (a) eliciting business contexts of the business system and user roles in the business contexts, (b) capturing and modelling communicational requirements (dialogues and dialogue acts) based on the roles, and (c) analysing and modelling the structure and behaviour of the IS part of WBIS in object orientation based on the dialogues and dialogue acts in the user-website interactive communication model. This model provides a vehicle for designing easy to use and interactive user interfaces, navigation structures and web pages in WBIS development and is useful in developing the system towards easy to use and interaction.

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