Simulating User Behaviour – A Proposed Approach to Improving Web Information Systems

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Abstract: modelling and simulating user's behaviours could be an approach that aids web developers to improve the utility of Web-based Information Systems (WIS). This paper presents a conceptual model of WIS-user behaviours. The intention of simulating those behaviours presented in the model is also stated.

1 Introduction

WIS has recently become a dominant type of Information Systems (IS). However, in this paper's view at present, lack of appropriate procedures, methods and tools for measuring and managing the utility of WIS is one of the obstacles for vendors and customers to better benefit from WIS. A successful WIS requires an in-depth understanding of the communication aspects relevant to customer behaviours when the user navigates through a WIS [Wa03]. Understanding and being able to predict the behaviours of WIS users, therefore, could be one of the important tasks in the development of WIS.

2 Related work

A WIS development method obviously is only sustainable if it puts both vendor and user in a win-win situation. [Bi04] suggested that the success of a WIS is based on "deep understanding of the application area, the customer's needs, abilities and habits. In the work done by [Ka03], a context modelling approach for WIS was proposed. [Ka03] investigated on how contexts of WIS can be modelled in order to avoid customer getting lost or confused while navigating through the information space implemented by a WIS. Based on the notion of context space, the source suggests "…depending on the location of a customer in the information space of the WIS, the usage history and a corresponding user type a suitable continuation will be suggested to a customer, which will allow him or her to regain the possibility of using the respective WIS efficiently".

The work in [Wa03] emphasized the importance of communication aspects to the development of a successful WIS. The pilot study carried out by [Wa03] showed that the strongest impacts on internet user successfully using the WIS are more related to human factors than to technical aspects. The results from their case study also suggested that design methodologies for web sites should

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start with the human factors rather than the technical issues, i.e. the human-human interaction that could affect the use of a WIS. They then recommended that localisation abstraction and the use of metaphors are two promising techniques that may enhance the user's understanding and successful navigation.

3 Utility of WIS

Developing WIS, as a special case of developing software, is a complex task throughout which quality aspect must always be considered. The WIS quality concept has been addressed by many researchers ([Ne00], [Fi00], [Zh01]) since e-commerce has become more and more popular. Details on the WIS quality concept could be found in [Ne00], [Fi00] and [Zh01]

In order to increase the relevance of the quality concept of WIS, this paper proposes an addition aspect to the quality concept of WIS, i.e. the utility aspect of WIS. Following is a working definition of WIS utility:

> *Let W be a WIS and U be one of its users and g be the goal that the user wants to achieve from using W. The utility u(W,U) of W with respect to U is the aid that W provides to U for effectively and efficiently achieving his or her goals. u(W,U) is measured by the degree to which W provides to U the resources he or she needs to effectively and efficiently achieve his or her goals.*

4 WIS service – a high level classification

Classifying WIS services is important to the improvement of WIS utility. Appropriate classification of WIS services would help many parties who are involved in the business of a WIS. It would help to minimise the navigation difficulties as well as to overcome human communication barriers (see [Ka03] for details on human communication barriers). Obviously, each group of similar information and services would apply to and benefit different groups of users whose status, knowledge, experience are not the same. The users, therefore, should be able to assess their own status and go to the direct navigational path in order to fulfil their needs. Furthermore, identifying classes of WIS services would enable the WIS's developers to observe usage patterns with respect to the services offered. These patterns could be analyzed and recommendations could be drawn from them regarding improving the utility of the WIS.

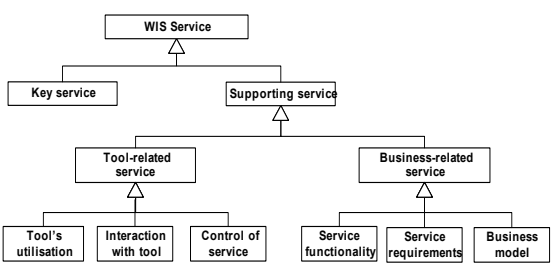

Figure 1: High level of classification of WIS service

WIS service could be categorised into two main groups: key service and supporting service (figure 1).

Key service is the services that are supposed to be needed by users and for which users would pay a fee. These services offer more functionalities than just retrieving data such as saving or updating information into the database, creating or tailoring solution based on user's inputs etc.

Supporting service is the services that provide the user with information retrieval function by which appropriate data and information could be retrieved or archived from the system's database. Additionally, supporting services are supposed to aid users in identifying, locating, accessing, triggering and executing key services.

The business-related supporting service provides users with information mainly regarding the key services and is further classified into the following classes (figure 1):

- Service functionality: describes the functionality of a key service
- Service requirements: specifies eligibility for invocation or purchase of a service (i.e. input needed for a service to be executed and output produced by that service)
- Business model: describes and explains business models such as shopping cart, payment, delivery tracking etc.

The tool-related supporting service provides users with more information about the WIS that they are interacting with, including the following categories (figure 1):

- Tool's utilisation: provides users with information regarding to things that they could do with the WIS
- Interaction with tool: explains to users how they could explore and tailor those services available in a WIS
- Control of service: gives users such information like how to trigger, control a service offered by the WIS as well as how to user the result of a service that was executed

5 A generic model of WIS-user behaviour

The author believes that understanding user's needs and being able to predict how the user would behave to achieve their goals and how the WIS should perform in corresponding to the user's request could be essential to improve the utility of WIS. This paper presents a working conceptual model of WIS user behaviours. The model (figure 2) basically represents cognitive tasks (or mental states) of the user when invoking WIS services. There are four main states identified, i.e. identifying need resolution, identifying solution, tailoring solution and finally executing solution.

Identifying need resolution: This is the state where the user decides what they want to do for their needs. Initially, the user might not understand what s/he really wants, or might not know how to satisfy what s/he needs. Navigating through a web site might help to find appropriate solutions.

Identifying solution: Having identified what is needed, the user then moves to the second state, i.e. the state of finding solution to his or her needs. Identifying solution is considered as one of the user's states that should be

further explored and investigated. A self-transition attached to this state means that the user could repeatedly identify the solution until the right solution is found.

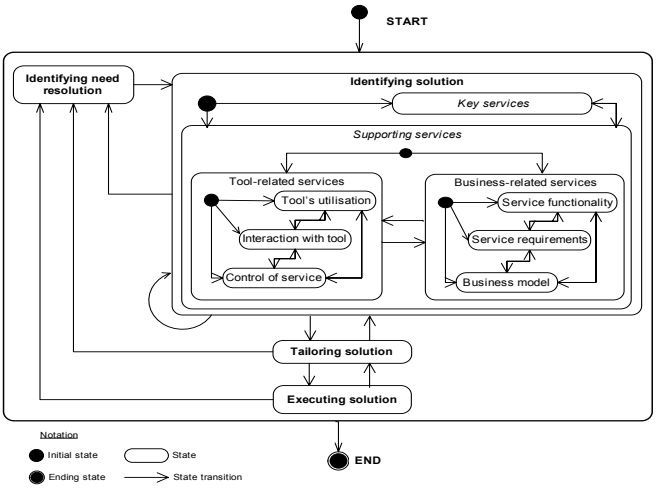

Figure 2: Simplified generic WIS-user behaviour model

Tailoring solution: At this state, the user, to the best of his/her knowledge achieved from previous states, will tailor the selected solution in order to match it with his/her need. One of the main action at this state could be providing all parameters needed for a solution to be executed.

Executing solution: This is the final state where the selected solution after being tailored will be executed and completed. The user might then exit the system if satisfying with the results, or restart the whole process if the results do not quite meet initial expectations.

This paper attempts to analyse and simulate possible behaviours of WIS users for many different purposes. Firstly, the author believes that having understood clearly possible journeys of users when navigating through a WIS could help to design such a WIS that could aid users to achieve what they need quickly and effectively. Secondly, simulating WIS user behaviours would help to observe changes in users' behaviours when interacting with WIS and the results obtained from this observation could help to improve WIS utility or to build a better WIS. For example, if one of the results from the observation shows that the average time a user spent in the state of "identifying solution" is about 15 minutes and more than expected, one could raise such questions as "why and how does it take the user that long to perform the task". The potential causes (like the interface is not user-friendly, the displayed information is confused etc.) then will be identified and solution to improvement will be conducted. Furthermore, different types of users can be identified according to the empirical data obtained from simulation such as data required, functionalities carried out, and experience with the business of WIS etc. [K*04] suggested that if several customer types have been identified, an attempt can be made to tailor the customer interface to the customer type. As a result of this, a significant decrease of data and functionality that might

not be needed by certain the individual customer types could be achieved. This eventually could save a lot of time for the users in achieving what they need and also a lot of resources allocated in a WIS.

6 Future works

The target of the whole project is to use simulation for investigating the utility of a WIS, then to propose some heuristics for building a better WIS that effectively and efficiently assists the users in achieving their goals. The WIS-user behaviour model presented in this paper will further be investigated and therefore possible changes to the model could be made. A lot of further works should and will be done in order to complete the study, such as:

- a model of system behaviour in corresponding to the WIS-user behaviour model presented. These two models then will be integrated and together they will be the bases for completed simulation model to be developed
- a modified simulation model that could be used to simulate a large number of users will be developed
- heuristics to improve the utility of WIS will be constructed
- an application of those models (behaviour model and simulation model) on a real WIS will be demonstrated
- some guidelines on the analysis of data input as well collected data from simulation run will be developed

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