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# User modelling: the consideration of the experience of time during journeys in public transportation

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## ABSTRACT

With the generalization of mobile computing devices, everyone can access to a large amount of information anytime and anywhere; the difficulty for the user is to access to the relevant information. This is more accurate in the public transportation field where during their trip users want to reach information on their move. But they also wish to access a whole range of services adapted to their needs. However, these are different for each traveller and evolve during the trip through the so-called *experience of time during journeys* specific to each individual. Unfortunately, tools or methods to manage these changes do not exist currently. The purpose of this paper is to suggest, by using a model driven approach, to take into account the activity of the travellers; that is to say the *experience of time during journeys*.

## Categories and Subject Descriptors

H.1.2 [User/Machine systems]: Human Factors  
H.5.2 [User Interfaces]: User-centered Design

## General Terms

Design, Human Factors

## Keywords

Model Driven Engineering, Interactive Applications, User Model

## 1. INTRODUCTION

With the generalization of mobile devices, everyone can access to a large amount of information anytime and anywhere; the difficulty being to access the right information at the right time. This is more important in the public transportation field where users need to reach information on mobility throughout their trip [1]. Also, it is essential to allow interactive applications to adapt themselves to the users. This requires a personalization of information and services [2] but also by taking into account the specificities of the business domain allowing to center the analysis on human needs [3]. In the public transportation field, it is only since a few years that researchers are on the problems of the use of time during journeys [4]. To our knowledge, this point has

never been taken into account within a modeling method. Finding a solution to these problems is not sufficient. Indeed, as applications are more and more complex, it is also necessary to create reusable models. It is what Model Driven Engineering (MDE) [5] proposes. But, today, it is only used in a limited way in the field of interactive applications [6] although its interest has been often highlighted [7]. In this article, we propose a method allowing us to manage, within an MDE approach, the so-called *experience of times during journeys* concept.

## 2. APPLICATIONS MODELIZATION AND HUMAN-COMPUTER INTERACTIONS

### 2.1 Modeling of interactive applications

Today, in modelization, the new emergent paradigm seems to be the MDE approach [7] [8]. Its objective is to allow the creation of applications based on conceptual models or on an assembly of existing conceptual models; each model managing well defined business problems. The transition from conceptual models to applications is done through a succession of model transformations based on a Model Driven Architecture approach (MDA) [5]. In our work, we have studied this approach from the Human-Computer Interaction (HCI) point of view. Concerning application modeling, few researches, proposing a true MDA approach, exists [9] although its interest was often highlighted [10]. In this article, based on a modeling method described in [11,12], we will show how it is possible to integrate the *experience of time during journeys* concept in an MDA approach.

### 2.2 User modeling in interactive applications

To provide users with relevant information and services, it is necessary to be able to identify and characterize them. This generally requires the use of user profiles containing two types of information [13]: (1) explicit information provided by the users, (2) implicit information, collected by the system. But, to adapt the applications to the users, it is necessary to change the way of conceiving applications by adopting an approach of interactions centered on the users and on their goals [3]. It is also necessary to find new ways of interacting with them in order to allow faster adaptations. One of the possible solutions consists in recognizing the emotions of the user [14]. Today, if some research provides answers to these problems, few of them deal with problems specific to the public transportation.

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## 2.3 The experience of time during journeys

In public transportation, time during journeys is often regarded as a waste of time [15] during which activities are carried out by travelers only to kill time [16]. However, a study [17] showed that the time in transport was perceived as wasted time for less than 40% of travelers. On this basis, some researches have tried to differentiate the act of moving from the activities carried out [18].

Thus, a first categorization of these activities [4] proposes to classify them in three groups: (1) Productive activities, (2) Activities of relaxation and transition, (3) Social activities.

Another possible categorization, based on an anthropological and sociological study carried out during the Viatic.Mobilité project [1][21] (see §4), has defined four groups distributed on two axes: a vertical axis for the level of concentration and a horizontal axis for the level of openness to the others (cf. Figure 1). These groups are: (1) The *beaver* who has a productive activity; (2) The *owl* who is lost, who is looking for information; (3) The *peacock* who is showing off, who communicates with others; (4) The *marmot* who sleeps, who drowns, who looks at the landscape.

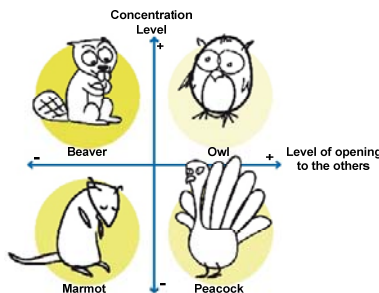


Figure 1. User categories identified in Viatic.Mobilité [21]

We have used this last categorization in order to take into account the *experience of times during journeys* concept (ETDJ).

## 3. ADAPTATION TO THE CONTEXT OF USE FOR INTERACTIVE APPLICATIONS

### 3.1 A new approach of the needs analysis

In well-known software engineering methods (RUP, SADT...), during the analysis phase, the organization of the tasks defines only the organization of the business tasks and considers the user only in a marginal or global way. That is why we propose to enrich the analysis phase (cf. Figure 2).

This enrichment will consist, once all the business tasks are identified, to gather them in business processes; i.e. in sets of tasks allowing to achieve a business goal. Then, they should be distributed in the various ETDJ categories. Then, if necessary, each process is adapted to the various ETDJ categories.

After the application is deployed, it is important to plan a loop phase to validate the choices done during the analysis phase through ground surveys. In the case of a variation, it will be necessary to reconsider the analysis phase and to adapt the distribution of the business processes in the various categories and/or to modify the adaptation to the categories. So the distribution of the business processes in each category and their adaptation must be a multi-field work (engineering and social sciences). This is one of the major challenges of our approach.

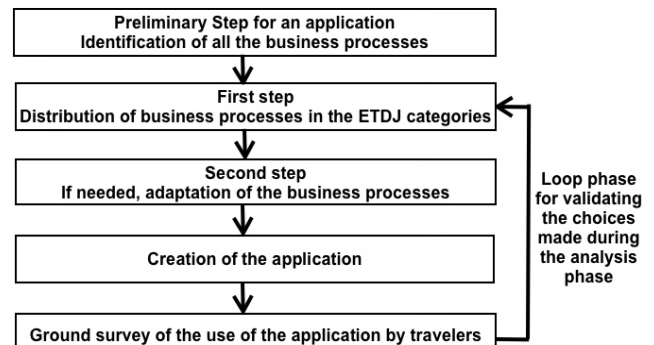


Figure 2. Specific analysis process associated to ETDJ

## 3.2 Identification of the ETDJ category

### 3.2.1 General principle

A problem with the ETDJ concept lies is that we need, at every moment, to know the category in which the traveler is. And, today, we do not have, to our knowledge, sensors or models that allow knowing surely the ETDJ category at every moment.

Within our work, we defined a basic technique for identifying the ETDJ category according to the “localization” of the user in the application. It is done from the knowledge of the business process used and of the context in which this one is used. Thus, in the application, the launch of each business process is always associated with specific level of ETDJ categories (see §3.2.2). For the moment, since we limit ourselves to applications of WIMP type (Windows, Icon, Menu, Pointing device), we propose to use the menus as the elements allowing to make this distribution. Once the category is identified, it is stored in the user profile allowing using it like a property of the explicit profile of the user.

### 3.2.2 Level of confidence and use of history log

For limiting incorrect changes, we propose to define, for each business process and for the associate ETDJ categories, a level of confidence. This level could have a value between 0 (certainly not) and 1 (surely). To determine the levels of confidence, we propose to proceed with a three steps process added to the needs analysis of §3.1: (1) Determination of the initial confidence levels during the initial definition of user needs. (2) Analyze of the results of the ground survey. (3) Adaptation of the levels of confidence if necessary and loop back on the second step.

But the level of confidence is not enough to determine if the ETDJ category should be changed or not. In fact, we must know also from which category the user is coming from and what he/she was doing before. This is done through the use of a history log where each change of business process is logged with the associate levels of confidence for each ETDJ category. Then, for each ETDJ category, a general level of confidence is determined by:

$$\sum (\text{level of confidence}) \times (\text{time in minutes in history log})$$

*for each business process inside history log*

The current ETDJ category is defined as the category with the higher general level of confidence. The problem is that, if the data contained inside the history log has no time limit, the system will become less and less efficient. As determined by the sociological and anthropological study carried out during Viatic.Mobilité [21], the change of an ETDJ category could be determined as been sure

after 7 minutes. If no change of business process is done during this time limit, only the information on the ETDJ categories of the last business process are kepted in the history log.

## 4. CASE STUDY

Our work has been done within the scope of the Viatic.Mobilité<sup>1</sup> project. The purpose of this project was to create a set of services to assist the travelers before, during and after their mobility in public transports, by using different information supports.

### 4.1 Access to adapted services

In Viatic.Mobilité [1], users access information through a portal. To determine the categories of each group of services, the needs approach presented in §3.1 has been used during the conception of the portal. This has been done through the creation of a workgroup with transport experts, sociologists and traveler’s representatives. This conducted to the creation of a simplified portal with five services groups: *Communication*, *Transport Information*, *General Information*, *Leisure*, *Work*. For each services group, the needs analysis conducted to the definition of the levels of confidence showed in table 1.

**Table 1. Levels of confidence on ETDJ category for each services group of the Viatic.Mobilité simplified Portal**

Service group	Beaver	Owl	Peacock	Marmot
<i>Communication</i>	0.4	0.3	0.8	0.1
<i>Transport information</i>	0.5	0.7	0.2	0.3
<i>General information</i>	0.5	0.4	0.2	0.3
<i>Leisure</i>	0.1	0.2	0.4	0.8
<i>Work</i>	0.9	0.1	0.1	0.1

During the Viatic.Mobilité project, for limited time reasons, only some experiments with users have been carried out. This does not allow us to have a definitive conclusion on the approach but this give us three main limitations: (1) The semantic characterization of each ETDJ category was not easy as each participant inside the workgroup used during the needs analysis has a different perception of it. (2) The definition of the levels of confidence is more experimental than scientific as, for the moment, we was unable to define rules for validating them. (3) The validation through ground surveys is not easy as the pollsters and analysts could have a different perception of the ETDJ categories.

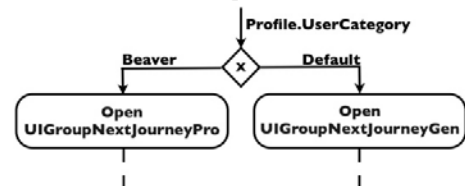
But it gives us also some good results as: (1) The change of the EDTJ category is done in accordance with the direct observation during ground surveys. (2) The incorrect determination of the current ETDJ category of the user inside the application is limited.

In fact, the main problem of the approach resides in the fact that it is not possible to determine an ETDJ category when the traveler does not use the application.

### 4.2 Adaptation of business processes

To illustrate the case of the adaptation of a business process to the ETDJ category, we will present a business process allowing the display of information associated with the next journey of the user. The needs analysis results in the identification of two

different adaptations for the business process. The first one, which is related to the *Beaver* category, will allow binding the display of information on displacement with the information contained in the professional diary of the user. The second one, which is common to all the other categories, will display only information associated with the journey itself. The access to this process could be done by using a button or an option in a menu. From there, a business process could be launched which would use a selection criterion to display a group of elements of interactions called “*UIGroupNextJourneyPro*” if the user belongs to the *Beaver* category and display another group of interaction elements “*UIGroupNextJourneyGen*” for the other categories. Figure 3 shows an extract of the business process model associated.



**Figure 3. Extract of the business process associated to the display of information on the next journey of the user (notation based on BPMN [22])**

### 4.3 Extension to other business domains

Regarding our approach, one of the main question is whether it is expandable on other business domains than transportation. In fact the problem here is to determine the categories which could be associated with the experience of time of the user in other business domains. As they will probably not be the same for each business domain, the question will be to know how to link each business domain together. It is a very critical question as a user could use different applications from different business domains.

One of the solutions could be to create semantic links between categories of the different business domains. As it will not always be easy to make direct links between two categories, we propose to use a weighting, between 0 and 1, on each semantic link which will allow to define a semantic distance between each categories. Table 2 shows an example of this type of relations.

**Table 2. Generic example of a semantic link between categories of experience of time for two business domains**

		ETDJ Category			
		Beaver	Owl	Peacock	Marmot
Experience of time categories for business domain X	Category A	0.1	0.8	0.3	0.6
	Category B	1.0	0.0	0.1	0.1
	Category C	0.4	0.2	0.7	0.3
	Category D	0.5	0.6	0.1	0.4

For time reasons, we have not been able to validate, this approach. But, for the sociologists and anthropologists working with us in the Viatic.Mobilité project, it has been considered as a good approach as it is quite simple to understand, handle and manage.

## 4.4 Discussion

As suggested in the previous examples, our approach allows managing the ETDJ at different levels in interactive applications: (1) Like an element allowing to distribute and to define the content of the business processes; (2) Like a selection criterion, in a direct way or through a business rule.

These examples allow us to see the main advantages of our approach: (1) The possibility to create applications which are

<sup>1</sup> The project was realized by a consortium of industrial companies (Archimed, Atos Wordline, Canal TP, Digiport, Infodio, IP4U, Transport Terrestres Promotion, Visionor, What time is it?, Worldspace, W@Lan, ) and research centers (Iemn, Inrets, Lagis, Lamih); coordination: Inrets.

more reactive to user needs by introducing the notion of ETDJ; (2) To manage the ETDJ categories in a smooth way through the use confidence levels which limit the risk of false selection; (3) The possibility to extend the concept to other business domains.

But, these two examples allow us also to see the current limits of the approach: (1) The importance of the preliminary phase of analysis to distribute and adapt the business processes which rely on a multi-disciplinary approach difficult to set up; (2) The difficulty of knowing, with certitude, the ETDJ category of the user; changes of category being carried out only through interactions done by the users. (3) Lastly, there are problems in the characterization of the ETDJ categories and their number. Within our work, we used four categories, but in other works only three can be found [8] and there is no proof that one would not have to use more than four categories. At the level of the ETDJ categories characterization, which defines with the criteria identifying to which category the user belongs to, the difficulty lies in the definition of sufficiently discriminating criteria to avoid any ambiguity when choosing an ETDJ category. But, it is also dependant on the ways of life and thus can evolve during time and in space (different user cultures); the question being then of knowing how to take into account these evolutions.

## 5. CONCLUSION

Taking into account the user in applications becomes more and more an important general criterion. Today, many works studied various derived concepts about: (1) user profile, (2) information personalization, (3) time consideration (user point of view).

But, to our knowledge, there is very few works which tried to bring conceptual and practical responses to the problem of the taking into account of the attitude of the travelers during their journeys in public transport. More exactly, no works have tried to manage into conceptual models the so-called *experience of time during journeys* concept. Within the Viatic.Mobilité project, through the use of results from a sociological and anthropological ground study and with the help of the industrial partners involved in the project, we bring a first answer to the problem. Thus, we propose to add new steps to the analysis phase of user needs, which is a precondition to any application development, so that this one takes into account the so-called *experience of time during journeys*. Then, we propose, through a MDA approach, solutions to take into account it within the conceptual models of the application. Lastly, we propose a solution to identify the category of *experience of time during journeys* according to the business processes used within the application. If our work leaves many questions without answers, it represents a new step concerning personalized application development in public transportation.

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