M-Modeler: A Framework Implementation for Modeling M-Commerce Applications

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ABSTRACT
At the present time, the use of mobile technology in business, is becoming an opportunity to generate competitive advantages within organization environments. Mobile technology helps a company to optimize its internal processes and services by means of added flexibility in order to access information anytime, anywhere. In this work we introduce M-Modeler, a software tool for modeling m-commerce businesses. Our approach starts from structural patterns in order to produce integral m-business solutions within organizations. M-Modeler implements a framework, based on m-business patterns that helps to reduce the ambiguity in business rules. This is specially useful in the design and construction phases of m-commerce systems development process. The framework allows the user to generate m-business solutions regardless of the specific mobile application. M-Modeler generates XML-based metadata of business workflows that may evolve with the constant necessities of change caused by the emergence of new market strategies demanded by the globalization.

Categories and Subject Descriptors
D.2.11 [**Software Architectures**]: Language Constructs and Features – *patterns, domain-specific architectures, data abstraction.*

General Terms
Design.

Keywords
m-commerce, e-commerce, business modeling, workflow business, XML.

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1. INTRODUCTION
In recent years, the demand of global markets as well as the accelerated rhythm in the development of communication technologies, had opened the way for new strategic forms of commercialization of services and products. Nowadays, Internet has become the medium for organizations to strive for competitiveness and to explore new and revolutionary modalities to exploit their businesses. A key role in this new scenario, is that of understanding customers' needs as well as facilitating business processes (in terms of procedures or activities for building a business objective within an organizational structure). One such modality is known as Electronic Commerce (e-commerce), which transfers several aspects of the legal and commercial processes between business entities to the telecommunication networks. This new strategy in either of its formalizations (B2B or B2C) is nowadays widely known and well defined. However, during the maturity process of these new business modalities, the telecommunication and information technologies made an important step forward with the development of wireless networks and mobile devices. Today, these devices are able to exploit electronic business technology and enhance it by offering the possibility of mobile access to the Internet. This situation opens the opportunity to generate electronic commerce with the added value of mobility, incorporated in the concept of mobile commerce (m-commerce).

Today, there is a wide variety of new m-commerce applications in the market for generating valuable information for businesses under the concept of anytime-anywhere [1] [2]. In this sense, companies are being forced to define flexible solutions to effectively combine business strategies with technological capacities. In this context, the business rules are obligatory criterions set, which are part of the a business process. Both are affected by the choice of the appropriate structure required by the dynamics of the new non-conventional work scenarios involved in mobile commerce. Due to the quick growth of the m-commerce trend, there is a necessity to generate new methodologies and tools to model m-commerce solutions to accelerate its successful adoption in today's businesses [3]. This paper presents a framework which is a container that incorporates business rules and process and its implementation into a software tool, that we named M-Modeler, which is used for m-commerce business modeling.

M-Modeler is an open source development oriented for the medium and small size companies. The proposed software tool is robust enough in order to model business to big scale, beginning with basic patterns of business for their later adaptation and enrichment, also it allows the participation in the process of design of all interested persons, without mattering their geographical location by means of the Internet.

2. M-COMMERCE MODELING

Modeling and designing business rules and processes for information systems are complex tasks. They may become even more complex when the rules and processes involved changes in a dynamic way, according to organizations needs for continuously adapting to new business scenarios with the smallest cost, minimum effort and in the possible shorter time. These demands of the global markets, are impossible to satisfy with the use of the traditional schemes of software design (figure 1), even when most of the changes in the business rules are not radical. The information in the business is manipulated by the diverse areas and/or departments that integrate the company, which incorporates the business processes and rules established and supported in computer systems. These schemes require a great effort in modifications, since the business rules are established in each of the applications in hard code.

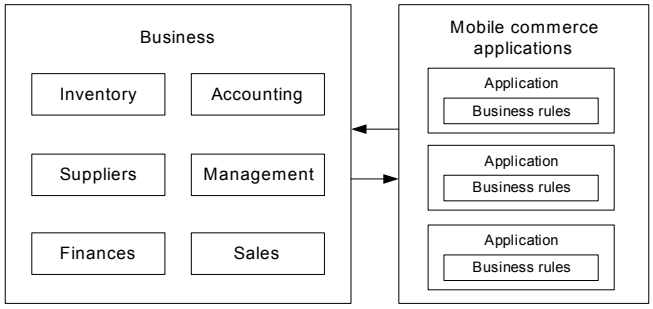

Figure 1. Traditional model of software design.

2.1 Research Strategy

In order to understand the m-commerce problem in real companies, we carried out a study of the existent models for the design of m-commerce business, including case studies of several mobile business: m-banking, m-sale, m-poll, m-learning, m-entertainment; as well as the necessities of the industry on these models. As a result of this study we decided that it was convenient to generate business patterns for specific business domains . The previous was used to obtain information about the appropriate standards for generating and supporting the generic wireless application model. After evaluating the standards, we obtained the design of the development methodology, starting from the result of the previous studies. In the same way, we made a research of the modeling tools that exist in the m-commerce market. Finally we designed and built a software tool for supporting the proposed models.

3. BUSINESS MODELING WITH M-MODELER

The model proposed in the software tool is described in figure 2. This model facilitates the construction of m-commerce applications through a framework that concentrates the business rules and processes involved in mobile technology-based applications. These business rules are coded into a XML metadata container that is used as a layout that describes the workflows (intended as the way that the documents, information or tasks are passed from one participant to other, according to a set of procedural rules), with the purpose of creating different m-commerce applications, through a XML vocabulary [7].

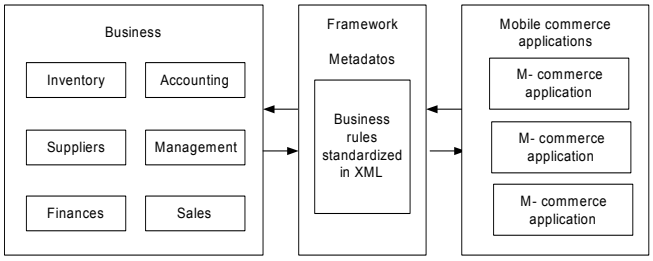

Figure 2. Proposed model for the software tool.

3.1 M-commerce Framework

The framework implemented in M-Modeler consists of a general scheme that comprises a wide range of m-commerce applications. The proposed framework [4] starts with a business to be modeled (left part in Figure 3) and helps the user with the main rules and processes involved in creating a shell (in the context of M-Modeler a shell represents a basic pattern of the structure for a specific business) with the main characteristics of a m-commerce application (central box in figure 3). This shell may be detailed with more specific rules and processes to define and complete a business workflow for the specific application [5] (right box in Figure 3).

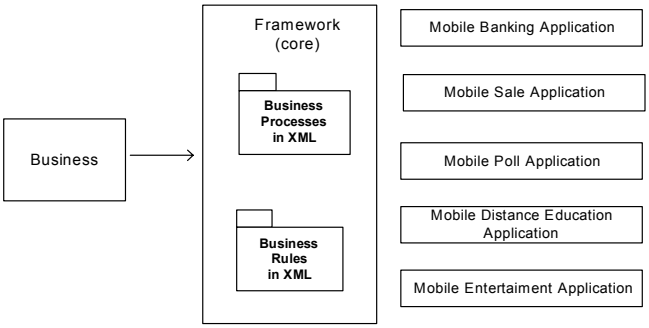

Figure 3. Framework Application Scenarios.

The shells are the product of e-commerce and m-commerce research of different companies belonging to specific business domains [6]. The process for obtaining shells supported in M-Modeler is shown in the figure 4. This process consists on the generation of a business macro model, which is decomposed in its main activities. The obtained shells can be enriched and modified by users in order to improve or establish personalized basic shell in a business context.

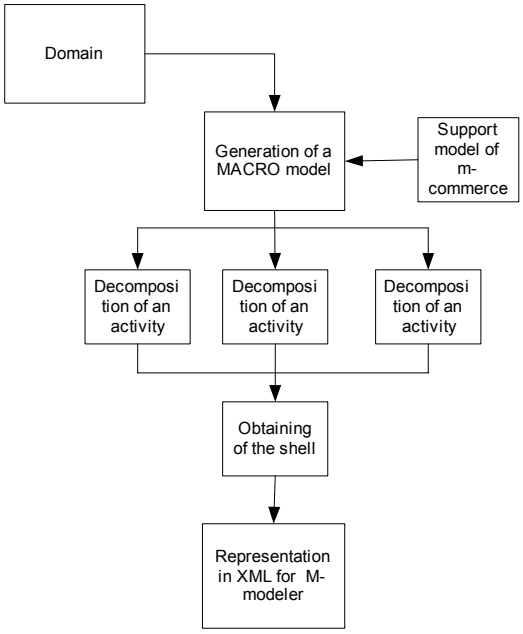

Figure 4. Obtaining of shells.

The proposed framework includes the possibility of either updating an e-commerce business to a m-commerce solution or building a complete m-commerce solution from scratch. In both cases, it is recommended that the workflows of the company go through a reengineering process so that they are adapted to the advantages and restrictions of the new mobile environment.

4. SOFTWARE PROTOTYPE

For the implementation of the framework we built a software tool called M-Modeler. This tool allows to design the workflow for a m-commerce application from a repository (information container) of XML-coded rules and processes. The repository was created by drawing a collection of best practices for various typical m-business applications such as m-sales, m-learning, m-government, m-entertainment, m-poll, and others. The construction of a new model is done by first selecting the kind of m-business projected (m-sales, m-learning, m-government, etc). With this action, the system creates a basic shell including a collection of the most relevant rules and processes involved in the selected type of m-business. Then, the user may detail the business workflow by selecting more rules and patterns from the metadata repository or by entering new rules and processes in order to refine the particular application. The new rules introduced by the user may be incorporated to the system in order to improve the metadata repository. Once the rules and processes have been set, the system gives as output an activity diagram of the whole business workflow and an XML file containing the detailed relationships among the rules and processes of the application.

4.1 Tool Technology

M-Modeler was built using J2EE technology in order to facilitate its use under the most popular operating systems and web servers in industry. In order to reduce the ambiguity in the interpretation of business rules between the design and construction phases, the metadata was built in a technology that allowed simultaneously a formal language representation and a high level of interoperability. To this end, we set out to encode the business rules using XML. With this approach, the system allows us to generate a repository of understandable and portable metadata for m-commerce applications independent of the technological base. In order to further reduce ambiguity in the interpretation of XML code, our system supplements XML. This is done by encoding the proposed rules as formal expressions in this language, that can be parsed and interpreted by a wide range of technologies to construct m-commerce applications.

4.2 Tool Architecture

The M-Modeler tool is composed by various modules that perform complementary tasks in the creation of m-business workflows. The architecture of the system is represented in blocks in figure 5. In this figure a central metadata repository is shared by every step in the model-generating process. The different modules correspond the stages involved in the process. In the following sections we will discuss each one of them in turn.

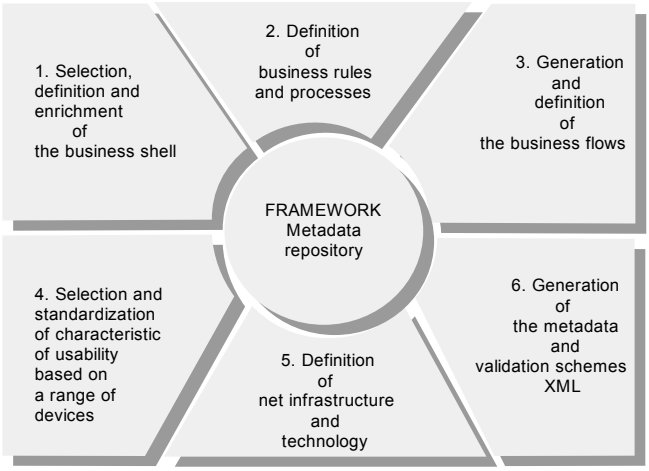

Figure 5. Tool Architecture.

4.3 Example of a M-sales Case

M-Modeler allows to update versions of a same project during its construction. Each project starts from a general framework, which might contain multiple shells. In this paper we illustrate the use of M-Modeler during the whole lifecycle of a project with a m-sales example. Figure 6 shows the basic construction of the creation of a new project for m-sales. The left side in the figure shows a dynamic tree with the name of project as well as the main elements that contain it. M-Modeler contains a wizard that helps us to choose the elements that we consider for our applications in a step-by-step mode.

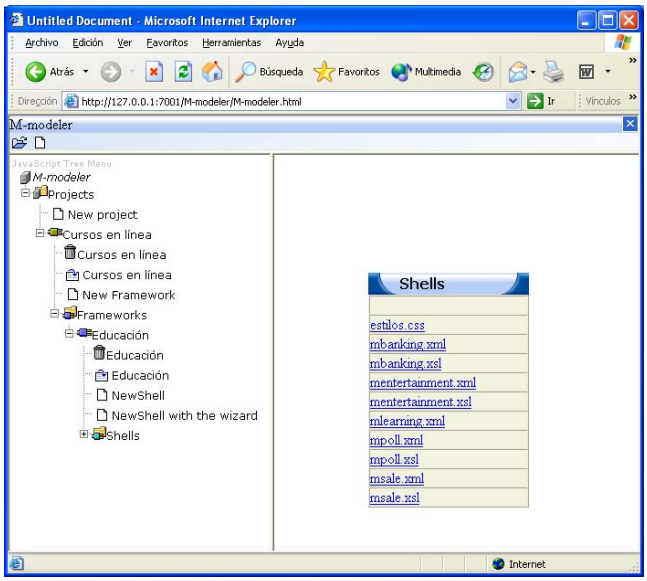

Figure 6. M-sales Project.

Starting from the chosen shell, we can enrich and adapt the m-sales project to the specific necessities of our business through the available options in M-Modeler. The presentation of the generic elements required in a m-sales application is shown the figure 7.

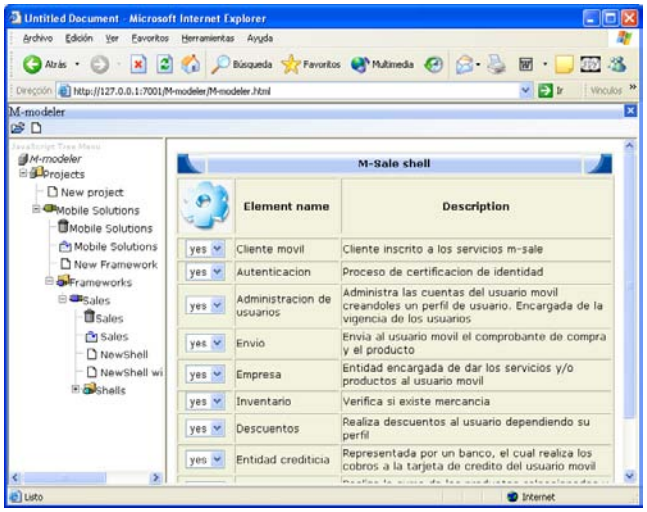

Figure 7. M-sales Elements.

The software tool shows a list of elements in form of a dynamic tree. Figure 8 represents the list of configurable elements for the m-sales project . Each one of the elements can be modified and delete as required by the project as shown in figure 9.

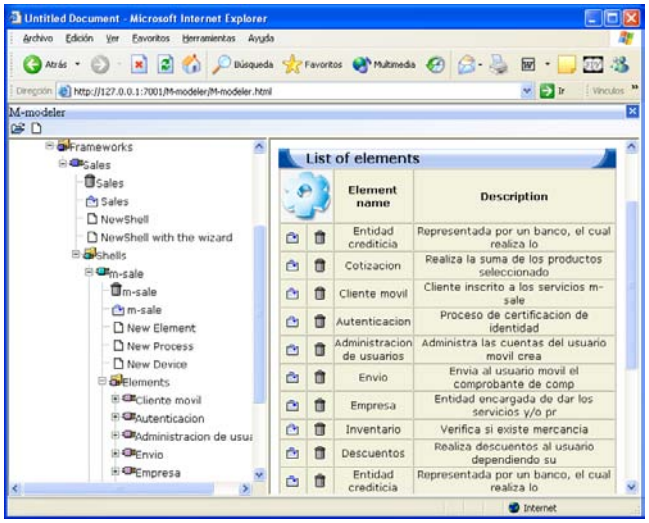

Figure 8. M-sales generic list of elements.

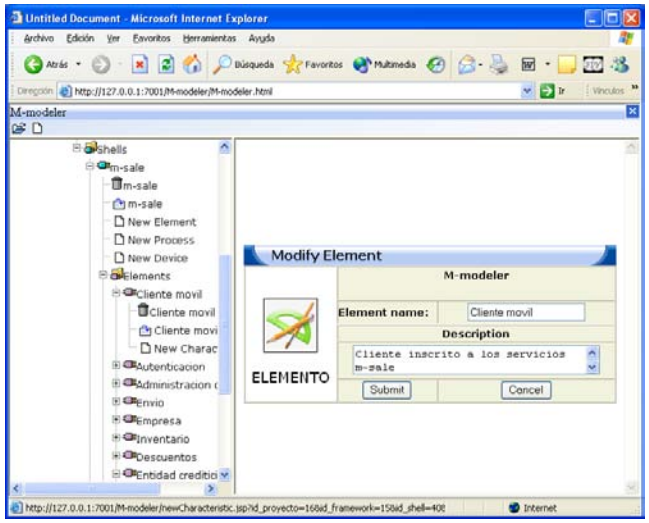

Figure 9. Modified M-sales Elements.

After creating the elements of the shell, each element is configured with specific characteristics that set their definition and the model itself. This characteristics represent the main attributes of each of the elements. Figure 10 shows how new features are added as new characteristic to the m-sales shell.

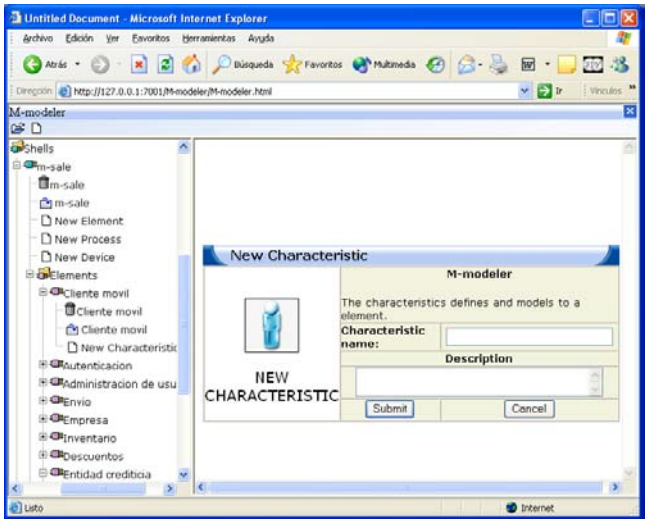

Figure 10. Incremental Features in M-sales.

Figure 11 shows the m-sales shell with its elements and characteristics in XML format after being configured.

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- edited with XML Spy v4.3 U (http://www.xmlspy.com) by Ana (ITESM) -->
<?xml-stylesheet type="text/xsl" href="msale.xsl"?>
<shell nombre="M-sale" descripcion="Propone la comercializacion de productos en cualquier momento desde casi
cualquier lugar, poniendo a los usuarios de dispositivos moviles con Internet, los catalogos, caracteristicas y precios,
de una gran gama de productos.">
    <elemento nombre="Cliente movil" descripcion="Cliente inscrito a los servicios m-sale">
        <caracteristica nombre="Clave" descripcion="Numero unico de identificacion" tipo="Integer"/>
        <caracteristica nombre="Nombre" descripcion="Identidad del usuario" tipo="String"/>
        <caracteristica nombre="Apellido_materno" descripcion="Identidad del usuario" tipo="String"/>
        <caracteristica nombre="Apellido_paterno" descripcion="Identidad del usuario" tipo="String"/>
        <caracteristica nombre="Edad" descripcion="Identidad del usuario" tipo="Integer"/>
        <caracteristica nombre="No. tarjeta de credito" descripcion="Identidad del usuario" tipo="Integer"/>
    </elemento>
    <elemento nombre="Autenticacion" descripcion="Proceso de certificacion de identidad">
        <caracteristica nombre="Clave" descripcion="Numero de usuario validado comparado en la entida de
administracion de usuario" tipo="Integer"/>
    </elemento>
    <elemento nombre="Administracion de usuarios" descripcion="Administra las cuentas del usuario movil
creandoles un perfil de usuario. Encargada de la vigencia de los usuarios">
        <caracteristica nombre="Clave" descripcion="Clave de los usuarios registrados como vigentes "
tipo="Integer"/>
    </elemento>
    <elemento nombre="Envio" descripcion="Envia al usuario movil el comprobante de compra y el producto">
        <caracteristica nombre="Clave" descripcion="Clave del envio del producto" tipo="Integer"/>
    </elemento>
    <elemento nombre="Empresa" descripcion="Entidad encargada de dar los servicios y/o productos al usuario
movil">
        <caracteristica nombre="Clave" descripcion="Clave de la empresa que da los servicios" tipo="Integer"/>
    </elemento>
    <elemento nombre="Inventario" descripcion="Verifica si existe mercancia ">
        <caracteristica nombre="Clave" descripcion="Clave de cada producto  o servicio y/o producto que se ofrece"
tipo="Integer"/>
    </elemento>
```

Figure 11. M-sales Shell XML.

M-Modeler contains a generator of business flows, where the business processes, the entities, the objects and the information flow are defined. Figure 12 shows a process in a dynamic tree (in the right side of the picture), which contains entities and objects, that belong to the m-sales project. The left side contains the elements with the workflow that control the flow of the objects.

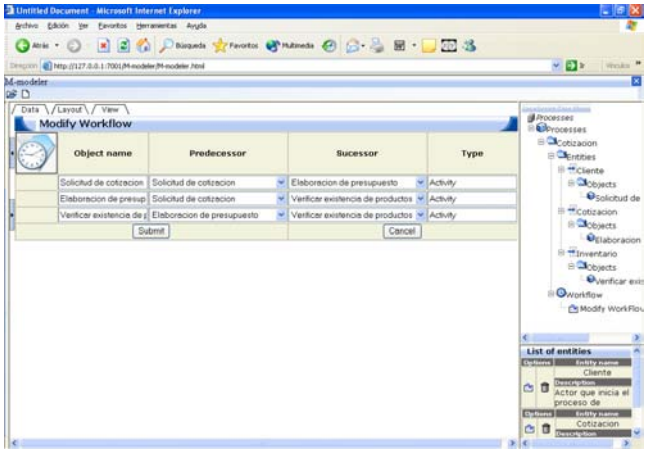

Figure 12. M-sales Processes.

Figure 13 shows an alternative way of presenting the previous workflow. In this figure, a visual form for representing the entities and objects is shown. The objects associated to each entity are displayed below its corresponding icon.

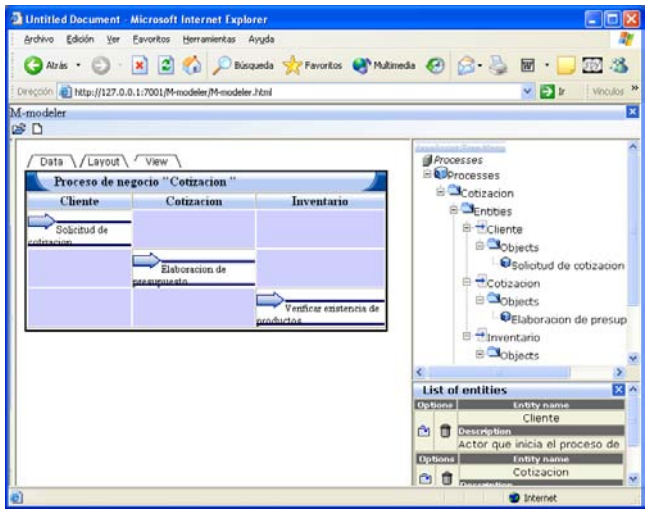

Figure 13. M-sales Processes.

The workflow of the previous m-sales processes is storage in a XML file that contains the business rules and processes description (figure 14).

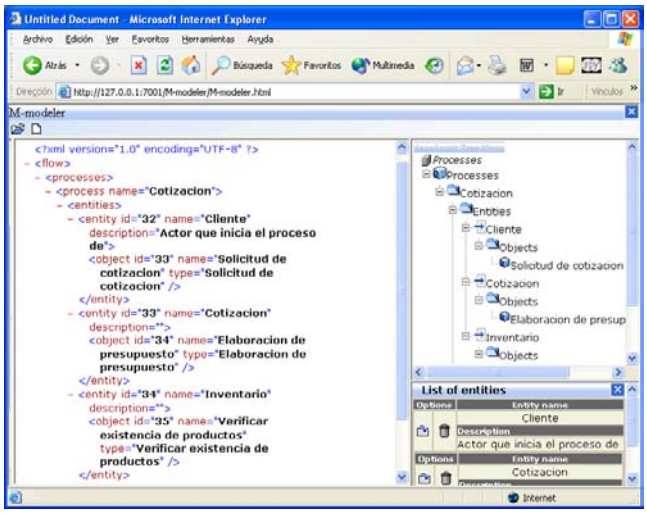

Figure 14. M-sales Processes.

Finally M-Modeler includes a support module for the design of the mobile application, where the types of devices are considered for defining a better device-specific rendering that includes ad-hoc characteristics for storage, display and transactions management. Figure 15 shows the types of devices available for the m-sales application.

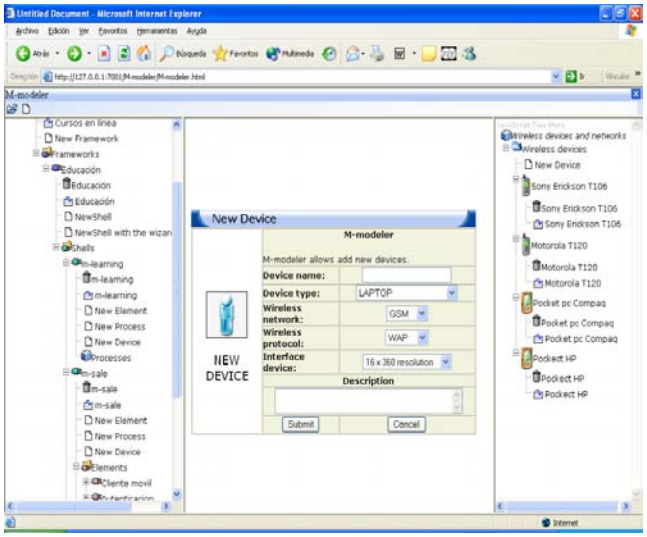

Figure 15. Mobile devices for m-sales project.

At the moment M-Modeler, is under a test process that includes several activities concerning the performance and usability of the tool.

4.4 Current research progress

Currently we have developed a first version of the M-Modeler tool, constructed from the specification defined during this investigation. The following issues represent the advance obtained in this first version 1.0.

1.- Generation of the shells.

2.- Exportation of the shell to format XML.

3.- Import shell-XML.

4.- The description of processes.

5.- The visual environment for the generation of workflows.

6.- The definition of the characteristics of the mobile devices.

7.- The personalization of existent shells.

8.- The generation of new shells starting from a new model.

10.- The generation of final metadata.

5. RELATED WORK

Previous work related with the idea of generating e-business patterns was discussed by Oscar Barros [6]. In his methodology the patterns were used for modeling e-business applications. In this work, we made an adaptation of Barros' original patterns in order to make them suitable for m-commerce.

Other work proposed by Varsney [5], study the challenges and necessities that today's industry requests for the development of m-commerce applications. In his work, a framework for identifying m-commerce patterns was proposed as well as a classification of m-commerce applications.

Tarasewich et al [1] proposed a methodology of adequacy of the models that we adopt to the mobile context.

5.1 Related Tools

CAWE (Computer-Aided Web Engineering)

The CAWE tool allows a integrated environment of design, development, implantation and maintenance, that help users to make the complete cycle within the tool [9]. This software cycle is based in an operational IDE for the conceptual modeling oriented to objects based on OO-H (Object-Oriented Hypermedia). The process of design is guided for the logical interconnection of interfaces, without a clear model in the expression of the business processes and rules. The tool allows the automatic generation of code for the technologies such as ASP, PHP, XML and JSP. The tool includes schemes for e-commerce and m-commerce, but it doesn't include the characteristic of the mobile devices and nets.

WebSphere Commerce Suite

WebSphere is a development software tool for e-commerce solutions that can be extended to be used in m-commerce applications [8]. This software tool includes the construction of the applications with mobile devices using technologies like JSP, WAP, I-mode and DHTML. This tool supports Rational Rose UML and force users to create m-commerce stereotypes (inexistent in standard UML). The fusion of Rational Rose with this software is suggested within a design methodology called "m-commerce direct application design guidelines", that includes some aspects as: usability design, content grouping based on device, modifying shopping flow, and so on.

M-Modeler

M-Modeler is a software tool for modeling mobile business. It allows the generation of business models starting from basic patterns for the a wide set of mobile business. The tool includes the possibility to generate new business patterns from the personalized models to the necessities of each company, supporting the exchange of the knowledge among the companies. Furthermore it imbibes the business processes and rules that are expressed within the tool in defined-XML metadata., which are able to work in an independent way or on the whole framework as horizontal business components that can support vertical applications. This business components maintain the applications separating the business rules of the hard code, which reduces cost and effort in the maintenance. Its Web environment allows its use in big scale projects where participants might be in different geographical areas.

6. FUTURE RESEARCH

Future work under this project plans to include an adaptation model to the context in M-Modeler (as outlined in the figure 16) considering the environment, participants, activities [1] and range of mobile devices to use.

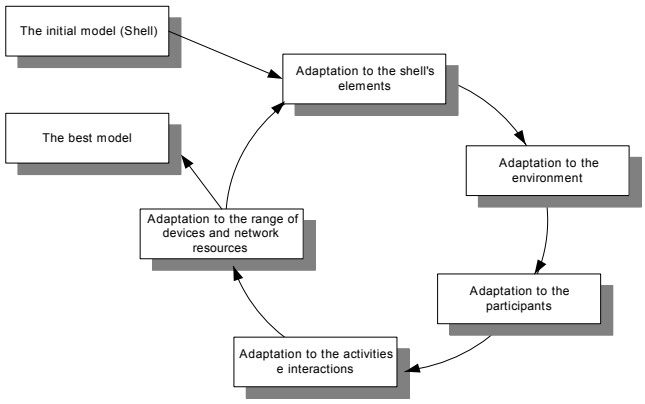

Figure 16. Adaptation model.

After adapting the business processes and rules, these should be transported to the XML metadata container, by means of a formal model for the abstract expression of rules and business processes based on a semantics and syntax XML. This XML representation will help to reduce the ambiguity in the interpretation of the expressions contained in the business workflows.

7. CONCLUSION

This paper presents M-Modeler, a software tool to model m-business workflows from a framework linked to various mobile-technology application domains. M-Modeler codifies general m-business rules and processes in XML and stores them in a repository to create business patterns applicable to various mobile applications. The main aim of the M-Modeler tool is to provide companies having the intention to work with mobile technology, with a mechanism to create a business shell to support m-commerce applications. The repository contained in M-Modeler allows to store and reuse models for many m-commerce applications. This last characteristic is important in terms of the great challenge that companies are facing today to use innovation as a key factor for success while maintaining a fast pace in system development.

8. ACKNOWLEDGMENTS

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