Deliverable

WP10: Case study eBanking
D10.3
Financial Ontology

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EXECUTIVE SUMMARY

This document describes the financial ontology that has been created for Bankinter for the first eBanking case study in DIP, which is described in the deliverable D10.2. This application consists of a mortgage simulation and comparison service.

The financial ontology consists of several ontologies at different levels of abstraction: services and products; and channels, users and currencies. All of them are described in section 4. The ontology does not aim at covering the whole financial domain but focuses mainly on modelling conceptually the mortgage domain (the first application to be developed in the workpackage). The ontology has been designed to be modular enough to allow refinements in the context of the current domain and extensions to other domains in the financial area.

We explain the reasons why it is difficult to build an ontology that covers the complete financial domain, including previous standardization experiences and business aspects.

The financial ontology has been developed following the Methontology methodology [4]. For the specification phase we have used a technique proposed in the context of the kick-off phase of the On-to-knowledge methodology [9], which has proven to be useful to obtain the initial set of concepts and relations, and their classification, from non-experts in knowledge representation.

This deliverable is especially relevant to workpackage 3.
# Document Information

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<td><strong>EU Project officer</strong></td>
<td>Kai Tullius</td>
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**Abstract (for dissemination)**
This document describes a financial ontology that has been developed for the first eBanking case study (mortgage simulator/comparator).

**Keywords**
Financial ontology, mortgage

## Version Log

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1 INTRODUCTION

The overall objective of WP10 in the DIP integrated project is the development of a case study in the ebanking domain. The case study selected as a result of deliverable D10.1 [2] is a Simulation tool for Mortgage Comparison.

The financial ontology described in this deliverable has been developed using Methontology [4], a methodology for ontology construction that has been recommended in DIP deliverable D3.3 for the development of the ontologies needed in all the workpackages.

It is beyond the scope of this deliverable and of the specific case study the creation of a complete financial ontology, deepening in all the possible branches of products and services offered by a bank. For this reason, we have focused on those parts of the ontology that are applicable to our specific case study, as follows:

1) We have considered all the cases that can be applied to mortgage processes, which are about the comparison and simulation of mortgages and with the internal procedure of approval of the mortgage.

2) We have established relationships between all the concepts available from the same point of view, with special attention to the possible combinations of information that a simulator/comparison tool can perform.

There are several reasons for which building an ontology that covers the whole financial domain is difficult:

- Standardisation efforts in the banking domain are very slow and several examples exist of unsuccessful attempts. For instance, we can cite the example of Mobipay in Spain, a micro-payments standardisation initiative, where different interests were involved and no effective market action was finally made.

- Innovation-oriented banks like Bankinter prefer creating innovative products on their own, so that they have some competitive advantage during a short period of time (usually around half a year) until the rest of banks implement such innovations too. That is, we strongly believe that a bank like Bankinter will adopt its own conceptual model and then, if successful, this model will be progressively adopted by other banks. This is well documented by a Forrester Research’s business report [10], where the process of ontology adoption in business is explained.

- The financial domain is very dynamic: new products appear on a weekly basis and some of them cannot be categorised a priori.

- There is a high complexity in the current financial standards, such as IFX (International Financial eXchange Forum), and the agreement between different financial entities is difficult as well, as aforementioned.

There are also strong reasons to develop a new ontology (based on existing ontologies and standardisation initiatives) instead of directly reusing already existing ones:

- In a mature market, such as the financial one, the only advantage between competitors is the know-how and the technology approach. Therefore, proposals of standardisation usually result in long projects, as aforementioned. In these projects, the strongest banks usually impose their own criteria to the rest, whilst small banks try to find a way to make things slightly (or completely) different in order to
compete where the big ones cannot. In that frame, a descriptive but not-too-complex ontology makes the standardization process easier and faster. It also allows each Bank to model its own complexity while maintaining a certain degree of differentiation within a common framework.

- Most of the existing ontologies that we have studied model the financial domain from a client point of view, and do not cover sufficiently the internal processes that a bank must follow to deploy a mortgage contract.

The current version of the financial ontology is the result of the analysis and partial reuse of different knowledge sources in the financial domain: IFX\(^1\) (Interactive Financial eXchange), existing mortgage comparison Web sites and heterogeneous mortgage information providers from a representative set of Spanish bank Web sites, and existing financial ontologies publicly available. From this analysis we have extracted the most representative concepts, unifying the different ways used to express them and removing duplicates. For instance, there are several bases that can be applied to calculate periodically the rates of mortgages at a variable rate. All of them have been grouped under the concept *ProductRateApplication*.

On the other hand we have tried to cover the most common cases of the European mortgage market, instead of covering all the cases and peculiarities that can occur in all the national markets.

Also, several specific products have been intentionally left apart due to its low market share. For instance, there are mortgages whose rates are related to specific balances in a saving account or to other financial products. These situations would have a negative influence in the complexity of the framework of this case study and with a small impact in the simulator results, hence losing our general focus.

### 2 Ontology Building Methodologies

As described in the introduction of this deliverable, and as proposed by WP3, we have used Methontology [4] to develop the ontology. Methontology enables the construction of ontologies at the knowledge level and includes [1]: the identification of the ontology development process, a life cycle based on evolving prototypes, and particular techniques for carrying out each activity. Methontology is supported by ODE [1], [4] and WebODE, although other ontology tools can be used to create ontologies with it. In this case, Protégé-2000 [7] with its OWL plug-in [6] has been used. The editor created in the context of the DIP project will be used in the future, if the ontology needs to be modified or extended.

#### 2.1 Ontology Development Process

The ontology development process [3] refers to *which* activities are carried out when building ontologies. It is crucial to identify these activities in order to reach agreement on ontologies that are to be built co-operatively by geographically distant teams, with some assurance of correctness and completeness. If this is the case, it is advisable to perform the three categories of activities presented below and steer clear of anarchic constructions (Figure 1).

---

\(^1\) http://www.ifxforum.org/ifxforum.org/standards/index.cfm
• **Project Management Activities** include planning, control and quality assurance. *Planning* identifies which tasks are to be performed, how they will be arranged, how much time and what resources are needed for their completion. This activity is essential for reusing ontologies which have already been built or for building ontologies that require different levels of abstraction and generalisation. *Control* guarantees that planned tasks are completed according to the way they were intended to be performed. Finally, *Quality Assurance*, assures that the quality of each and every product outputted (ontology, software and documentation) is satisfactory. [8] describes how these activities are performed.

• **Development-Oriented Activities** include specification, conceptualisation, formalisation and implementation. *Specification* states why the ontology is being built, what are its intended uses and who are the end-users. *Conceptualisation* structures the domain knowledge as meaningful models at the knowledge level. *Formalisation* transforms the conceptual model into a formal or semi-computable model. *Implementation* builds computable models in a computational language. Finally, *Maintenance* updates and corrects the ontology. [4] gives details of how all the development activities, except Formalisation and Maintenance, are performed.

• **Support Activities** include a series of activities, performed at the same time as development-oriented activities, without which no ontology could be built. They include knowledge acquisition, evaluation, integration, documentation and configuration management. *Knowledge Acquisition* acquires knowledge of a given domain. *Evaluation* makes a technical judgement of the ontologies, their associated software environments and documentation with respect to a frame of reference during each phase and between phases of their life cycle [5]. *Integration* of ontologies is required when building a new ontology reusing other ontologies that are already available. *Documentation* details, clearly and exhaustively, each and every one of the phases completed and products generated. *Configuration Management* records all the versions of the documentation, software and ontology code to control the changes. In [4], [5], a description is given of how Knowledge Acquisition was performed in the CHEMICALS ontology (an ontology about chemical elements and their properties), and Evaluation, Integration and Configuration Management is discussed in [6], where the documentation produced is discussed as part of the description of each activity.
2.2 Ontology Life Cycle

It identifies the set of stages through which the ontology moves during its lifetime, describes what activities are to be performed in each stage and how the stages are related (relation of precedence, return, etc.). In [3], a justification is given of why the ontology life cycle should be based on evolving prototypes. For each prototype, Methontology proposes to begin with the specification of the ontology. Simultaneously with this phase, the knowledge acquisition activity starts. Once the first prototype has been specified, the construction of the conceptual model is built at the conceptualisation phase. It is like assembling a jigsaw puzzle from the pieces supplied by the knowledge acquisition activity. The puzzle is completed during the conceptualisation stage [4]. After the conceptualisation, formalisation and implementation of knowledge are carried out.

Formalisation is not a mandatory activity, because using ontology tools the conceptualisation model is usually automatically implemented with translators to ontology languages.

Control, quality assurance, integration, evaluation, documentation, and configuration management are carried out simultaneously to the development activities. However, the stage where the effort for doing integration and evaluation is bigger is the conceptualisation one.

3 DEVELOPMENT OF THE FINANCIAL ONTOLOGY

3.1 Specification. Goal and scope of the ontology

In the ontology specification phase we have used the techniques proposed for the kick-off phase of the On-To-Knowledge methodology [9], which consist in obtaining the first list of concepts and relations by means of brainstorming sessions with domain experts and by using supporting tools like MindManager® or similar. Figure 2 presents the type of result of this phase, which consists of a conceptual map with suggestions of how to classify the relevant concepts and relations.
Figure 2. MindMap illustrating the type of output of a brainstorm session to classify relevant concepts and relations, which later are consolidated in the financial ontology.
3.2 Knowledge sources

Several knowledge sources have been used during the knowledge acquisition phase of the ontology development process. The objective of using several sources was to create an ontology that could be adopted, in the future, by as many other organisations as possible, although this is not a strong requirement. The knowledge sources used are the following:

- Interactive Financial eXchange (IFX), which is an XML-based, financial messaging protocol, built by financial industry and technology leaders, designed for interoperability of systems seeking to exchange financial information internally and externally.

- Aggregated mortgage information provided by http://www.comparador.com/.

- Mortgage information publicly provided by the Web sites of 12 Spanish banks, including the most important ones with respect to the mortgage market\(^2\), which are: BBVA\(^3\), BSCH\(^4\), Caja Madrid, La Caixa\(^5\), Banco Popular\(^6\), iBanesto\(^7\), Patagon\(^8\), Bankinter\(^9\), Banco Pastor\(^10\), Banco Sabadell, and BBK. Annex I provides information about the process followed to obtain this information.

- A financial ontology\(^11\) developed by Teknowledge and written in KIF. The ontology extends the SUMO upper-level ontology and provides some top-level terms in the financial domain.

As a result of the knowledge acquisition process, the most important terms of all the knowledge sources were identified, as well as their commonalities and differences.

4 CONCEPTUALIZATION

In this section we present the conceptualisation of the ontology according to the intermediate representations proposed by Methontology for this conceptualisation phase.

4.1 Knowledge Architecture

The financial ontology is composed of several ontologies at different levels of abstraction: services and products, channels, users, and currencies. In the following sections we provide the details of these ontologies.

\(^2\) An unofficial ranking of Spanish banks with respect to their position on the mortgage market is available at: http://www.euroresidentes.com/vivienda/hipotecas/entidades_que_le_dan_la_hipoteca.htm

\(^3\) http://www.bbva.es/TLBS/tlbs/jsp/esp/pusted/prodserv/hipotecas/hipotecacuotafinal.jsp?Pestana=Haga%20n%FAmeros

\(^4\) https://www.gruposantander.com/SimH_SCH/portada.jsp?login=particular&password=particular

\(^5\) http://portal1.lacaixa.es/Channel/Ch_Redirect_Tx?dest=1-12-10-00000101

\(^6\) http://www.bancopopular.es/simuladores/simula.asp

\(^7\) http://www.ibanesto.com

\(^8\) https://bancaonline.patagon.es/servlet/PProxy?app=DJ&cmd=8009&active=0&opcion=BC

\(^9\) https://www.ebankinter.com/www/es-es/cgi/ebk+hip+compra_venta

\(^10\) http://www.bancopastor.es/d30/d3020/3020_stage2.html

\(^11\) http://einstein.teknowledge.com:8080/download/register.jsp?fileType=.tar&fileName=FinancialOnt.tar
4.2 Ontology conceptualisation: Service ontology

Terms glossary

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<td>AddedValue</td>
<td>Bank service. The sales revenue from selling a product less the cost of the materials or purchases used in those products. It is an indicator of relative efficiency within and between firms, although in the latter case it is open to distortion where mark-up varies between standard and premium-priced segments of a market</td>
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<tr>
<td>Collection</td>
<td>Bank service. Deposit in a saving account</td>
<td>Concept</td>
</tr>
<tr>
<td>Payment</td>
<td>Bank service. Money given to pay for something</td>
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<tr>
<td>Invoice</td>
<td>An itemized statement given to a buyer by a seller and usually specifying the price of goods or services and the terms of sale</td>
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<td>ServiceContractedByCustomerInChannel</td>
<td>Product or service contracted by a channel</td>
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<td>Service contracted</td>
<td>Relation</td>
</tr>
<tr>
<td>channel(ServicesContractedByCustomerInChannel, Channel)</td>
<td>Channel where the contract has taken place</td>
<td>Relation</td>
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<tr>
<td>customer(ServicesContractedByCustomerInChannel, Customer)</td>
<td>Customer that has contracted a service</td>
<td>Relation</td>
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Concept classification tree

```
Service -- AddedValue -- Collection -- Payment -- Invoice -- ServiceContractedByCustomerInChannel
```

Concept dictionary

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4.3 Ontology conceptualisation: Product ontology

Terms glossary

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<td>Product</td>
<td>Bank product that requires the signature of a contract between the customer and the bank</td>
<td>Concept</td>
</tr>
<tr>
<td>Asset</td>
<td>The land or property of a company or individual, payments due from bills, investments, and anything else owned that can be turned into cash</td>
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</tr>
<tr>
<td>InvestmentAccount</td>
<td>Account setup to perform an investment, such as a fixed term deposit</td>
<td>Concept</td>
</tr>
<tr>
<td>InvestmentFund</td>
<td>Investment club where a set of customers put their money so that the bank performs an investment on behalf of them.</td>
<td>Concept</td>
</tr>
<tr>
<td>SavingAccount</td>
<td>Account without a chequebook and normally with a low interest rate</td>
<td>Concept</td>
</tr>
<tr>
<td>Loan</td>
<td>Money let out at interest</td>
<td>Concept</td>
</tr>
<tr>
<td>MortgageLoan</td>
<td>A long-term loan backed by real estate or valuable property, usually the item purchased with the loan. The creditor can claim that property if all payments are not made by the borrower when they are due</td>
<td>Concept</td>
</tr>
<tr>
<td>CurrentMortgageLoan</td>
<td>Current mortgage loan that the user is willing to change.</td>
<td>Concept</td>
</tr>
<tr>
<td>FutureMortgageLoan</td>
<td>Future mortgage loan that the user will use instead of the current one</td>
<td>Concept</td>
</tr>
<tr>
<td>Liability</td>
<td>The amount that is owed by an individual or company, whether money, products, or services, to others.</td>
<td>Concept</td>
</tr>
<tr>
<td>ProductRateApplication</td>
<td>Applied interest rate</td>
<td>Concept</td>
</tr>
<tr>
<td>ProductRateApplicationMixed</td>
<td>Mixed interest rate, usually composed of fixed and variable interest rates</td>
<td>Concept</td>
</tr>
<tr>
<td>ProductRateApplicationFixed</td>
<td>Fixed interest rate. It never varies during the mortgage life</td>
<td>Concept</td>
</tr>
<tr>
<td>ProductRateApplicationVariable</td>
<td>Variable interest rate. It may vary during the mortgage life</td>
<td>Concept</td>
</tr>
<tr>
<td>Quota</td>
<td>Amount to be paid in a loan</td>
<td>Concept</td>
</tr>
<tr>
<td>cancelationCommission</td>
<td>Commission to be paid when a mortgage is cancelled</td>
<td>Relation</td>
</tr>
<tr>
<td>openingCommission</td>
<td>Commission to be paid when a mortgage is opened</td>
<td>Relation</td>
</tr>
<tr>
<td>subrogationCommission</td>
<td>Commission to be paid when a mortgage is subrogated</td>
<td>Relation</td>
</tr>
<tr>
<td>currencyProduct</td>
<td>Currency of a bank product</td>
<td>Relation</td>
</tr>
<tr>
<td>Name</td>
<td>Description</td>
<td>Type</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>interestRateType</td>
<td>Type of interest rate of a bank product</td>
<td>Relation</td>
</tr>
<tr>
<td>payments</td>
<td>Payments due in a saving account</td>
<td>Relation</td>
</tr>
<tr>
<td>handlingCapital</td>
<td></td>
<td>Instance</td>
</tr>
<tr>
<td>interestNextRevision</td>
<td>Interest Rate that will be effective in the next period.</td>
<td>Instance</td>
</tr>
<tr>
<td>saleCostProperty</td>
<td>Sale cost from the building to which reference the mortgage</td>
<td>Instance</td>
</tr>
<tr>
<td>buyCostProperty</td>
<td>Buy cost from the building to which reference the mortgage</td>
<td>Instance</td>
</tr>
<tr>
<td>quotaAfterRevision</td>
<td>Monthly payment that will pay after the revision of the interest rate.</td>
<td>Instance</td>
</tr>
<tr>
<td>delayInterestRate</td>
<td>Interest rate that will be applied in case of delay in the payment.</td>
<td>Instance</td>
</tr>
<tr>
<td>homelInsurance</td>
<td>It indicates if it's necessary contract a home insurance.</td>
<td>Instance</td>
</tr>
<tr>
<td>initialQuota</td>
<td>Monthly payment that will pay at the beginning.</td>
<td>Instance</td>
</tr>
<tr>
<td>initialPeriod</td>
<td>Period that customer will pay the inical quota</td>
<td>Instance</td>
</tr>
<tr>
<td>lifeInsurance</td>
<td>It indicates if it's necessary contract a life insurance</td>
<td>Instance</td>
</tr>
<tr>
<td>mortgageTaxation</td>
<td>Value of the property. This value has been specified by an expert.</td>
<td>Instance</td>
</tr>
<tr>
<td>periodicityQuota</td>
<td>Regularity of the monthly payment, annual payments etc</td>
<td>Instance</td>
</tr>
<tr>
<td>revisionTerm</td>
<td>Term between two revisions of the type of interest</td>
<td>Instance</td>
</tr>
<tr>
<td>term</td>
<td>Term payment.</td>
<td>Instance</td>
</tr>
<tr>
<td>interestRateValue</td>
<td>Interest rate of financial product.</td>
<td>Instance</td>
</tr>
<tr>
<td>capital</td>
<td>Total capital of the mortgage.</td>
<td>Instance</td>
</tr>
<tr>
<td>APR</td>
<td>The annual percentage rate (APR) is an interest rate that includes other commissions.</td>
<td>Instance</td>
</tr>
<tr>
<td>expirationDate</td>
<td>Expiration date for mortgage</td>
<td>Instance</td>
</tr>
<tr>
<td>signalDateContract</td>
<td>Initial date of mortgage</td>
<td>Instance</td>
</tr>
</tbody>
</table>
Concept classification tree

Concept dictionary

<table>
<thead>
<tr>
<th>Concept name</th>
<th>Class attributes</th>
<th>Instance attributes</th>
<th>Relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>--</td>
<td>APR expirationDate</td>
<td>currencyProduct</td>
</tr>
<tr>
<td></td>
<td></td>
<td>signalDateContract</td>
<td>interestRateType</td>
</tr>
<tr>
<td>Asset</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>InvestmentAccount</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>InvestmentFund</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>SavingAccount</td>
<td>--</td>
<td>--</td>
<td>payments</td>
</tr>
<tr>
<td>Loan</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>MortgageLoan</td>
<td>--</td>
<td>revisionTermNext</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>capital</td>
<td></td>
</tr>
<tr>
<td>CurrentMortgageLoan</td>
<td>--</td>
<td>handlingCapital</td>
<td>cancelationCommission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>interestNextRevision</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>saleCostProperty</td>
<td></td>
</tr>
<tr>
<td>FutureMortgageLoan</td>
<td>--</td>
<td>buyCostProperty</td>
<td>openingCommission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>quotaAfterRevision</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>delayInterestRate</td>
<td>subrotationCommission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>homeInsurance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>initialQuota</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>initialPeriod</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>interesDelay</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>lifeInsurance</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>mortgageTaxation</td>
<td></td>
</tr>
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<td></td>
<td></td>
<td>periodicityQuota</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>revisionTerm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>term</td>
<td></td>
</tr>
<tr>
<td>Liability</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>ProductRateApplication</td>
<td>--</td>
<td>interestRateValue</td>
<td>--</td>
</tr>
<tr>
<td>ProductRateApplicationMixed</td>
<td>--</td>
<td>termRateFixed</td>
<td>--</td>
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<tr>
<td>Concept name</td>
<td>Class attributes</td>
<td>Instance attributes</td>
<td>Relations</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>------------------</td>
<td>---------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>ProductRateApplicationFixed</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>ProductRateApplicationVariable</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Quota</td>
<td>--</td>
<td>endingDate</td>
<td>startingDate</td>
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</tbody>
</table>

Binary relation table

<table>
<thead>
<tr>
<th>Relation name</th>
<th>Source concept</th>
<th>Source cardinality (Max)</th>
<th>Target concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>cancelationCommission</td>
<td>CurrentMortgageLoan</td>
<td>1</td>
<td>Quota</td>
</tr>
<tr>
<td>openingCommission</td>
<td>FutureMortgageLoan</td>
<td>1</td>
<td>Quota</td>
</tr>
<tr>
<td>subrogationCommission</td>
<td>FutureMortgageLoan</td>
<td>1</td>
<td>Quota</td>
</tr>
<tr>
<td>currencyProduct</td>
<td>Product</td>
<td>1</td>
<td>Currency</td>
</tr>
<tr>
<td>interestRateType</td>
<td>Product</td>
<td>n</td>
<td>ProductRateApplication</td>
</tr>
<tr>
<td>payments</td>
<td>SavingAccount</td>
<td>n</td>
<td>Payment</td>
</tr>
</tbody>
</table>

Instance attribute table

<table>
<thead>
<tr>
<th>Instance attribute name</th>
<th>Concept name</th>
<th>Value type</th>
<th>Cardinality</th>
</tr>
</thead>
<tbody>
<tr>
<td>handlingCapital</td>
<td>CurrentMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>interestNextRevision</td>
<td>CurrentMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>saleCostProperty</td>
<td>CurrentMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>buyCostProperty</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>quotaAfterRevision</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>delayInterestRate</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>homeInsurance</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>initialQuota</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>initialPeriod</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>interesDelay</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>lifeInsurance</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>mortgageTaxation</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>periodicityQuota</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>revisionTerm</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>term</td>
<td>FutureMortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>interestRateValue</td>
<td>Product, ProductRateApplication</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>revisionTermNext</td>
<td>MortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>Instance attribute name</td>
<td>Concept name</td>
<td>Value type</td>
<td>Cardinality</td>
</tr>
<tr>
<td>-------------------------</td>
<td>-------------------</td>
<td>------------</td>
<td>-------------</td>
</tr>
<tr>
<td>capital</td>
<td>MortgageLoan</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>APR</td>
<td>Product</td>
<td>String</td>
<td>(0, 1)</td>
</tr>
<tr>
<td>expirationDate</td>
<td>Product</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>signalDateContract</td>
<td>Product</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>termRateFixed</td>
<td>ProductRateAplicationMixed</td>
<td>String</td>
<td>(0, 1)</td>
</tr>
<tr>
<td>endingDate</td>
<td>Quota</td>
<td>String</td>
<td>(0, n)</td>
</tr>
<tr>
<td>startingDate</td>
<td>Quota</td>
<td>String</td>
<td>(0, n)</td>
</tr>
</tbody>
</table>

4.4 Ontology conceptualisation: Channel ontology

Terms glossary

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>Communication means used in the relationship between the bank and its customers, including branches, phone, Internet, virtual banking, etc.</td>
<td>Concept</td>
</tr>
<tr>
<td>Branch</td>
<td>Physical bank office</td>
<td>Concept</td>
</tr>
<tr>
<td>vBanking</td>
<td>Virtual Banking. Banking without human intervention</td>
<td>Concept</td>
</tr>
</tbody>
</table>

Concept classification tree

![Channel](image)
- ![Branch](image)
- ![vBanking](image)

Concept dictionary

<table>
<thead>
<tr>
<th>Concept name</th>
<th>Class attributes</th>
<th>Instance attributes</th>
<th>Relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Branch</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>vBanking</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

4.5 Ontology conceptualisation: User ontology

Terms glossary

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>Any user of the system: customers, departments, and employees</td>
<td>Concept</td>
</tr>
<tr>
<td>Customer</td>
<td>Bank client, who usually has a contractual relationship with the bank</td>
<td>Concept</td>
</tr>
<tr>
<td>Company</td>
<td>A number of people grouped together as a business enterprise. Types of companies include public limited companies, partnerships, joint ventures and proprietorships, and branches of foreign companies</td>
<td>Concept</td>
</tr>
<tr>
<td>Person</td>
<td>Bank client that represents a single person (physical or juridical)</td>
<td>Concept</td>
</tr>
<tr>
<td>SOHO</td>
<td>Small Office, Home Office. It usually refers to professionals who work in their own offices</td>
<td>Concept</td>
</tr>
</tbody>
</table>
### Name | Description | Type
--- | --- | ---
Department | Internal area of the bank that performs a specific function | Concept
Corporate | Company with a specific set of characteristics that require a personalised commercial treatment. Depending on each bank, the set of characteristics may change, although they normally refer to number of employees and annual turnover. It includes company groups, multinational companies, etc. | Concept
Individual | Department that deals with physical persons | Concept
SME | Small or Medium Enterprise | Concept
Employee | Employee | Concept
Administrative | Employee with administrative functions | Concept
Commercial | Employee with commercial functions | Concept
Staff | Central Services of a company, such as Human Resources, Management, Innovation, etc. | Concept
titularity | Product that a customer holds | Relation
login | User login | Instance Attribute
password | User password | Instance Attribute
name | Product or customer name | Instance Attribute
CIF | Código de Identificación Fiscal | Instance Attribute
NIF | Número de Identificación Fiscal | Instance Attribute

### Concept classification tree

![Concept Classification Tree](image)

### Concept dictionary

<table>
<thead>
<tr>
<th>Concept name</th>
<th>Class attributes</th>
<th>Instance attributes</th>
<th>Relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>--</td>
<td>login, password</td>
<td>--</td>
</tr>
<tr>
<td>Customer</td>
<td>--</td>
<td>name</td>
<td>titularity</td>
</tr>
<tr>
<td>Company</td>
<td>CIF</td>
<td>Person</td>
<td>NIF</td>
</tr>
<tr>
<td>---------</td>
<td>-----</td>
<td>--------</td>
<td>-----</td>
</tr>
<tr>
<td>Corporation</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Individuals</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>SME</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Employee</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Administrative</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Commercial</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Staff</td>
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</tbody>
</table>

**Binary relation table**

<table>
<thead>
<tr>
<th>Relation name</th>
<th>Source concept</th>
<th>Source cardinality (max)</th>
<th>Target concept</th>
</tr>
</thead>
<tbody>
<tr>
<td>titularity</td>
<td>Customer</td>
<td>N</td>
<td>Product</td>
</tr>
</tbody>
</table>

**Instance attribute table**

<table>
<thead>
<tr>
<th>Instance attribute name</th>
<th>Concept name</th>
<th>Value type</th>
<th>Cardinality</th>
</tr>
</thead>
<tbody>
<tr>
<td>login</td>
<td>User</td>
<td>String</td>
<td>1..1</td>
</tr>
<tr>
<td>password</td>
<td>User</td>
<td>String</td>
<td>1..1</td>
</tr>
<tr>
<td>name</td>
<td>Customer</td>
<td>String</td>
<td>1..1</td>
</tr>
<tr>
<td>NIF</td>
<td>Company</td>
<td>String</td>
<td>1..1</td>
</tr>
<tr>
<td>CIF</td>
<td>Person, SOHO</td>
<td>String</td>
<td>1..1</td>
</tr>
</tbody>
</table>

4.6 Ontology conceptualisation: Currency ontology

**Terms glossary**

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency</td>
<td>Money in circulation</td>
<td>Concept</td>
</tr>
</tbody>
</table>

**Concept classification tree**

![Currency]

**Concept dictionary**

<table>
<thead>
<tr>
<th>Concept name</th>
<th>Class attributes</th>
<th>Instance attributes</th>
<th>Relations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Currency</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>
5 IMPLEMENTATION

The financial ontology has been implemented in OWL, since it has been modelled with the Protégé tool\(^\text{12}\) and the OWL plug-in [6]. It has been transformed later into WSML, so that it can be used by the DIP architecture components. The source code in both languages is available in the DIP BSCW server\(^\text{13}\).

6 REFERENCES


\(^{12}\) http://protege.stanford.edu/

\(^{13}\) https://bscw.dip.deri.ie/
ANNEX I. ANALYSIS OF WEB MORTGAGE SIMULATORS

As shown in section 3.2, we have used a set of 12 mortgage simulators as a knowledge source for the financial ontology. These simulators are mainly offered by financial institutions, although other non-financial Web sites are also available with the same kind of information.

The institutions analysed have usually more than one simulator, varying from 1 to almost 20, due to the following reasons:

- In several cases, each type of mortgage has its own simulator.
- In most of the cases, there are one or several commission simulators.
- In most of the cases, there are tax simulators.
- In several cases, the actual interest type is provided by the institution, while in others, the simulator requires the client to specify it.
- In several cases, the cost of the property to be bought is required, in others the Public Registry value is required, and in a few cases, no value has to be provided.

Hence, we really analysed more than 70 simulators from 12 financial institutions.

In a first approach, we identified an extensive list of concepts used as inputs and outputs by at least one of the mentioned simulators.

<table>
<thead>
<tr>
<th>INPUT DATA</th>
<th>OUTPUT DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importe del prestamo</td>
<td>Cuota actual</td>
</tr>
<tr>
<td>Plazo del prestamo</td>
<td>Limite de prestamo recomendado</td>
</tr>
<tr>
<td>Tipo de interes estimado</td>
<td>Gastos totales compra/venta e hipoteca del inmueble.</td>
</tr>
<tr>
<td>Ingresos netos anuales un. familiar</td>
<td>Valor maximo del inmueble a comprar</td>
</tr>
<tr>
<td>Gastos anuales un. familiar</td>
<td>Cuota estimada tras revision</td>
</tr>
<tr>
<td>Valor compra inmueble</td>
<td>Comision de apertura y/o estudio</td>
</tr>
<tr>
<td>Tipo inmueble (Nueva/usada)</td>
<td>Impuestos compra inmueble</td>
</tr>
<tr>
<td>Comunidad Autonoma</td>
<td>Notario compra inmueble</td>
</tr>
<tr>
<td>Vendedor inmueble</td>
<td>Gestoria compra inmueble</td>
</tr>
<tr>
<td>Ahorro estimado destinado a la compra</td>
<td>Tasacion compra inmueble</td>
</tr>
<tr>
<td>Importe venta inmueble actual</td>
<td>Impuestos Hipoteca</td>
</tr>
<tr>
<td>Inversiones en reformas, etc</td>
<td>Notario Hipoteca</td>
</tr>
<tr>
<td>Gastos compra/venta e hipoteca del inmueble</td>
<td>Gestoria hipoteca</td>
</tr>
<tr>
<td>Tipo interes prestamo actual</td>
<td>Diferencia mensual con otra entidad comparada</td>
</tr>
<tr>
<td>Plazo hasta proxima revision prestamo actual</td>
<td>Diferencia anual con otra entidad comparada</td>
</tr>
<tr>
<td><strong>INPUT DATA</strong></td>
<td><strong>OUTPUT DATA</strong></td>
</tr>
<tr>
<td>----------------------------------------------------</td>
<td>------------------------------------------------------</td>
</tr>
<tr>
<td>Tipo interés estimado próxima revisión préstamo actual</td>
<td>Diferencia total con otra entidad comparada</td>
</tr>
<tr>
<td>Importe préstamo actual</td>
<td>Notaría cancelación préstamo actual</td>
</tr>
<tr>
<td>Porcentaje s/cuota final</td>
<td>Gestoria cancelacion préstamo actual</td>
</tr>
<tr>
<td>Tipo de interes inicial</td>
<td>Registro cancelacion préstamo actual</td>
</tr>
<tr>
<td>Duracion periodo inicial</td>
<td>Plazo amortizacion hipoteca</td>
</tr>
<tr>
<td>Valor tasacion inmueble a comprar</td>
<td>Cuota con seguro vida</td>
</tr>
<tr>
<td>Tipo: fija, variable, mixta, autopromotor</td>
<td>Cuota con seguro hogar</td>
</tr>
<tr>
<td>Indice de referencia (Euribor. irph)</td>
<td>Cuota con ambos seguros</td>
</tr>
<tr>
<td>Importe préstamo sobre total valor compra</td>
<td></td>
</tr>
<tr>
<td>Numero miembros unidad familiar</td>
<td></td>
</tr>
<tr>
<td>Tipo trabajo (Cuenta ajena, autonomo, ambos)</td>
<td></td>
</tr>
<tr>
<td>Tipo contrato (fijo, mensual)</td>
<td></td>
</tr>
<tr>
<td>Antiguedad en el empleo (fijo/temporal)</td>
<td></td>
</tr>
<tr>
<td>Primera hipoteca (si/no)</td>
<td></td>
</tr>
<tr>
<td>Cuota inicial</td>
<td></td>
</tr>
<tr>
<td>Comprobacion registral</td>
<td></td>
</tr>
<tr>
<td>Provincia vivienda nueva</td>
<td></td>
</tr>
<tr>
<td>Comision apertura</td>
<td></td>
</tr>
<tr>
<td>Periodicidad de la cuota (mensual, trimestral, semestral, anual, 14 cuotas al año)</td>
<td></td>
</tr>
<tr>
<td>Pesetas/euros</td>
<td></td>
</tr>
<tr>
<td>Tipo de interes aplicable en otra entidad</td>
<td></td>
</tr>
<tr>
<td>Comision de cancelacion préstamo actual</td>
<td></td>
</tr>
<tr>
<td>Seguro de vida</td>
<td></td>
</tr>
<tr>
<td>Seguro de hogar</td>
<td></td>
</tr>
<tr>
<td>Ambos seguros</td>
<td></td>
</tr>
<tr>
<td>Sin seguros</td>
<td></td>
</tr>
</tbody>
</table>

Then we proceeded with the filtering of the results. We identified that several inputs were used in just one simulator or for a very specific type of mortgage. Some of the inputs that were filtered are the following:

- Ingresos netos anuales un. Familiar
- Gastos anuales un familiar
- Tipo inmueble (Nueva/usada)
- Vendedor inmueble (persona fisica o juridica)
• Ahorro estimado que posee el solicitante destinado a la compra
• Numero miembros unidad familiar
• Tipo trabajo (Cuenta ajena, autónomo, ambos)
• Tipo contrato (fijo, mensual)
• Antigüedad en el empleo (fijo/temporal)
• Primera hipoteca (sí/no)
• Comprobación registral
• Provincia vivienda nueva
• Tipo de interés aplicable en otra entidad

Some of the outputs that were filtered are the following:
• Tasación compra inmueble
• Notaria: cancelación préstamo actual
• Gestoría: cancelación préstamo actual
• Registro: cancelación préstamo actual

The second filter was to identify which of the input and output terms could be unified in a common concept. For example we identified that 'Plazo del préstamo' and 'Plazo de amortización de hipoteca' referred to the same entity in more than 90% of the cases.

The third step was to define the meaning of each concept, taking into account its main use in most of the simulators. Then, we decided which terms should be considered as concepts, which ones should be considered as concept properties or relations, etc., and we obtained the mind map shown in figure 2.
ANNEX II. FINANCIAL ONTOLOGY IN OWL

<?xml version="1.0"?>

<rdf:RDF
    xmlns:protege="http://protege.stanford.edu/plugins/owl/protege#"
    xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
    xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
    xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
    xmlns:owl="http://www.w3.org/2002/07/owl#"
    xmlns:daml="http://www.daml.org/2001/03/daml+oil#"
    xmlns="http://users.isoco.net/~slosada/swws/bank.owl#"
    xmlns:dc="http://purl.org/dc/elements/1.1/"
    xml:base="http://users.isoco.net/~slosada/swws/bank.owl">
    <owl:Ontology rdf:about=""
        imports rdf:resource="http://protege.stanford.edu/plugins/owl/protege"/>
    </owl:Ontology>

    <owl:Class rdf:ID="Quota">
        <rdfs:comment xml:lang="en">Amount to be paid in a loan</rdfs:comment>
    </owl:Class>

    <owl:Class rdf:ID="InvestmentAccount">
        <rdfs:comment xml:lang="en">Account setup to perform an investment, such as a fixed term deposit</rdfs:comment>
        <rdfs:comment xml:lang="es">Cuenta de inversión. Por ejemplo una imposición a plazo fijo (IPF) o un depósito remunerado</rdfs:comment>
        <owl:subClassOf rdf:resource="#Asset"/>
    </owl:Class>

    <owl:Class rdf:ID="ProductRateApplicationVariable">
        <owl:disjointWith>
            <owl:Class rdf:about="#ProductRateApplicationFixed"/>
        </owl:disjointWith>
        <owl:subClassOf rdf:resource="#ProductRateApplication"/>
    </owl:Class>

</rdf:RDF>
<owl:disjointWith>
<owl:Class rdf:about="#ProductRateApplicationMixed"/>
</owl:disjointWith>

<rdfs:comment xml:lang="es">tipo de interés variable. Es un tipo de interés que se modifica periódicamente en función de los tipos de interés de mercado que se hayan predefinido en contrato</rdfs:comment>

<rdfs:comment xml:lang="en">Variable interest rate. It may vary during the mortgage life</rdfs:comment>

<owl:Class rdf:ID="User"/>

<owl:Class rdf:ID="ServiceContractedByCustomerInChannel">
<rdfs:comment xml:lang="en">Product or service contracted by a channel</rdfs:comment>
<rdfs:comment xml:lang="es">Productos contratados por un canal</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Customer">
<rdfs:comment xml:lang="en">Bank client, who usually has a contractual relationship with the bank</rdfs:comment>
<rdfs:subClassOf rdf:resource="#User"/>
<rdfs:comment xml:lang="es">Cliente que mantiene una relación contractual con el banco (normalmente una cuenta bancaria)</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="ProductRateApplicationMixed">
<owl:disjointWith>
<owl:Class rdf:about="#ProductRateApplicationFixed"/>
</owl:disjointWith>

<rdfs:comment xml:lang="en">Mixed interest rate, usually composed of fixed and variable interest rates</rdfs:comment>
<rdfs:comment xml:lang="es">tipo de interés mixto. Es una mezcla de tipo fijo y variable. Normalmente fijo en las primeras cuotas y variable en las demás</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="FutureMortgageLoan"/>
<rdfs:comment xml:lang="es">Préstamo hipotecario por el que el usuario está pensando cambiar su préstamo actual</rdfs:comment>

<owl:Class rdf:ID="Collection">
<owl:disjointWith>
<owl:Class rdf:about="#Person"/>
</owl:disjointWith>
<owl:disjointWith>
<owl:Class rdf:about="#Company"/>
</owl:disjointWith>
<owl:disjointWith>
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</owl:Class>
<owl:Class rdf:ID="SOHO">
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<owl:Class rdf:about="#Person"/>
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<owl:disjointWith>
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<owl:disjointWith>
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</owl:Class>
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</owl:Class>
<owl:Class rdf:ID="Loan">
<owl:subClassOf>
<owl:Class rdf:about="#Asset"/>
</owl:subClassOf>
<owl:Comment xml:lang="es">Préstamo, crédito, cualquier cuenta con saldo a favor del banco</owl:Comment>
</owl:Class>
<owl:Class rdf:about="#Service"/>
</owl:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Collection">
<owl:disjointWith>
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<owl:Class rdf:about="#Person"/>
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<owl:disjointWith>
<owl:Class rdf:about="#Person"/>
</owl:disjointWith>
<owl:disjointWith>
<owl:Class rdf:about="#Company"/>
<owl:Class rdf:ID="Branch">
  <rdfs:comment xml:lang="es">Oficina bancaria fisica</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Channel"/>
  </rdfs:subClassOf>
  <rdfs:comment xml:lang="en">Physical bank office</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Staff">
  <rdfs:comment xml:lang="es">Servicios Centrales de una empresa. Por ejemplo: Recursos humanos, Alta dirección, Inmuebles y Servicios Generales, Innovación, etc.</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Employee"/>
  </rdfs:subClassOf>
  <rdfs:comment xml:lang="en">Central Services of a company, such as Human Resources, Management, Innovation, etc.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Person">
  <rdfs:comment xml:lang="es">Persona física o jurídica</rdfs:comment>
  <owl:disjointWith>
    <owl:Class rdf:about="#Company"/>
  </owl:disjointWith>
  <rdfs:subClassOf rdf:resource="#Customer"/>
  <rdfs:comment xml:lang="en">Bank client that represents a single person (physical or juridical)</rdfs:comment>
  <owl:disjointWith rdf:resource="#SOHO"/>
</owl:Class>

<owl:Class rdf:ID="vBanking">
  <rdfs:comment xml:lang="es">Virtual Banking. Banca por medios fisicos o sin intermediación humana.</rdfs:comment>
  <rdfs:comment xml:lang="en">Virtual Banking. Banking without human intervention</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Currency">
  <rdfs:comment xml:lang="es">Divisa, incluyendo la moneda nacional</rdfs:comment>
  <rdfs:comment xml:lang="en">Money in circulation</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Company">
  <owl:disjointWith rdf:resource="#Person"/>
  <owl:disjointWith rdf:resource="#SOHO"/>
  <rdfs:comment xml:lang="en">A number of people grouped together as a business enterprise. Types of companies include public limited companies, partnerships, joint ventures and proprietorships, and branches of foreign companies</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#Customer"/>
</owl:Class>

<owl:Class rdf:ID="Commercial">
  <rdfs:comment xml:lang="es">Empleado con funciones comerciales</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Employee"/>
  </rdfs:subClassOf>
  <rdfs:comment xml:lang="en">Employee with commercial functions</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="ProductRateApplication">
  <rdfs:comment xml:lang="es">Tipo de interés aplicado</rdfs:comment>
  <rdfs:comment xml:lang="en">Applied interest rate</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="CurrentMortageLoan">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#MortgageLoan"/>
  </rdfs:subClassOf>
  <rdfs:comment xml:lang="es">Préstamo hipotecario actual que el usuario está pensando en cambiar</rdfs:comment>
  <rdfs:comment xml:lang="en">Current mortgage loan that the user is willing to change</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="AddedValue"/>
The sales revenue from selling a product less the cost of the materials or purchases used in those products. It is an indicator of relative efficiency within and between firms, although in the latter case it is open to distortion where mark-up varies between standard and premium-priced segments of a market.

Es el valor con que enriqueces algo al transformarlo. Normalmente se calcula como la diferencia entre el valor de compra y el valor de venta, aunque es algo más intangible.
<rdfs:comment xml:lang="en">The land or property of a company or individual, payments due from bills, investments, and anything else owned that can be turned into cash</rdfs:comment>

</owl:Class>

<owl:Class rdf:ID="Payment">
    <rdfs:subClassOf>
        <owl:Class rdf:about="#Service"/>
    </rdfs:subClassOf>
    <rdfs:comment xml:lang="en">Money given to pay for something</rdfs:comment>
    <rdfs:comment xml:lang="es">Pago</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="InvestmentFund">
    <rdfs:comment xml:lang="en">Investment club where a set of customers put their money so that the bank performs an investment on behalf of them.</rdfs:comment>
    <rdfs:comment xml:lang="es">Fondo de Inversión. Club de inversión donde muchas personas ponen un dinero que el Banco invierte en su nombre y cuyos beneficios/pérdidas se reinvierten. Es disponible en cualquier momento vendiendo las participaciones que en su día se compraron.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Channel">
    <rdfs:comment xml:lang="es">Canal de relación entre el cliente y el banco. Es el medio que utiliza el cliente o el Banco para comunicarse: Oficinas, Internet, Banca Telefónica, Teléfono móvil, Agentes, Oficinas Virtuales, etc.</rdfs:comment>
    <rdfs:comment xml:lang="en">Communication means used in the relationship between the bank and its customers, including branches, phone, Internet, virtual banking, etc.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Corporative">
    <rdfs:comment xml:lang="en">Company with a specific set of characteristics that require a personalised commercial treatment. Depending on each bank, the set of characteristics may change, although they normally refer to number of employees and annual turnover. It includes company groups, multinational companies, etc.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Department"/>
</rdfs:comment xml:lang="es">Empresa que por sus características merece un tratamiento comercial individualizado. Dependiendo de cada Banco estas características
pueden variar, aunque normalmente se refieren a número de empleados y/o facturación anual. Incluye grupos de empresas, multinacionales, etc.

<owl:Class rdf:ID="Liability">
  <rdfs:subClassOf rdf:resource="#Product"/>
  <rdfs:comment xml:lang="en">The amount that is owed by an individual or company, whether money, products, or services, to others.</rdfs:comment>
  <rdfs:comment xml:lang="es">Cantidad que un individuo o compañía debe a otros. Esta cantidad puede ser dinero, productos o servicios.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="Invoice">
  <rdfs:comment xml:lang="es">Factura.</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#Payment"/>
  <rdfs:comment xml:lang="en">An itemized statement given to a buyer by a seller and usually specifying the price of goods or services and the terms of sale.</rdfs:comment>
</owl:Class>

<owl:Class rdf:ID="ProductRateApplicationFixed">
  <rdfs:comment xml:lang="en">Fixed interest rate. It never varies during the mortgage life.</rdfs:comment>
  <owl:disjointWith rdf:resource="#ProductRateApplicationMixed"/>
  <owl:disjointWith rdf:resource="#ProductRateApplicationVariable"/>
  <rdfs:subClassOf rdf:resource="#ProductRateApplication"/>
</owl:Class>

<owl:Class rdf:ID="Administrative">
  <rdfs:comment xml:lang="en">Employee with administrative functions.</rdfs:comment>
  <rdfs:comment xml:lang="es">Empleado con funciones de administración.</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#Employee"/>
</owl:Class>

<owl:Class rdf:ID="MortgageLoan">
A long-term loan backed by real estate or valuable property, usually the item purchased with the loan. The creditor can claim that property if all payments are not made by the borrower when they are due.<rdfs:comment xml:lang="es">Préstamo hipotecario</rdfs:comment>

Account without a chequebook and normally with a low interest rate.<rdfs:comment xml:lang="es">Cuenta de Ahorro. Es lo mismo que una cuenta corriente, pero con libreta y sin talonario de cheques. Normalmente está remunerada a un tipo de interés que suele ser bajo</rdfs:comment>

Departamento. Area interna del Banco que tiene una misión dentro de él.<rdfs:comment xml:lang="en">Internal area of the bank that performs a specific function</rdfs:comment>

Cualquier producto bancario que requiere la firma de un contrato (ejemplo: una cuenta corriente o un crédito).<rdfs:comment xml:lang="en">Bank product that requires the signature of a contract between the customer and the bank</rdfs:comment>

Service es el tipo de cosas que se pueden hacer pero que no requieren contrato (ejemplo: una orden de transferencia). Service tambien es cualquier producto no financiero que distribuya un banco.<rdfs:comment xml:lang="en">Financial products offered by a bank or services that do not require a contract, like a bank transfer order</rdfs:comment>
<owl:Class rdf:about="#SOHO"/>
<owl:Class rdf:about="#Person"/>
</owl:unionOf>
</owl:Class>
</rdfs:domain>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="password">
<rdfs:domain rdf:resource="#User"/>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="cancelationCommission">
<rdfs:range rdf:resource="#Quota"/>
<rdfs:comment xml:lang="es">Comisión de cancelación</rdfs:comment>
<rdfs:domain rdf:resource="#CurrentMortageLoan"/>
<rdf:type rdf:resource="http://www.w3.org/2002/07/owl#InverseFunctionalProperty"/>
<rdfs:comment xml:lang="en">Commission to be paid when a mortgage is cancelled</rdfs:comment>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="service">
<rdfs:domain rdf:resource="#ServiceContractedByCustomerInChannel"/>
<rdfs:range rdf:resource="#Service"/>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="channel">
<rdfs:range rdf:resource="#Channel"/>
<rdfs:domain rdf:resource="#ServiceContractedByCustomerInChannel"/>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="titularity">
<rdfs:range rdf:resource="#Product"/>
<rdfs:domain rdf:resource="#Customer"/>
<rdf:type rdf:resource="http://www.w3.org/2002/07/owl#SymmetricProperty"/>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="subrogationCommission">
<rdfs:comment xml:lang="en">Commission to be paid when a mortgage is subrogated</rdfs:comment>

<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Comisión de subrogación.</rdfs:comment>
<rdfs:domain rdf:resource="#FutureMortgageLoan"/>
<rdfs:range rdf:resource="#Quota"/>
<rdf:type rdf:resource="http://www.w3.org/2002/07/owl#FunctionalProperty"/>
</owl:ObjectProperty>

<owl:ObjectProperty rdf:ID="payments">
<rdfs:domain rdf:resource="#SavingAccount"/>
<rdfs:comment xml:lang="en">Payments due in a saving account</rdfs:comment>
<rdfs:range rdf:resource="#Payment"/>
</owl:ObjectProperty>

<owl:ObjectProperty rdf:ID="customer">
<rdfs:range rdf:resource="#Customer"/>
<rdfs:domain rdf:resource="#ServiceContractedByCustomerInChannel"/>
</owl:ObjectProperty>

<owl:ObjectProperty rdf:ID="interestRateType">
<rdfs:range rdf:resource="#ProductRateApplication"/>
<rdfs:comment xml:lang="en">Type of interest rate of a bank product</rdfs:comment>
<rdfs:domain rdf:resource="#Product"/>
</owl:ObjectProperty>

<owl:ObjectProperty rdf:ID="CIF">
<rdfs:comment xml:lang="es">Código de Identificación Fiscal</rdfs:comment>
<rdfs:domain rdf:resource="#Company"/>
</owl:ObjectProperty>

<owl:ObjectProperty rdf:ID="currencyProduct">
<rdfs:domain rdf:resource="#Product"/>
<rdfs:range rdf:resource="#Currency"/>
</owl:ObjectProperty>

<owl:ObjectProperty rdf:ID="rateVariable">
<rdfs:range rdf:resource="#ProductRateApplicationVariable"/>
<rdfs:domain rdf:resource="#ProductRateApplicationMixed"/>
</owl:ObjectProperty>

<owl:DatatypeProperty rdf:ID="interesDelay">
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>

<rdfs:domain rdf:resource="#FutureMortgageLoan"/>

<rdfs:comment>Interes de demora. No es necesario para simulación</rdfs:comment>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="signalDateContract">
  <rdfs:domain rdf:resource="#Product"/>
  <rdfs:comment>Fecha que se firma el contrato del producto financiero.</rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#date"/>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="endingDate">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#date"/>
  <rdfs:domain rdf:resource="#Quota"/>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="name">
  <rdfs:comment>Nombre del producto financiero.</rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
  <rdfs:domain>
    <owl:Class>
      <owl:unionOf rdf:parseType="Collection">
        <owl:Class rdf:about="#Customer"/>
        <owl:Class rdf:about="#Product"/>
      </owl:unionOf>
    </owl:Class>
  </rdfs:domain>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="typeReferenceRate">
  <owl:DataRange>
    <owl:oneOf rdf:parseType="Resource">
      <rdf:first>Euribor</rdf:first>
      <rdf:rest rdf:parseType="Resource">
        <rdf:rest rdf:parseType="Resource">
          <rdf:first>IRPH-cajas</rdf:first>
          <rdf:rest rdf:parseType="Resource">
            <rdf:first>IRPH-cajas</rdf:first>
          </rdf:rest>
        </rdf:rest>
      </rdf:rest>
    </owl:oneOf>
  </owl:DataRange>
</owl:DatatypeProperty>
<rdf:rest rdf:parseType="Resource">
  <rdf:first>IRPH-ent</rdf:first>
  <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
</rdf:rest>
</rdf:rest>
</rdf:rest>
</owl:oneOf>
</owl:DataRange>
</rdfs:range>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="saleCostProperty">
  <rdfs:domain rdf:resource="#CurrentMortgageLoan"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="buyCostProperty">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
  <rdfs:comment xml:lang="es">Valor de la propiedad asociada a la hipoteca</rdfs:comment>
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
</owl:DatatypeProperty>
</owl:DatatypeProperty>
</rdfs:comment>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="expirationDate">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#date"/>
  <rdfs:comment>Fecha en la que expira el producto financiero. p.e. Plazo fijo.</rdfs:comment>
  <rdfs:domain rdf:resource="#Product"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="term">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#duration"/>
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
  <rdfs:comment>Plazo de amortización de la hipoteca.</rdfs:comment>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="interestRateValue"/>
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
<rdfs:comment>Valor numérico del tipo de interés</rdfs:comment>
<rdfs:domain>
<owl:Class>
<owl:unionOf rdf:parseType="Collection">
<owl:Class rdf:about="#Product"/>
<owl:Class rdf:about="#ProductRateApplication"/>
</owl:unionOf>
</owl:Class>
</rdfs:domain>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="lifeInsurance">
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#boolean"/>
<rdfs:comment>Indica si los suscriptores de la hipoteca tienen un seguro de vida cuyo beneficiario es la hipoteca.</rdfs:comment>
<rdfs:domain rdf:resource="#FutureMortgageLoan"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="initialPeriod">
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#duration"/>
<rdfs:comment>¿Período de tiempo en hipotecas de interés variable en el que se paga tipo de interés fijo?</rdfs:comment>
<rdfs:domain rdf:resource="#FutureMortgageLoan"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="startingDate">
<rdfs:domain rdf:resource="#Quota"/>
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#date"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="interestNextRevision">
<rdfs:domain rdf:resource="#CurrentMortgageLoan"/>
<rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="typeOfRate">
<rdfs:range>
<owl:DataRange>
<owl:oneOf rdf:parseType="Resource">
<rdf:rest rdf:parseType="Resource">
  <rdf:rest rdf:parseType="Resource">
    <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
    <rdf:first>variable</rdf:first>
  </rdf:rest>
  <rdf:first>mixed</rdf:first>
</rdf:rest>
</owl:oneOf>
</owl:DataRange>
</rdfs:range>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="initalQuota">
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
    Cuota inicial a pagar.
  </rdfs:comment>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="revisionTerm">
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#duration"/>
  <rdfs:comment>
    Periodo de revisión. Tiempo en el que se revisará el tipo de interes
  </rdfs:comment>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="periodicityCuota">
  <rdfs:comment>
    Periodos en los que se paga la cuota cada tres meses, 12 cuotas al año etc.
  </rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#duration"/>
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="delayInterestRate">
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:comment>
    Tipo de interes si se demoran pagos. No es necesario para la simulación.
  </rdfs:comment>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="homeInsurance">
  <rdfs:comment>Indica si el inmueble tiene un seguro.</rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#boolean"/>
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="revisionTermNext">
  <rdfs:domain rdf:resource="#MortgageLoan"/>
  <rdfs:comment>Plazo de tiempo que transcurre hasta la proxima revision del tipo de interes en hipotecas de interes variable</rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#duration"/>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="mortgageTaxation">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">Impuestos de la hipoteca.</rdfs:comment>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="login">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
  <rdfs:domain rdf:resource="#User"/>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="capital">
  <rdfs:comment xml:lang="es">Importe de la hipoteca, capital prestado</rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#double"/>
  <rdfs:domain rdf:resource="#MortgageLoan"/>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="APR">
  <rdfs:comment>Tasa anual efectiva. Poner formula matematica</rdfs:comment>
  <rdfs:comment xml:lang="es">Tasa Anual Efectiva (TAE)</rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdfs:comment xml:lang="en">Annual Percentage Rate</rdfs:comment>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="quotaAfterRevision">
  <rdfs:comment xml:lang="es">Cuota estimada tras la próxima revisión del tipo de interés</rdfs:comment>
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
</owl:DatatypeProperty>

<owl:DatatypeProperty rdf:ID="handlingCapital">
  <rdfs:domain rdf:resource="#CurrentMortgageLoan"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
</owl:DatatypeProperty>

<owl:FunctionalProperty rdf:ID="openingCommission">
  <rdfs:domain rdf:resource="#FutureMortgageLoan"/>
  <rdfs:comment>Comisión de apertura.</rdfs:comment>
  <rdfs:range rdf:resource="#Quota"/>
  <rdfs:comment xml:lang="en">Commission to be paid when a mortgage is opened</rdfs:comment>
  <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#ObjectProperty"/>
</owl:FunctionalProperty>

<owl:FunctionalProperty rdf:ID="termRateFixed">
  <rdfs:domain rdf:resource="#ProductRateApplicationMixed"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#duration"/>
  <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#DatatypeProperty"/>
</owl:FunctionalProperty>

<owl:FunctionalProperty rdf:ID="value">
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#float"/>
  <rdf:type rdf:resource="http://www.w3.org/2002/07/owl#DatatypeProperty"/>
</owl:FunctionalProperty>
</rdf:RDF>