INSTITUTO POLITÉCNICO NACIONAL
ESCUELA SUPERIOR DE CÓMPUTO

DISTRIBUTED DATABASES

"Database Fragmentation Manager (DBFM)"

Project Report no. 3

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Deadline: November 21st-24th of 2017 (Horizontal F.)
December 4th-8th of 2017 (Vertical F.)

Abstract

Within this report we will see the analysis, design and modeling of a fragmentation system. We will aboard two types of fragmentation: Horizontal and Vertical.

The system will be used by two types of users, the administrator that have access to all the functionalities of the system and the user, which will only can consult information of the sites, fragments and its content.

We made a description about the features and the design about the developed system, its representing database model, at conceptual and logical level, along with the insight for why this system was created. Finally, a user manual will be presented which will give us a detail walkthrough of the application.

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1 Introduction

The system is being developed for the enterprise Mueblerías Quetzal S.A. de C.V.

> "The organization is dedicated to producing furniture and distribute them across the Metropolitan Area of the México City. This organization wholesales furniture and retails to different client types, as people or enterprises. The organization recently implemented an e-commerce system for retails and an inventory control system."

In this stage the company needs to have its database fragmented, for this reason it is necessary to be clear about what fragmentation is:

> Fragmentation is a feature of the database server that can be applied when data is stored at the table level. Fragmentation allows defining groups of names or index keys within a table, according to some algorithm or scheme. You can store each group or fragment in a separate database space associated with a specific physical disk. SQL statements are used to create the fragments and assign them to the database spaces.
>
> From the perspective of an end user or client application, a fragmented table is identical to a non-fragmented table. Client applications do not have any modification to allow access to data from fragmented tables.

"Mueblería Quetzal" would require fragmentation because with the fragmentation we have some advantages like these:

- Single user response time
- Concurrence
- Availability
- Backup and restoration features
- Loading data

2 Objective

The general objective of this project development and main purpose is to:

> "Improve the performance on information accessing by implementing horizontal and vertical fragmentation to a database system using a homogeneous architecture, and mounting the system on web-based application"

It is mandatory that a beta version of the system, which must contain horizontal fragmentation scope, were ready to implement in MQuetzal enterprise from November 21st-24th of 2017. And the full version implementation deadline is from December 4th-8th of 2017.

3 Analysis

In this section is described the requirements that represents the user needs and the requirements; risks on project management subject; and context diagram of the system with the stakeholders involved.

3.1 Requirements

The user requirements are the following ones and based on these requirements, the system requirements are related to at least one of the user requirements.

3.1.1 User Requirements

UR-01 The administrator needs a way to create a simple predicate based on MQuetzal database relation.

UR-02 The administrator needs to know which mini-term predicate comply minimality.

UR-03 The administrator needs to create fragments of the specified MQuetzal database relations.

UR-04 The administrator needs to know what mini-terms predicates were created with which simple predicate.

UR-05 The administrator needs to save a fragment in a specific site without altering original database.

UR-06 The user (non-administrator) needs to see the fragmented information of his/her department that were saved in each site.

3.1.2 System Requirements

SR-01 The system must specify if it can create the fragmentation of every relation with the simple predicates that the user provided.

*Ref: **UR-03***

SR-02 The system must specify if a mini-term predicate satisfies minimality.
Ref: UR-02

SR-03 The system must allow user to choose a MQuetzal relation that him / her wants.
Ref: UR-01

SR-04 The system must allow creating all the simple predicates that him / her wants.
Ref: UR-01

SR-05 The system must allow the user to choose one of the available servers to save the fragment that him / her wants.
Ref: UR-05

SR-06 The system must not change the Muebleria Quetzal original database.
Ref: UR-05

SR-07 The system must show the fragmented information of the user's department that were saved in each site.
Ref: UR-06

SR-08 The system must specify from which simple predicate is a mini-term predicate.
Ref: UR-04

3.2 Risks

In this section we will do the analysis of potential risks that our project may have, these risks might or might not occur.

The risks identification will be ruled by the following parameters:

- Concerns about future happenings.
- Change in mind, opinion, actions, places, etc.
- A choice and the uncertainty that choice entails.

Risk Categorization:

- Product size risks.
- Business impact risks.
- Customer related risks.
- Development environment risks.
- Process issue risks.
- Staff size and experience.
- Technical issue risks.

- Technology risks.
- Other potential risks.

3.2.1 Product size risks

Questionnaire on product size risks:	Checklist:
1. Estimated size of the product in LOC or FP? 2. Degree of confidence in estimated size estimate? 3. Estimated size of product in number of programs, files, transactions? 4. Percentage deviation in size of product from average for previous products? 5. Size of database created or used by the product? 6. Number of users of the product? 7. Number of projected changes to the requirements for the product? Before delivery? After delivery? 8. Amount of reused software?	1. Medium ✓ 2. High ✓ 3. Medium ✓ 4. 25-50% ✗ 5. Medium ✓ 6. < 1000 ✓ 7. Not available ✗ 8. High ✓

Risk Summary	Risk Category	Probability	Impact	RMMM
No. 4	Product size risks	Medium	(3) Marginal	**Mitigation:** A greater deviation in size will impact in the days estimated for the project to be finished. **Monitoring:** When working on the project, the team shall be aware of the schedule assigned to each activity. **Management:** As the project is bigger to any made before, more hours shall be dedicated to documentation and codification.
No. 7	Product size risks	Very Low	(1) Catastrophic	**Mitigation:** Since there is no clear projection on how many changes to the requirements shall be made, this could lead to a total redefinition of the project. **Monitoring:** These requirements shall be completely checked and approved by all members of the staff before the scheduled day. **Management:** The slightest change in our requirements can result in a complete change of the code, thus this point shall be reviewed cautiously.

3.2.2 Business impact risks

Since we are not looking for a business model for the moment, this list shall be ignored.

3.2.3 Customer related risks

Comentado [1]: Aquí me faltan terminar algunos puntos de MMM que ya son pocos

Questionnaire on customer related risks:	Checklist:
1. Has the customer worked with us in the past? 2. Does the customer have a solid idea of what is required? 3. Has the customer taken the time to write this down? 4. Will the customer agree to spend time in formal requirements gathering meetings to identify project scope? 5. Is the customer willing to establish rapid communication links with the developer? 6. Is the customer willing to participate in reviews? 7. Is the customer technically sophisticated in the product area? 8. Is the customer willing to let your people do their job that is, will the customer resists to be look over your shoulder during technically detailed work? 9. Does the customer understand the software engineering process?	1. Yes ✓ 2. Yes ✓ 3. Yes ✓ 4. Yes ✓ 5. Yes ✓ 6. Yes ✓ 7. Yes ✓ 8. Yes ✓ 9. Yes ✓

No customer related risks founded.

3.2.4 Development environment risks

Questionnaire on development environment risks:	Checklist:
1. Is a software project management tool available? 2. Is a software process management tool available? 3. Are tools for analysis and design available? 4. Do analysis and design tools deliver methods that are appropriate for the product to be built? 5. Are compilers or code generators available and appropriate for the product to be built? 6. Are testing tools available and appropriate for the product to be built? 7. Are software configuration management tools available? 8. Does the environment make use of a database or repository? 9. Are all the software tools integrated with one another? 10. Have members of the project teams received training in each of the tools? 11. Are local experts available to answer questions about the tools? 12. Is on-line help and documentation for the tools adequate?	1. Yes ✓ 2. No ✗ 3. Yes ✓ 4. Yes ✓ 5. Yes ✓ 6. Yes ✓ 7. Yes ✓ 8. Yes ✓ 9. No ✗ 10. No ✗ 11. Yes ✓ 12. Yes ✓

Risk Summary	Risk Category	Probability	Impact	RMMM
No. 2	Development environment	Very High	(4) Negligible	**Mitigation** A software process tool might help us to develop the documentation faster, but it is not really required. **Monitoring** As the project advances it can turn more complex, therefore the team shall decide if a software process tool is required. **Management** The use of a software process tool will make some procedures easier to make then the management will improve.
No. 9	Development environment	Medium	(2) Critical	**Mitigation** Incompatibility in the software might lead to serious problems in the development of the project. **Monitoring** The team shall check that all the components and software used for the project are compatible with each other in every stage of the project. **Management** The use of a homogeneous DBMS and web host will make easier to do maintenance to the project and will reduce the possibilities that a failure appears.
No. 10	Development environment	High	(3) Marginal	**Mitigation** If a member is not capable to use one of the development tools, it might overload work to the members that know how to use them, and the project will be delayed. **Monitoring** The team shall distribute the tasks in a way that each member of the team is capable to do at least in a 80%, with the purpose of not delaying the work of other members. **Management** If not all the members are capable to use all the development tools designated for this project, if a work has to be done and all the members capable to do it are busy with other tasks, it will delay the project.

3.2.5 Process issue risks

Questionnaire on process issue risks:	Checklist:
1. Does your senior management (team leader) support a written policy statement that emphasizes the importance of a standard process for software development?	1. No ✗
2. Has your organization/team developed a written description of the software process to be used on this project?	2. Yes ✓
3. Are staff members signed-up to the software process as it is documented and willing to use it?	3. Yes ✓
4. Is the software process used for other projects?	4. Yes ✓
5. Has your organization/team developed or acquired a series of software engineering training courses for managers and technical staff?	5. Yes ✓
6. Are published software engineering standards provided for every software developer and software manager?	6. No ✗
7. Have document outlines and examples been developed for all deliverables defined as part of the software process?	7. No ✗
8. Are formal technical reviews of the requirements specification, design, and code conducted regularly?	8. Yes ✓
9. Are formal technical reviews of test procedures and test cases conducted regularly?	9. No ✗
10. Are the results of each formal technical review documented, including defects found and resources used?	10. Yes ✓
11. Is there some mechanism for ensuring that work conducted on a project conforms with software engineering standards?	11. No ✗
12. Is configuration management used to maintain consistency among system/software requirements, design, code, and test cases	12. Yes ✓
13. Is a mechanism used for controlling changes to customer requirements that impact the software?	13. Yes ✓
14. Is there a documented statement of work, software requirements specification, and software development plan for each subcontract?	14. Yes ✓
15. Is a procedure followed for tracking and reviewing the performance of subcontractors?	15. No ✗

Risk Summary	Risk Category	Probability	Impact	RMMM
No. 1	Process issue	Very High	(4) Negligible	**Mitigation** Without a standardize policy some procedures might not be compatible with other applications in the future. **Monitoring** The team shall follow the best as possible the standards that IEEE give us in the

				development of the software. **Management** Following good practices of design, analysis and development of the software allow us to reduce and make easier the maintenance of the software.
No. 6	Process issue	Medium	(2) Critical	-
No. 7	Process issue	High	(3) Marginal	-
No. 9	Process issue	High	(2) Critical	-
No. 11	Process issue	Low	(3) Marginal	-
No. 15	Process issue	Low	(4) Negligible	-

Risk Refinement

At various points in the checklist, the lack of standardized methods is highlighted, even though the project uses various methods for software development it is not implemented in all the modules at all. For the moment, this is sufficient to the objective we want to achieve, if an expansion of this project in the future is required these points shall be considered.

3.2.6 Staff size and experience

Questionnaire on staff size risks:	Checklist:
1. Are the best people available? 2. Do the people have the right combination of skills? 3. Are enough people available? 4. Are staff committed for entire duration of the project? 5. Will some staff be working only part time on this project? 6. Do staff have the right expectations about the job at hand? 7. Have staff received necessary training? 8. Will turnover among staff be low enough to allow continuity?	1. Yes ✓ 2. Yes ✓ 3. Yes ✓ 4. Yes ✓ 5. Yes ✗ 6. Yes ✓ 7. No ✗ 8. No ✓

Risk Summary	Risk Category	Probability	Impact	RMMM
No. 5	Staff size and experience	Very High	(3) Marginal	**Mitigation** Since the team will not be working on the project full time, it might be delayed if is not made a proper schedule. **Monitoring** The team leader as well other members of the staff shall be constantly checking that all the points agreed on the

				schedule are fulfill in time. **Management** A team that is not full time in the project make harder to detect and correct issues that the project may have.
No. 7	Staff size and experience	Low	(2) Critical	**Mitigation** Not all the team members have received enough training in the areas of programming and analysis and design, as well the use of some CASE tools that make easier the life cycle of the software. **Monitoring** The team shall help other members in the tasks if it is necessary, more capable and experienced members shall take the leading role. **Management** A team that haven't received enough training make more difficult the management of the software, since it will be required another member to fulfill the task given, so training and capacitation for those members that require it.

3.2.7 Technical issue risks

Questionnaire on risks:	Checklist:
1. Are facilitated application specification techniques used to aid in communication between the customer and developer?	1. No ✗
2. Are specific methods used for software analysis?	2. Yes ✓
3. Do you use a specific method for data and architecture designs?	3. Yes ✓
4. Is more than 90% of your code written in a high order language?	4. Yes ✓
5. Are specific conventions for code documentation defined and used?	5. Yes ✓
6. Do you use a specific method for test case design?	6. No ✗
7. Are software tools used to support software planning and tracking activities?	7. Yes ✓
8. Are configuration management software tools used to control and track change activity throughout the software process?	8. No ✗
9. Are software tools used to support the software analysis and design process?	9. Yes ✓
10. Are tools used to create software prototypes?	10. No ✗
11. Are software tools used to support the testing process?	11. No ✗
12. Are software tools used to support the production and management of documentation?	12. Yes ✓
13. Are quality metrics collected for all software projects?	13. No ✗
14. Are productivity metrics collected for all software projects?	14. No ✗

Risk Summary	Risk Category	Probability	Impact	RMMM
No. 1	Technical issue	High	(3) Marginal	
No. 6	Technical issue	Very High	(3) Marginal	-
No. 8	Technical issue	Very High	(4) Negilible	-
No. 10	Technical issue	Very High	(4) Negilible	-
No. 11	Technical issue	High	(3) Marginal	-
No. 13	Technical issue	Medium	(3) Marginal	-
No. 14	Technical issue	Medium	(3) Marginal	-

Risk Refinement

At various points in the checklist, lack of software tools is identified as a potential risk. Due to time constraints, the members of the design team felt that searching for and learning to use additional software tools could be detrimental to the project, as it would take time away from project development. For this reason, we have decided to forget the use of software tools for testing. It will not be explored as a potential risk because all planning will be done without considering their use.
The use of metrics will not be considered for this project yet.

2.8.8 Technology risks

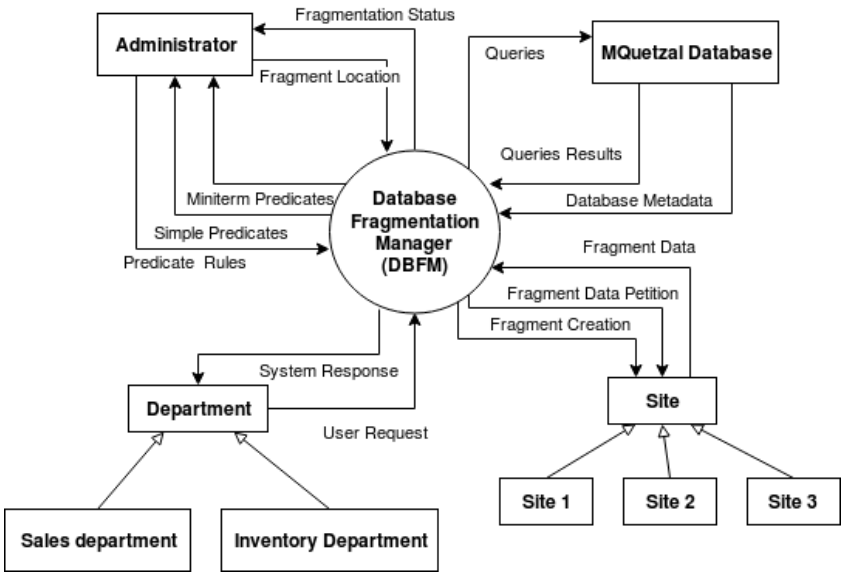
Questionnaire on technology risks:	Checklist:
1. Is the technology to be built new to your company? 2. Do the customer requirements demand the creation of new algorithms, input or output technology? 3. Does the software interface with new or unproven hardware? 4. Does the software to be built interface with a database system whose function and performance have not been proven in this application area? 5. Does the software to be built interface with vendor supplied software products that are unproven? 6. Is a specialized user interface demanded by product requirements?	1. Yes ✗ 2. No ✓ 3. No ✓ 4. No ✓ 5. No ✓ 6. No ✓ 7. Yes ✗

7. Do requirements for the product demand the creation of program components that are unlike any previously developed by your organization? 8. Do requirements demand the use of new analysis, design, or testing methods? 9. Do requirements demand the use of unconventional software development methods, such as formal methods, AI-based approaches, artificial neural networks? 10. Do requirements put excessive performance constraints on the product? 11. Is the customer uncertain that the functionality requested is "do-able"?	8. No ✓ 9. No ✓ 10. No ✓ 11. Yes ✓

Risk Summary	Risk Category	Probability	Impact	RMMM
No. 1	**Technology**	**Very High**	**(2) Critical**	**Mitigation** The fragmentation in a distributed is a new topic for our team that is has just been recently learned. **Monitoring** The team shall review the algorithms for fragmentation multiple times to understand the theory behind it. **Management** The implementation of a new technology might complicate us the first days of the management and development of the software but with the pass of the time this issue will be solved.
No. 7	**Technology**	**Medium**	**(2) Critical**	The same approach that was specified in the previous point.

3.3 Context Diagram

The following diagram shows the data flow between systems and users (Administrador and Department users), resources (as original MQuetzal Database) and logical components (as sites one, two or three).



The Department users are divided in two groups one belongs to sales department and other to inventory department. It is important to mention the following three rules.

- **The Sales Department** Users can only request data of fragment relation which origin relation was: *Asesora, Cliente, Compra, CompraMueble, Envio.*
- **The Inventory Department** Users can only request data of fragment relation which origin was: *Acabado, AcabadoModelo, Almacen, Categoria, CategoriaModelo, Envio, Estado, GestionAlmacen, Lote, Material, MaterialModelo, Modelo, Rotacion.*
- **The administrator** user can request data of all fragments, which original relation was one of the previously mentioned and *Supervisa, UsuarioEmpresa* relations; collocated on all sites.

The relational model of original database is detailed in section no. 6

4 Design

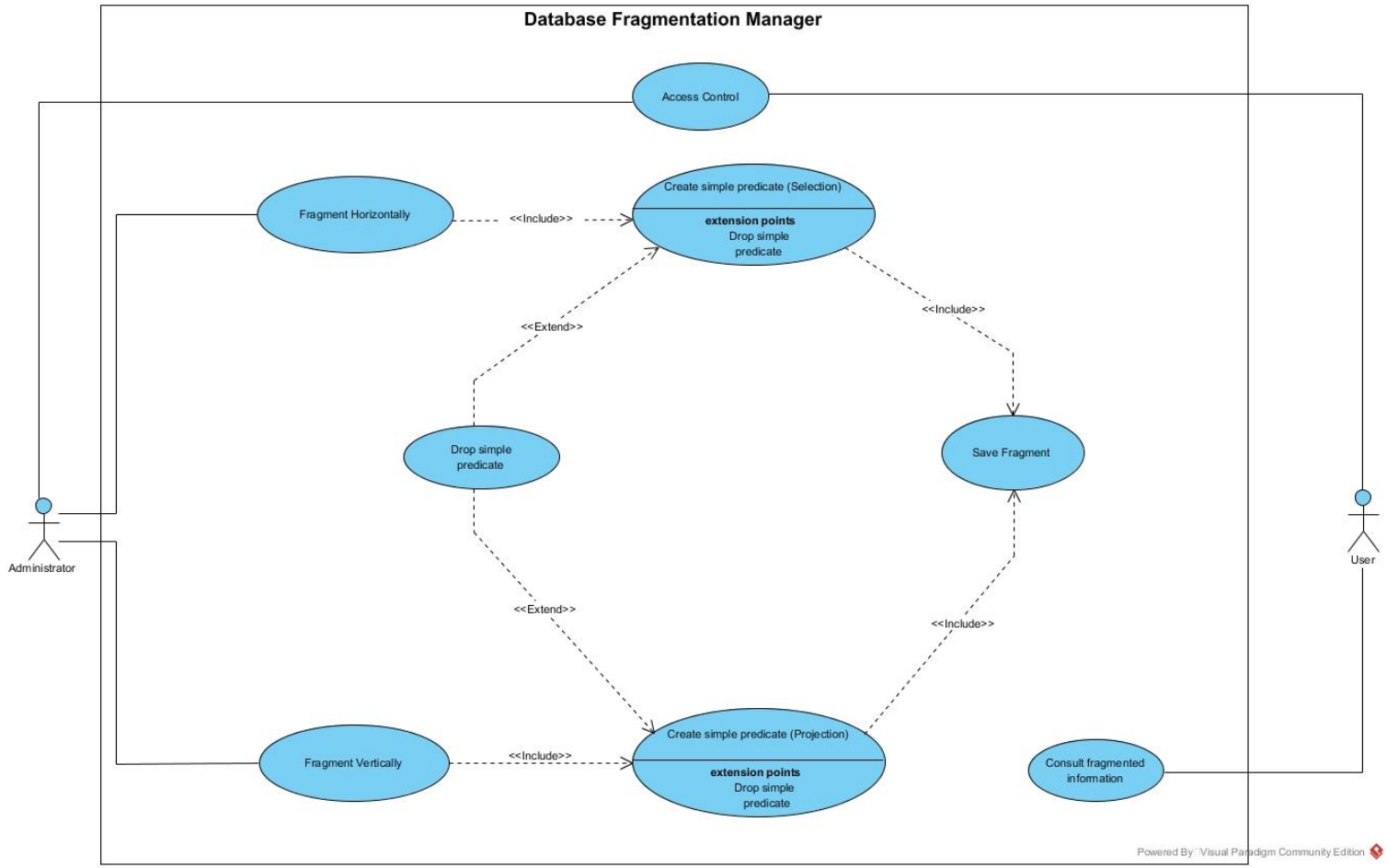
In this section are detailed the design modelling. It includes use-case diagram, with attribute table and the main path trajectories for each use-case in the diagram; the class diagram, with attributes for each class; and sequence diagram, related with each use-case classes involved.

4.1 Use-case Diagrams

In the next image we used use-cases diagram to represent all the execution actions that are allowed per each kind of actor. Then after, for each use-case we present the attributes and the execution way.

In the following image we use a use-case diagram to represent all the actions that each actor can do, then a full description per activity will be given.

Each use-case description was detailed on a data table, these tables contain basic information about the case such as name, version, attributes, etc. and contain specific data of the main trajectory that each case has in the system (Potential alternative trajectories also were considered).


Database Fragmentation Manager
Access Control
Fragment Horizontally
<<Include>>
Create simple predicate (Selection)
extension points
Drop simple predicate
<<Include>>
<<Extend>>
Drop simple predicate
Save Fragment
Administrator
User
<<Extend>>
<<Include>>
Fragment Vertically
<<Include>>
Create simple predicate (Projection)
extension points
Drop simple predicate
Consult fragmented information
Powered By Visual Paradigm Community Edition

4.1.2 Use Case Specification tables

UC-00 Access Control

Name:	Access Control	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Reviser:**	Evelyn Gabriela Reyes Jiménez
Actor:	All actors (Administrator and User)		
Purpose:	Authenticate and allow the access to the specified actors.		
Inputs:	User Id. Password.	**Output:**	UI - Access to vertical and horizontal fragmentation page (Admin). UI - Access to fragment information page (User).
Origin:	Keyboard	**Destination:**	Screen
Preconditions:	The user should be registered as must be a staff member of "Mueblerías Quetzal".		
Postconditions:	The system proportionate permissions according to specific actor.		
Errors:	1. Connection Error (AT1) 2. Fatal Error (AT2) 3. Access Denied (AT3)		
Observations:	All use-cases extends from the UC-00 (Access Control). the correspondent extend lines were not specified in the diagram to maintain the simplicity. Even though they are considered in the development.		

Basic Course of Action UC-00

1) A user wants to login into the database fragmentation manager.
2) The user introduces his user identifier and password, filling the required fields.
3) The user confirms the operation pressing the button "Entrar".
4) The system verifies the user identifier and password inserted. (AT1, AT2, AT3).
   4.1) **AT1:** The system tries to connect to the database (in order to retrieve the user information) but it fails, therefore it displays the message "Error de conexión".
   4.2) **AT3:** The introduced user identifier or password are incorrect or are not valid, therefore the system displays the message "Acceso Denegado".
   4.3) **AT3:** Once the previous message was shown, the system redirects the user to the beginning of this use case.
   4.4) **AT2:** For some reason an unknown error arises and the application stop working: *Fatal Error* the system cannot operate.
5) The system creates the session with the required user attributes.

Alternate course A:
6-A) The system redirects the user to the *"Fragmentacion Horizontal" page* (UC-01) if the user is an administrator.
Alternate course B:
6-B) The system redirects the user to the *"Información de Fragmentos" page* (UC-07) if the user is not an administrator.

UC-01 Fragment Horizontally

Name:	Fragment Horizontally	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Reviser:**	Daniel Isaí Ortega Zuñiga
Actor:	Administrator		
Purpose:	Fragment horizontally a relation of Mueblerías Quetzal database.		
Inputs:	Relations. Simple Predicate (Selection). Sites.	**Output:**	Confirmation message that the Horizontal Fragmentation was successfully saved in the specified site.
Origin:	Keyboard	**Destination:**	Screen
Preconditions:	The relation must exist in the global DB. The site must exist. The simple predicate was assembled correctly.		
Postconditions:	The system will store the generated fragment in the specified site.		
Errors:	1. Connection Error (AT1). 2. Fatal Error (AT2). 3. Completeness Error (AT4). 4. Repetition Error (AT5).		
Observations:	Only four errors are considered within this use case since all errors that may appear when we are creating a simple predicate or saving the fragment in the specified site are already considered within their specific use cases.		

Basic Course of Action UC-01

1) The user wants to fragment horizontally a relation of "mueblerías quetzal" database.
2) The user creates a simple predicate UC-03 *create simple predicate (Selection)* of the specified relation.
   2.1) **AT1:** The system tries to connect to database (in order to retrieve the relations), but it fails, therefore it displays the message "Error de conexión".
   2.2) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.

   Alternate course A:

   2-A) The user verifies if the set of simple predicates is complete, by pressing the button "Fragmentar", if it is incomplete then repeat the point no. 2 of this use case.
      2.1-A) **AT4:** The are not enough simple predicates per relation to fulfill the condition of completeness, therefore the system displays the message "Error, pocos predicados".
      2.2-A) **AT5:** The generated algebraic expression already exists within the set, therefore, the system displays the message "Ya existe el fragmento".
3) The user will verify from the set which mini-term predicates meet the minimality.
4) The user will choose a predicate from the ones that are fit to fragment, then the system will automatically generate the algebraic expression that represents that predicate, then the user has to save that fragment UC-05 *save fragment*.
5) The system will display a message confirming that the fragmentation was successful.

UC-02 Fragment Vertically

Name:	Fragment Vertically	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Reviser:**	Daniel Isaí Ortega Zuñiga
Actor:	Administrator		
Purpose:	Fragment vertically a relation of Mueblerías Quetzal database.		
Inputs:	Relations. Algebraic Expression (projection). Sites.	**Output:**	Confirmation message that Vertical Fragmentation was successfully saved in the specified site.
Origin:	Keyboard	**Destination:**	Screen

Preconditions:	The relation must exist in the global DB. The site must exist. The algebraic expression was assembled correctly.
Postconditions:	The system will store the generated fragment in the specified site.
Errors:	1. Connection Error (AT1). 2. Fatal Error (AT2). 3. Completeness Error (AT4). 4. Repetition Error (AT5).
Observations:	Only four errors are considered within this use case since all errors that may appear when we are creating an algebraic or saving the fragment in the specified site are already considered within their specific use cases.

Basic Course of Action UC-02

1) The user wants to fragment vertically a relation of "mueblerías quetzal" database.
2) The user creates an algebraic expression UC-04 *create algebraic expression (Projection)* of the specified relation.
   2.1) **AT1:** The system tries to connect to database (in order to retrieve the relations), but it fails, therefore it displays the message "Error de conexión".
   2.2) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.

   Alternate course A

   2-A) The user verifies if the set of algebraic expressions is complete, if it is incomplete then repeat the point no. 2 of this use case.
      2.1-A) **AT4**: The set of algebraic expressions do not contain a least once one of the attributes of the specified relation, therefore the system will display the message "El conjunto no es completo".
      2.2-A) **AT5**: The generated algebraic expression already exists within the set, therefore, the system displays the message "Ya existe el fragmento".
3) The user will select one of the fragments that were generated from the set.
4) Once selected the system will automatically generate the algebraic expression that represents that simple predicate (fragment), then the user must save that fragment UC-05 *save fragment*.
5) The system will display a message confirming that the fragmentation was successful.

UC-03 Create simple predicate (Selection)

Name:	Create simple predicate (selection)	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Reviser:**	David Flores Casanova
Actor:	Administrator		
Purpose:	Create a simple predicate based in the selection operator, given some conditions applied to an attribute.		
Inputs:	Relation Attributes Operators Value	**Output:**	Simple predicate (selection)
Origin:	Keyboard	**Destination:**	Screen.
Preconditions:	A relation must be chosen before adding values when the system has been initialized. There must be at least one attribute per relation. The value must not be too large, so it can be inserted within the field.		
Postconditions:	The system will generate a set of mini-term predicates (all possible permutations) from the specified simple predicates and it will validate its minimality.		
Errors:	1. Connection Error (AT1). 2. Fatal Error (AT2). 3. Relation missing Error (AT6). 4. Attribute missing Error (AT7). 5. Operator missing Error (AT8).		
Observations:			

Basic Course of Action UC-03

1) The user wants to create a simple predicate base in the selection operator of a given relation.
2) The user chooses a relation from the relation set.
3) The user chooses an attribute from the attribute set of the relation specified in the previous step.
   3.1) **AT1:** The system tries to connect to database (to retrieve the attributes from that relation), but it fails, therefore it displays the message "Error de conexión".
   3.2) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.

4) The user chooses an algebraic operator, this operator will apply a condition to the selected attribute.
5) The user will insert a value in the value field, the previous operator will be applied to this value.
6) Once the user has finished the previous points, it must press the "Agregar" button.
   6.1) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.
   6.2) **AT6:** The user does not select previously the relation, or it is unknown, therefore the system display the message "Error relación desconocida".
   6.3) **AT7:** The user does not select previously the attribute, or it is unknown, therefore the system displays the message "Error atributo desconocido".
   6.4) **AT8:** The user does not select previously the operator, or it is unknown, therefore the system displays the message "Error operador desconocido"
7) The simple predicate was successfully assembled.
   Alternate course A:
   7-1) Wants to remove the simple predicate from the set, UC-06 *"Drop predicate"*.

UC-04 Create algebraic expression (Projection)

Name:	Create simple predicate (projection).	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Reviser:**	Evelyn Gabriela Reyes Jiménez
Actor:	Administrator		
Purpose:	Create an algebraic expression based in the projection operator.		
Inputs:	Relation Determinant Attribute (Inserted Automatically). Attributes.	**Output:**	Algebraic Expression (projection).
Origin:	Keyboard	**Destination:**	Screen
Preconditions:	The primary key (determinant attribute) shall be included in all algebraic expressions of that relation (This action is done automatically). There must be at least one attribute per relation.		
Postconditions:	The system will generate an algebraic expression (Fragment) based on the projection operator that fulfill the specified requirements.		
Errors:	1. Connection Error (AT1). 2. Fatal Error (AT2). 3. Relation missing Error (AT6). 4. Attribute missing Error (AT7).		

Observations:	Although in the point number five we call to the action of remove an algebraic expression "Drop predicate" (Which can be confusing) it is done this way because we do the exact procedure as we eliminate a predicate in horizontal fragmentation, so in order to maintain simplicity and reusability of the cases we will maintain the same name.

Basic Course of Action UC-04

1) The user wants to create an algebraic expression base in the projection operator of a given relation.
2) The user chooses a relation from the relation set.
3) The user chooses one or more attributes from the attribute set of the relation specified in the previous step.
   3.1) **AT1:** The system tries to connect to database (to retrieve the attributes from that relation), but it fails, therefore it displays the message "Error de conexión".
   3.2) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.
4) Once the user has finished the previous points, it has to press the "Agregar" button.
   4.1) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.
   4.2) **AT6:** The user does not select previously the relation, or it is unknown, therefore the system display the message "Error relación desconocida".
   4.3) **AT7:** The user does not select previously the attribute, or it is unknown, therefore the system displays the message "Error atributo desconocido".
5) The algebraic expression was successfully assembled.
   Alternate course A:
   5-1) Wants to remove the algebraic expression from the set, UC-06 *"Drop predicate"*.

UC-05 Drop predicate

Name:	Drop simple predicate.	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Reviser:**	Daniel Ortega
Actor:	Administrator		
Purpose:	Delete a simple predicate from the simple predicate set		
Inputs:	Simple predicate	**Output:**	Simple predicate removed Delete confirmation message
Origin:	Keyboard	**Destination:**	Screen

Preconditions:	The simple predicate to delete has to exists in the simple predicate set.
Postconditions:	The selected simple predicate will be removed from the set.
Errors:	1. Connection Error (AT1). 2. Fatal Error (AT2).
Observations:	

Basic Course of Action UC-05

1) The user wants to delete a simple predicate from the simple predicate set.
2) The user chooses the simple predicate that wants to remove.
3) The user presses the delete button.
   3.1) **AT1:** The system tries to connect to database (to make the delete), but it fails, therefore it displays the message "Error de conexión".
   3.2) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.
4) The system will display a message confirming the delete action.

UC-06 Save fragment

Name:	Save fragment	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Revisor:**	David Flores Casanova
Actor:	Administrator		
Purpose:	Save the selected fragment in a specific site.		
Inputs:	Fragment Site	**Output:**	Fragment stored Save confirmation message
Origin:	Keyboard	**Destination:**	Screen
Preconditions:	The fragment to save must be correctly assembled. The specified site must exist.		
Postconditions:	The fragment will be stored in the specified site,		
Errors:	1. Connection Error (AT1) 2. Fatal Error (AT2) 3. Site missing Error (AT9)		

Observations:	

Basic Course of Action UC-06

1) The user wants to save a fragment to a specific site.
2) The user selects the fragment that wants to store.
3) The user selects a site from the site set
4) Once the user has finished the previous points, it has to press the "Colocar" button.
   4.1) **AT1:** The system tries to connect to the specified database (to store the fragment), but it fails, therefore it displays the message "Error de conexión".
   4.2) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.
   4.3) **AT9:** The user does not select previously the site, or it is unknown, therefore the system displays the message "Error sitio desconocido".
5) The system will display a message confirming the that the storage was successful.

UC-07 Consult fragmented information

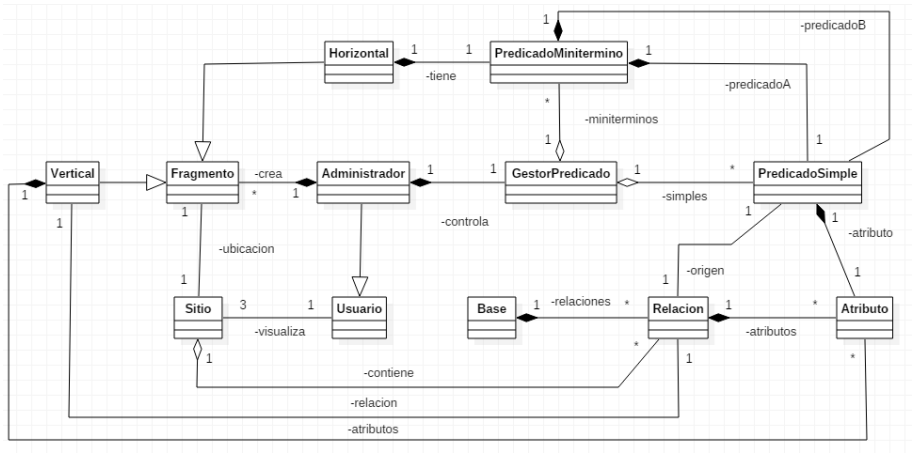
Name:	Consult fragmented information	**Autor:**	Eric Alejandro López Ayala
Version:	1.0	**Revisor:**	Evelyn Gabriela Reyes Jiménez
Actor:	User		
Purpose:	Consult the fragments that are stored, given a site and a relation of the database that is in that site.		
Inputs:	Site Relation	**Output:**	Table with the information of that relation.
Origin:	Keyboard	**Destination:**	Screen
Preconditions:	The specified site must exist. The relation must exist within the context of the database of that site.		
Postconditions:	A table dynamically generated with the content of that relation.		
Errors:	1. Connection Error (AT1) 2. Fatal Error (AT2) 3. Site missing Error (AT9)		
Observations:			

Basic Course of Action UC-07

1) The user wants to consult the information of a fragment that is stored in a site.

2) The user selects the site that wants to consult.
3) The user selects a relation from that site.
4) Once the user has finished the previous points, it has to press the "Colocar" button.
   4.1) **AT1:** The system tries to connect to the specified database (to retrieve the relations it contains), but it fails, therefore it displays the message "Error de conexión".
   4.2) **AT2:** For some reason an unknown error arises, and the application stop working: *Fatal Error* the system cannot operate.
   4.3) **AT9:** The user does not select previously the site, or it is unknown, therefore the system displays the message "Error sitio desconocido".
5) The system will display a table with the information of the relation requested.

4.2 Class Diagrams



Attributes

Usuario
- id : String
- tipo : char

Administrador
- crea : Fragmento[ ]
- controla : GestorPredicado

GestorPredicado
- miniterminos : PredicadoMinitermino[ ]
- simples : PredicadoSimple[ ]

Fragmento <DOUBT ABOUT IT>
- tiene : PredicadoMinitermino
- cumpleMinimalidad : boolean
- -ubicacion : String

Sitio
- direccion : String **
- contiene : Relacion[ ]

PredicadoSimple
- predicadoA : PredicadoSimple
- predicadoB : PredicadoSimple
- origen : String <Relation name>
- atributo : Atributo
- valor : String
- operador : String

Base
- relaciones : Relacion[ ]

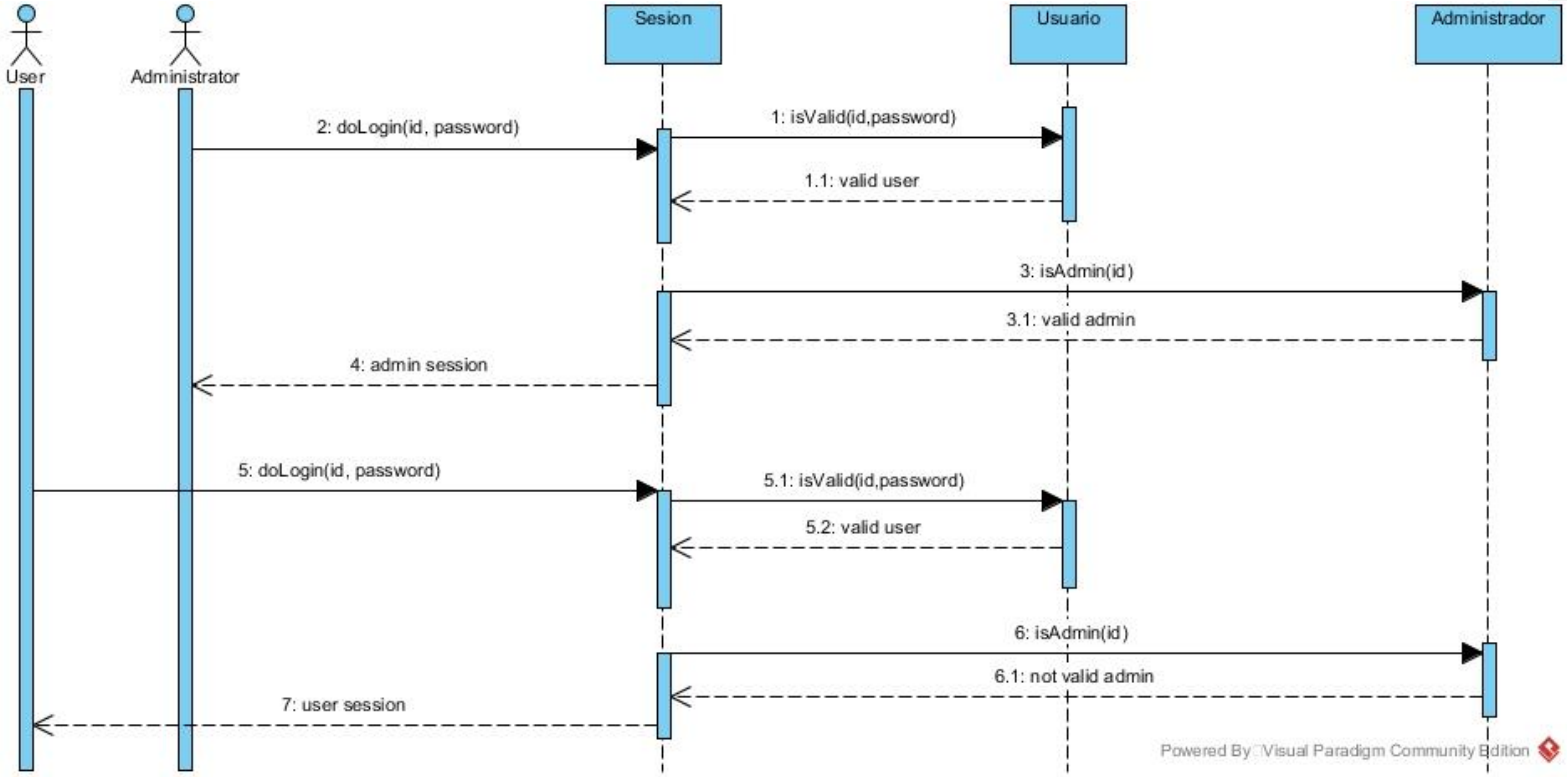
Relacion
- atributos : Atributo[ ]
- nombre : String

Atributo
- nombre : String
- tipo : String
- pk : boolean

PredicadoMinitermino
- predicadoA : PredicadoSimple
- predicadoB : PredicadoSimple
- cumpleMinimalidad : boolean
- forma : boolean[2]
- sql: String

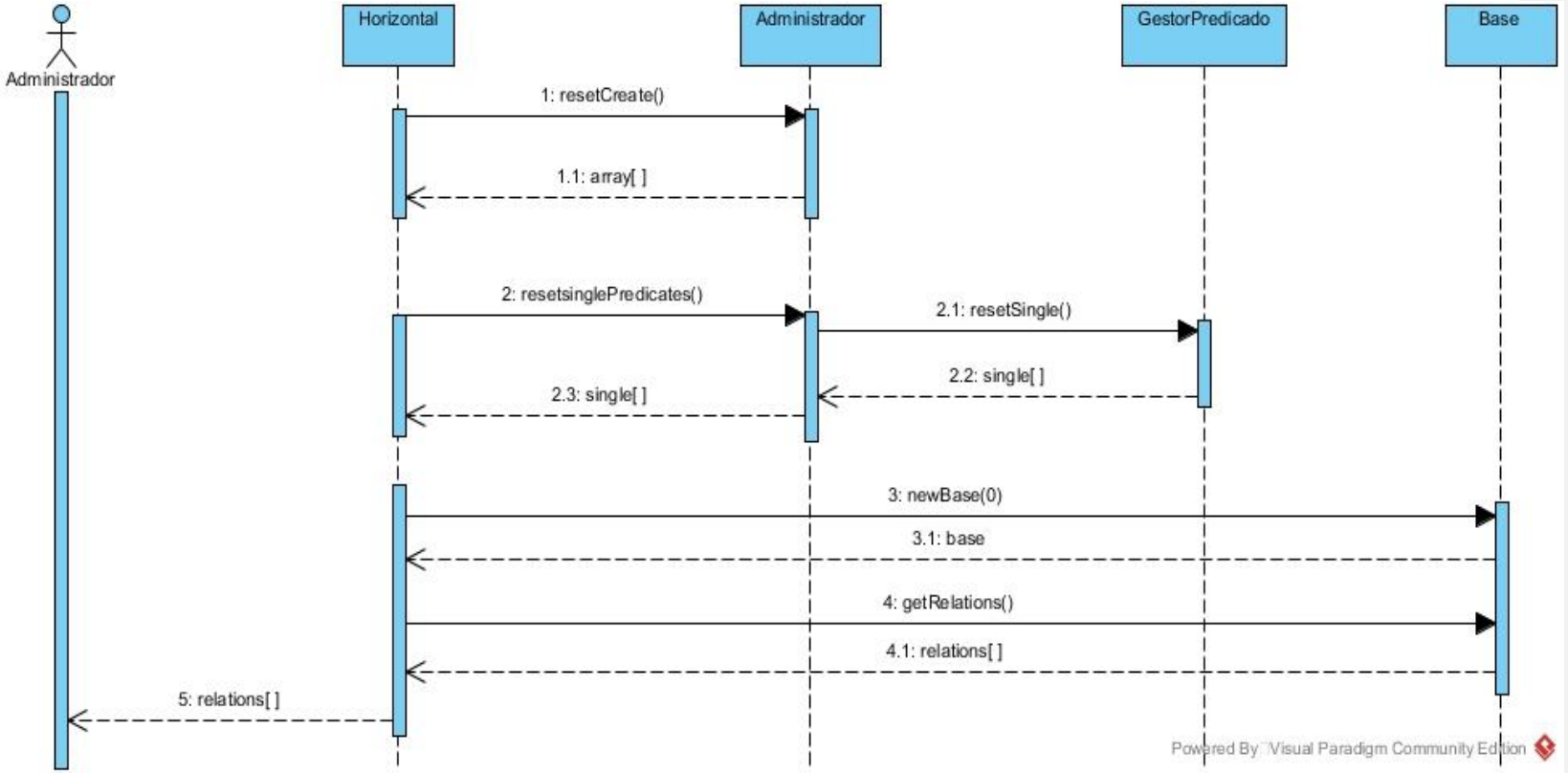
4.3 Sequence Diagrams

4.3.1 Login Sequence Diagram

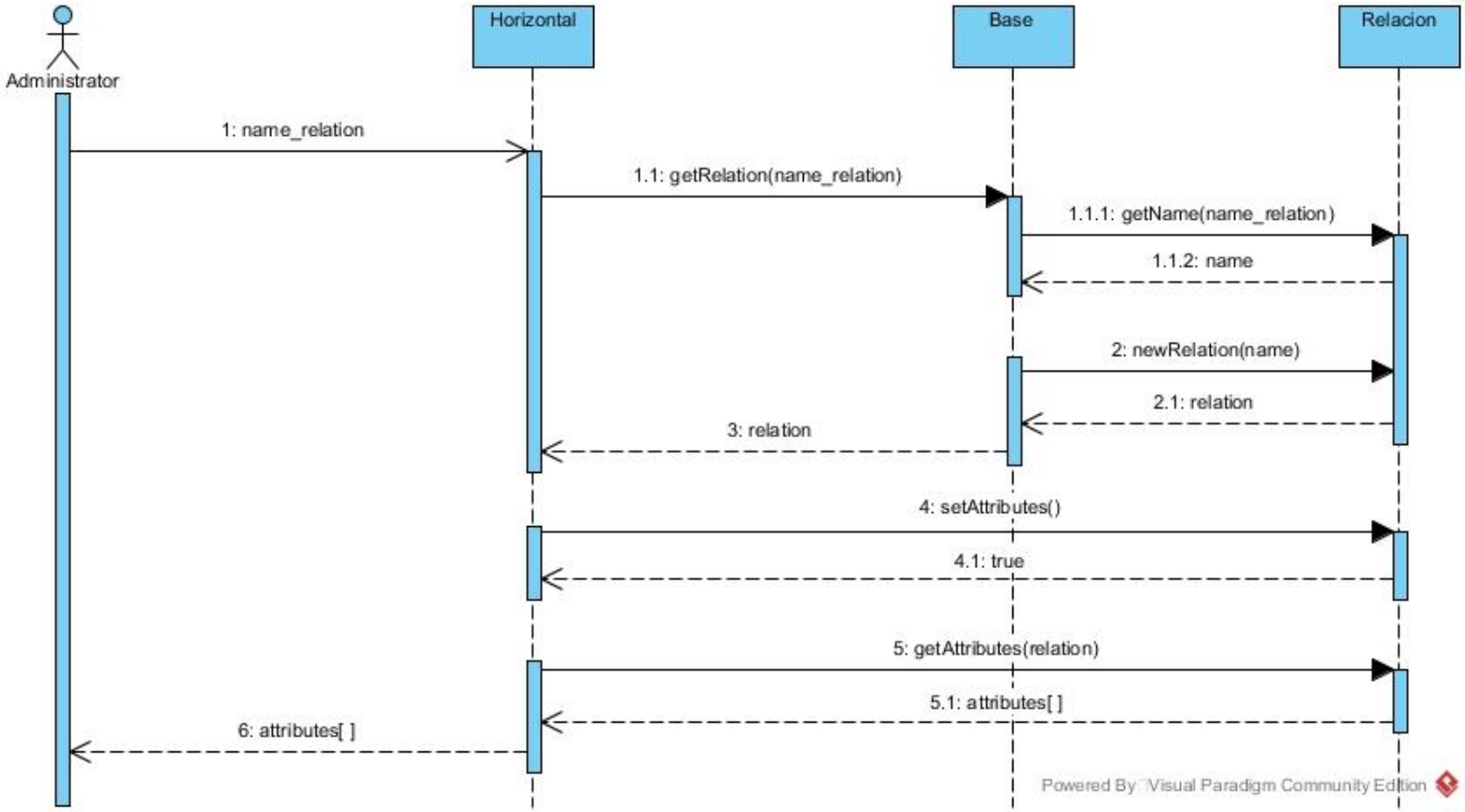


4.3.2 Horizontal Fragmentation Diagrams

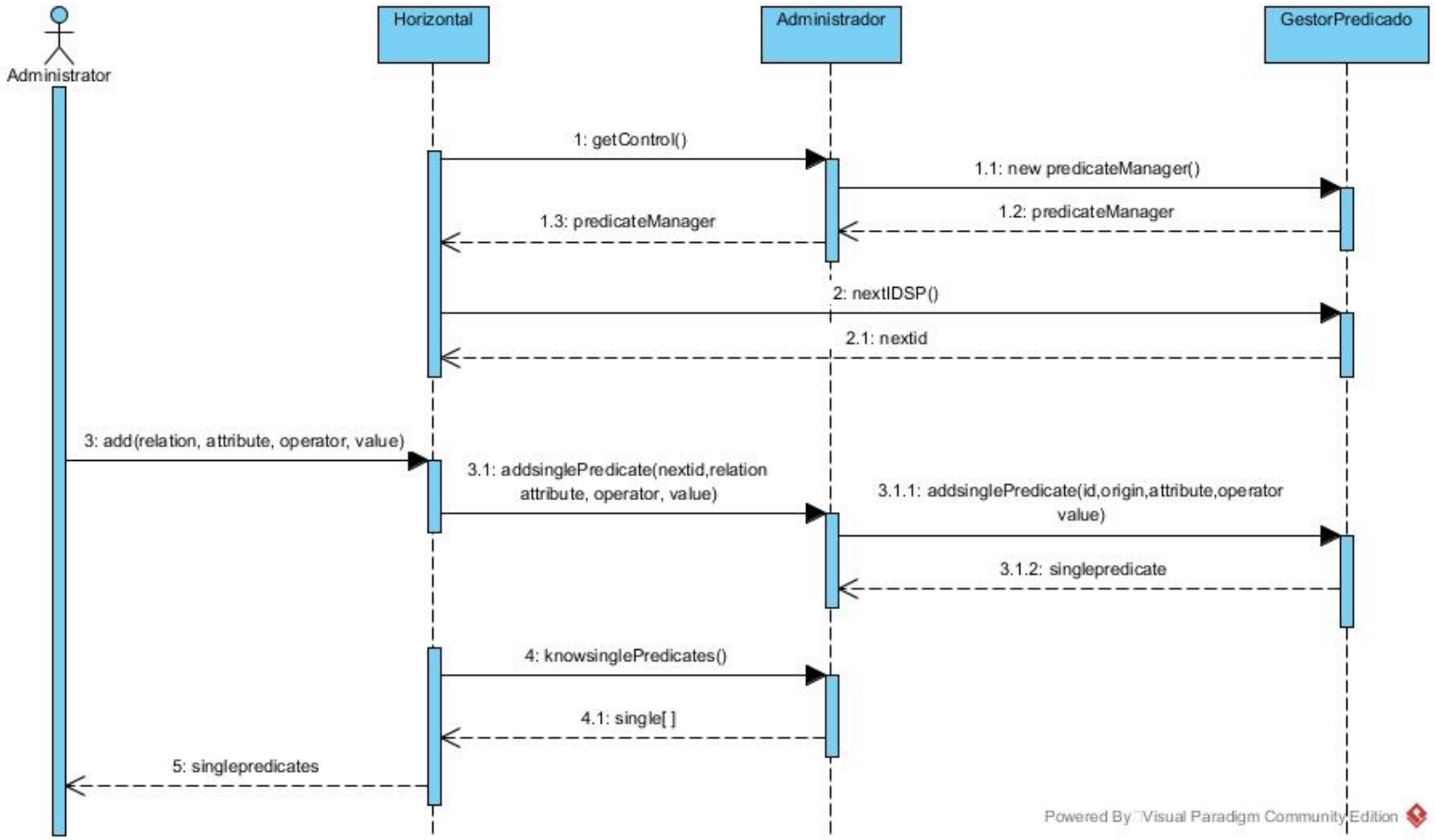
Get Relations



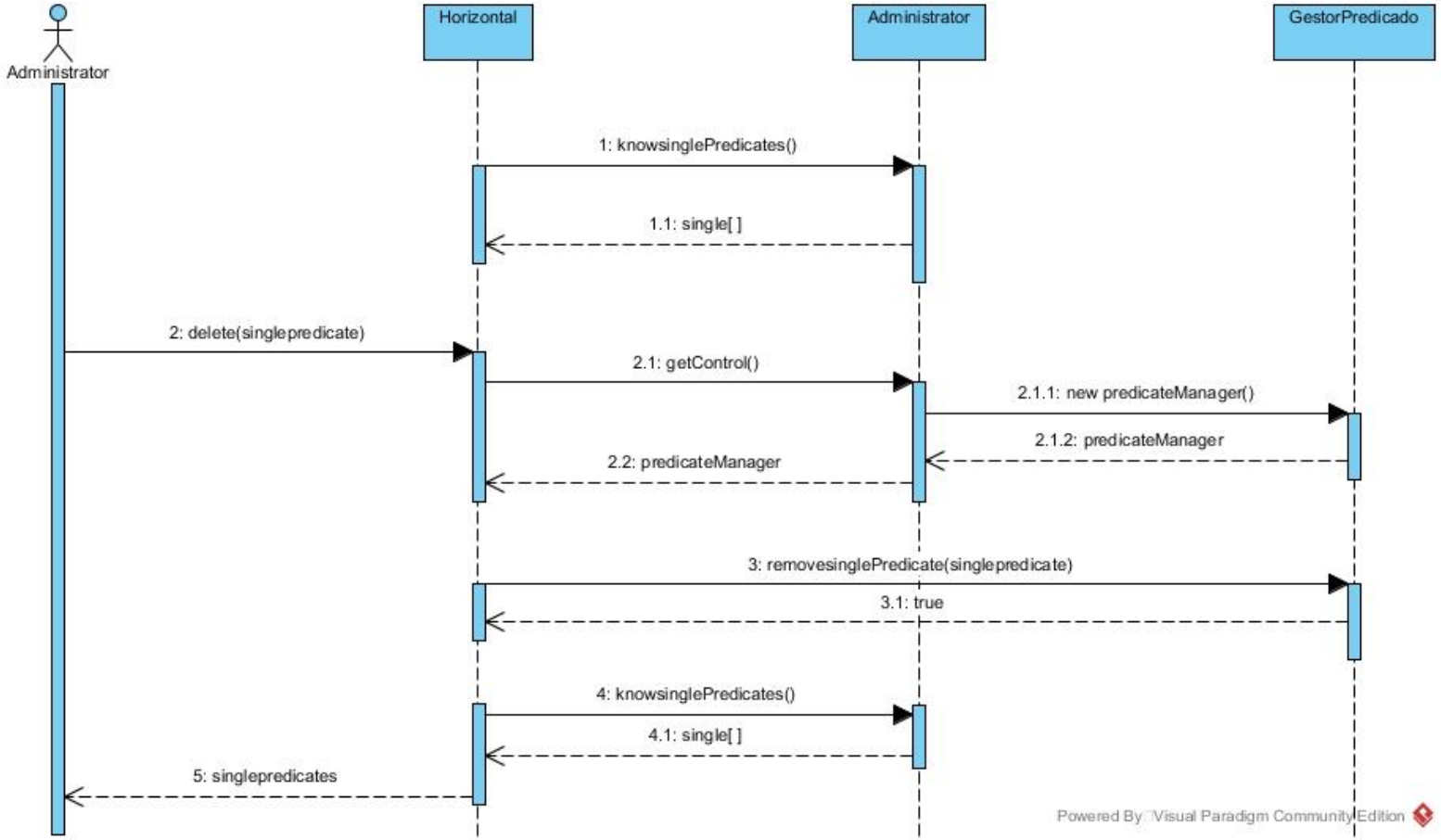
Get Attributes



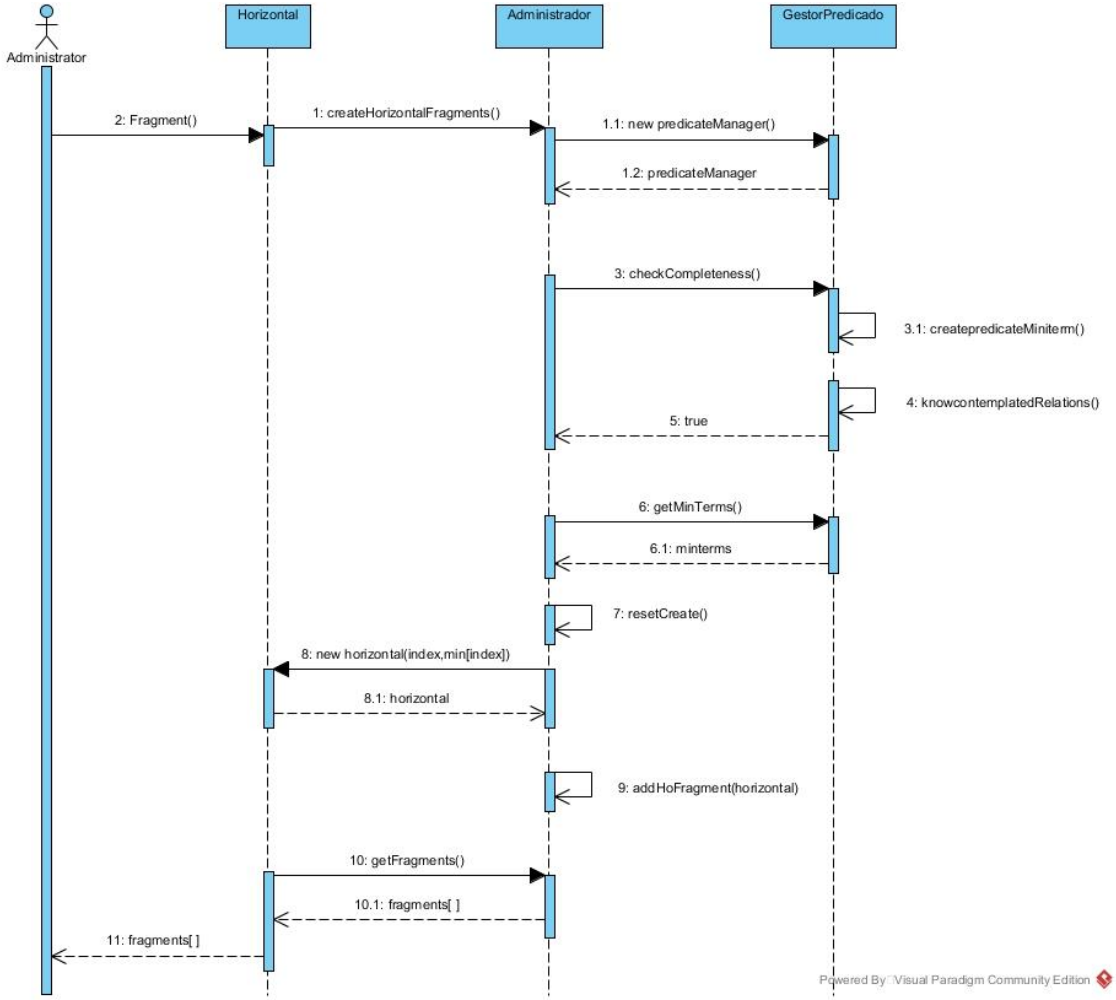
Create and Display Single Predicates



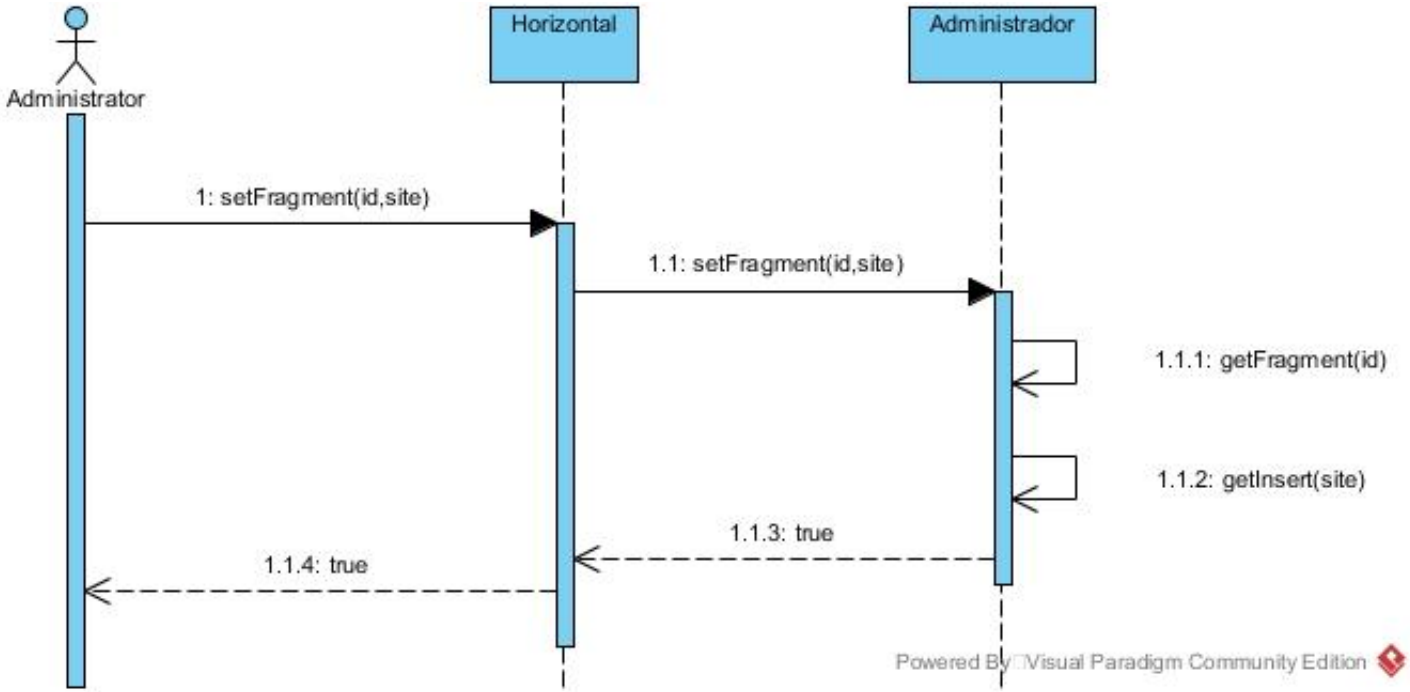
Remove Single Predicate



Create HFragment



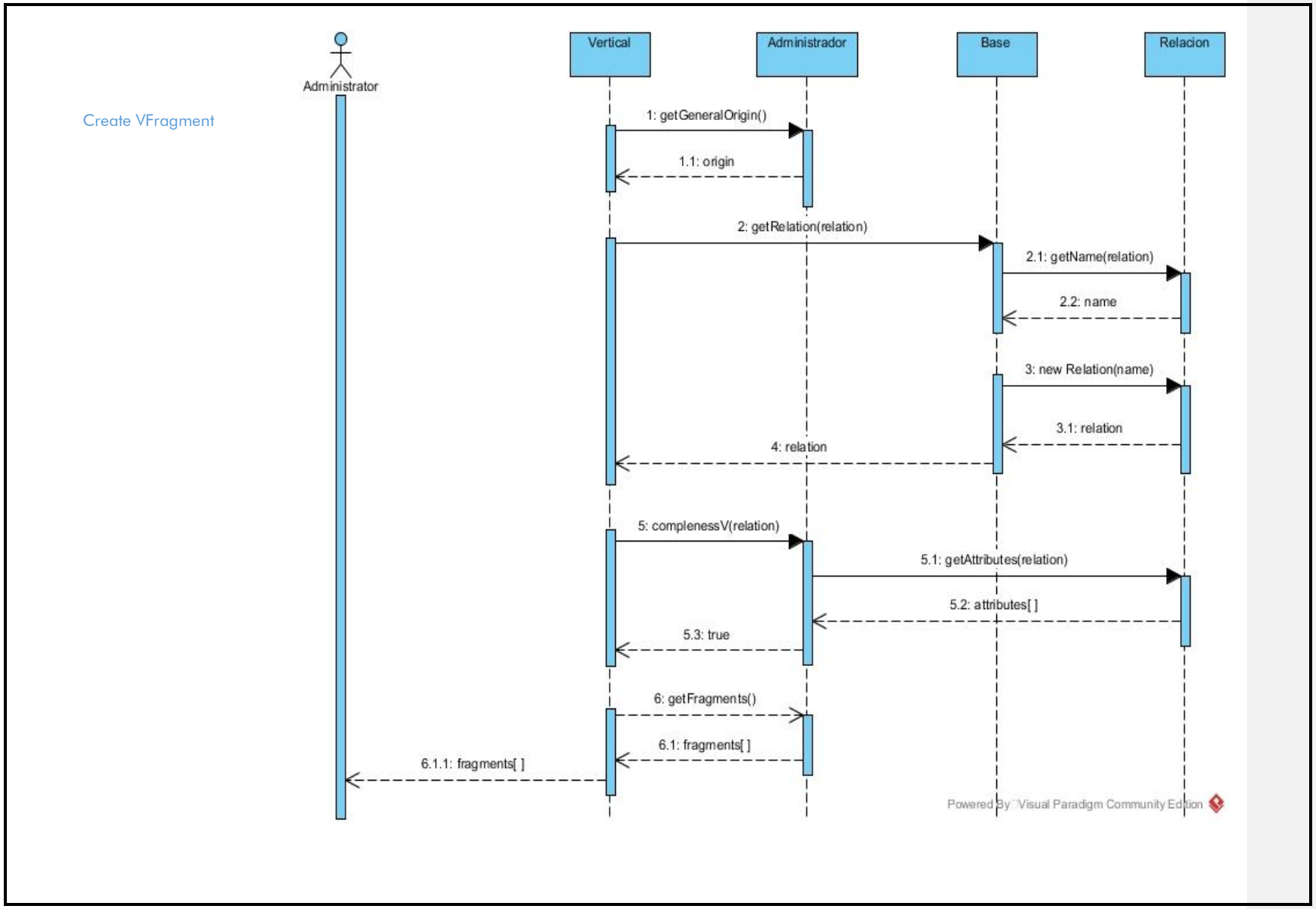
Set Fragment



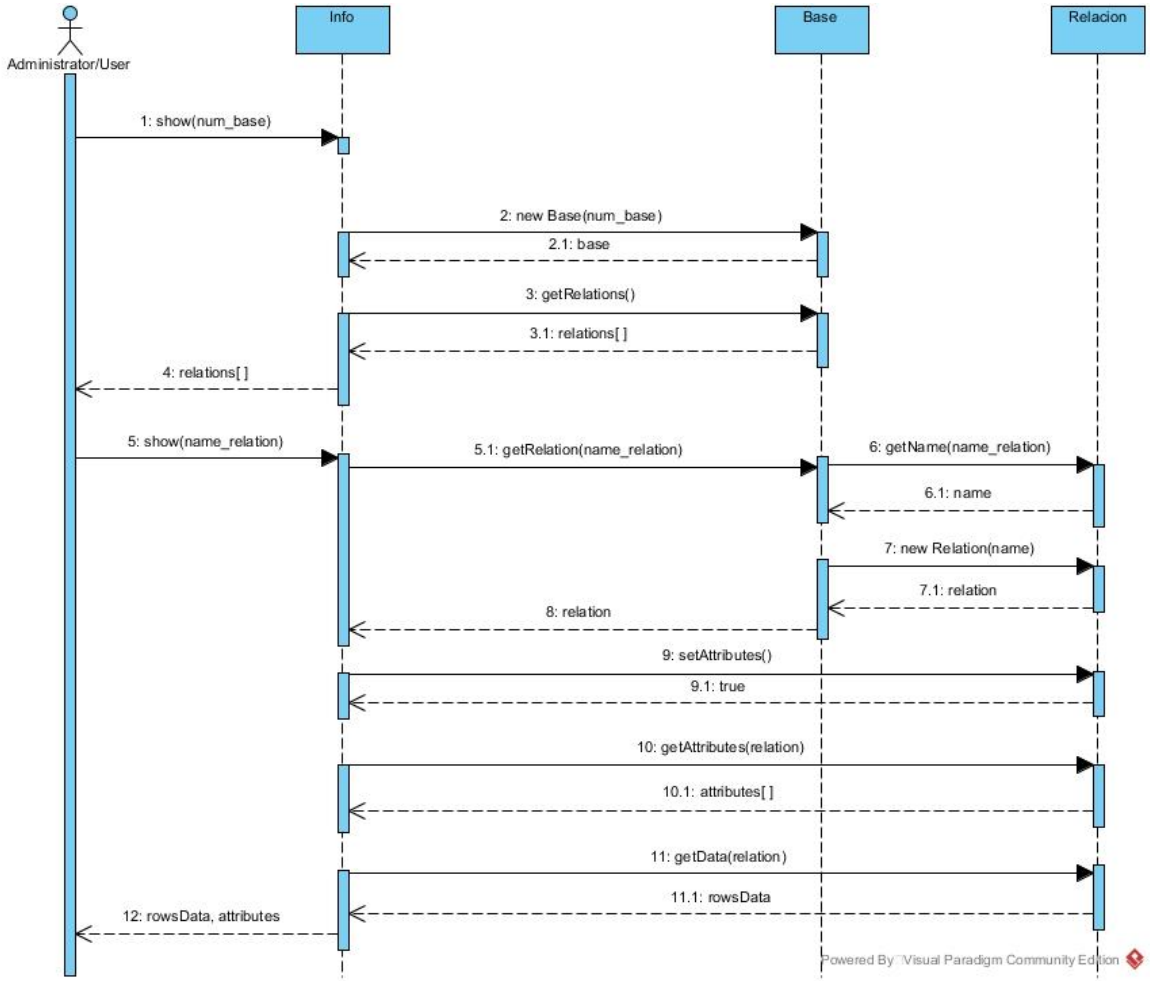
4.3.3 Vertical Fragmentation Diagrams

Some of the previous specified diagrams have the same behavior, these diagrams are:
Get Relations
Get Attributes
Remove singlePredicate – to Remove algebraicExp
Set Fragment
For vertical fragmentation, the object Horizontal is replaced by Vertical.

Create VFragment

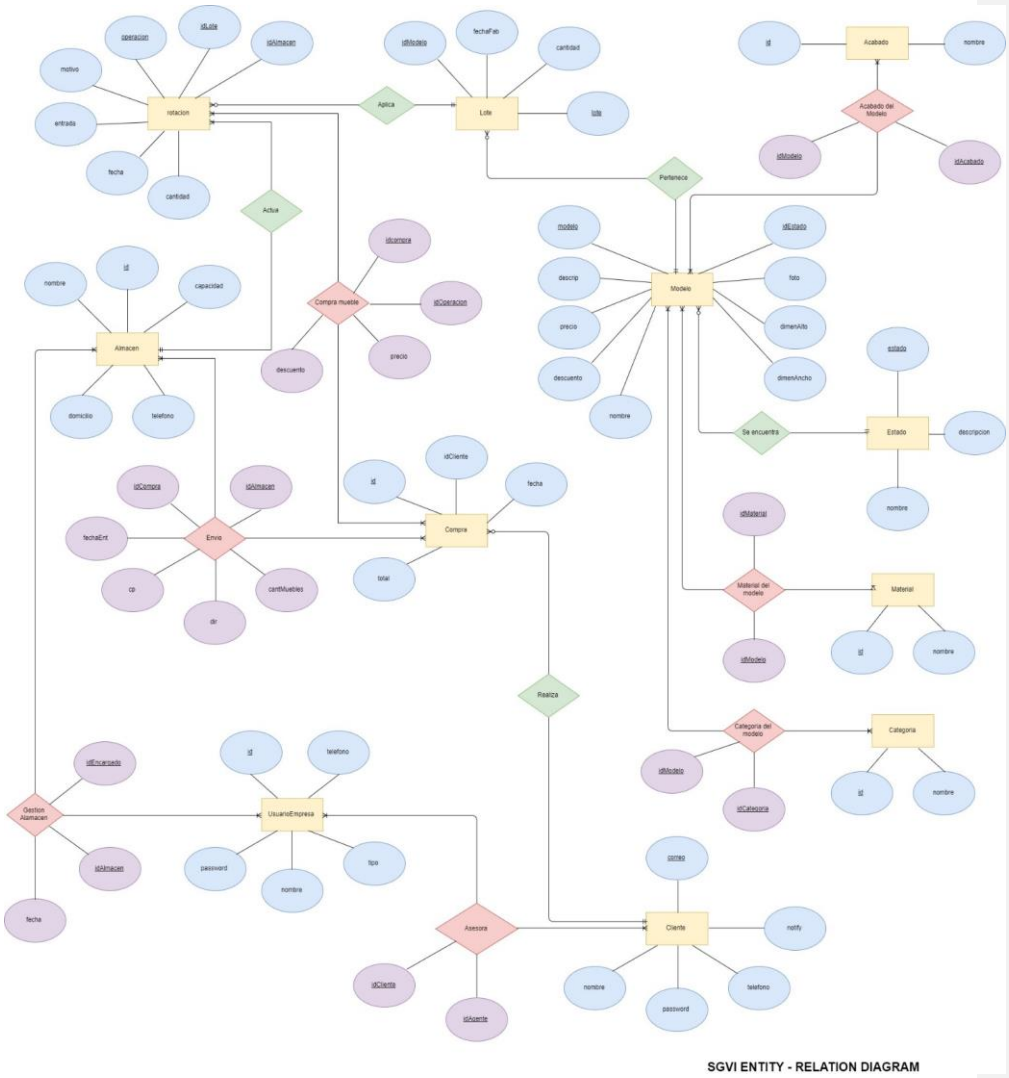


4.3.4 Fragments Info Diagram



5 Entity Relation Diagram

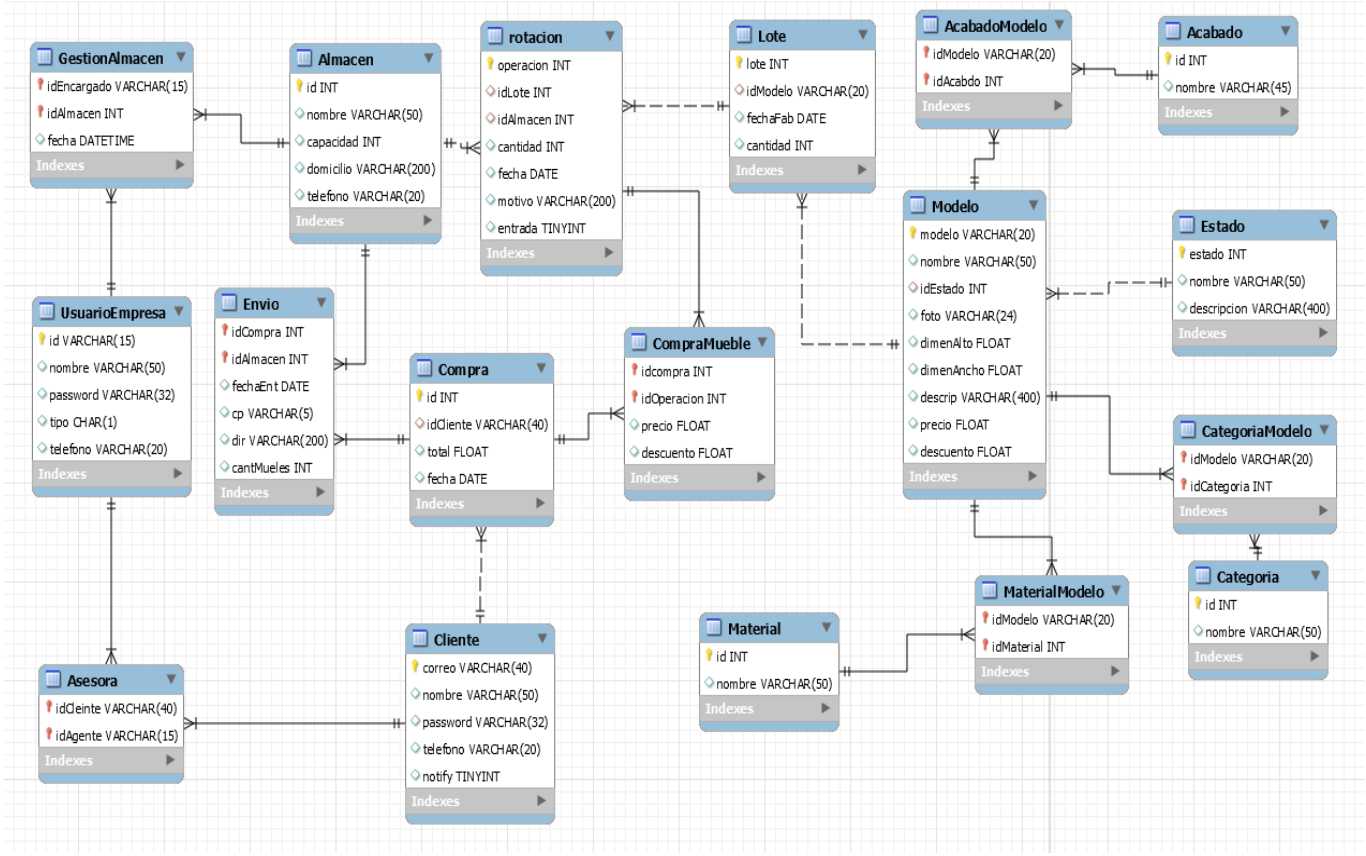
5.1 Original MQuetzal Database



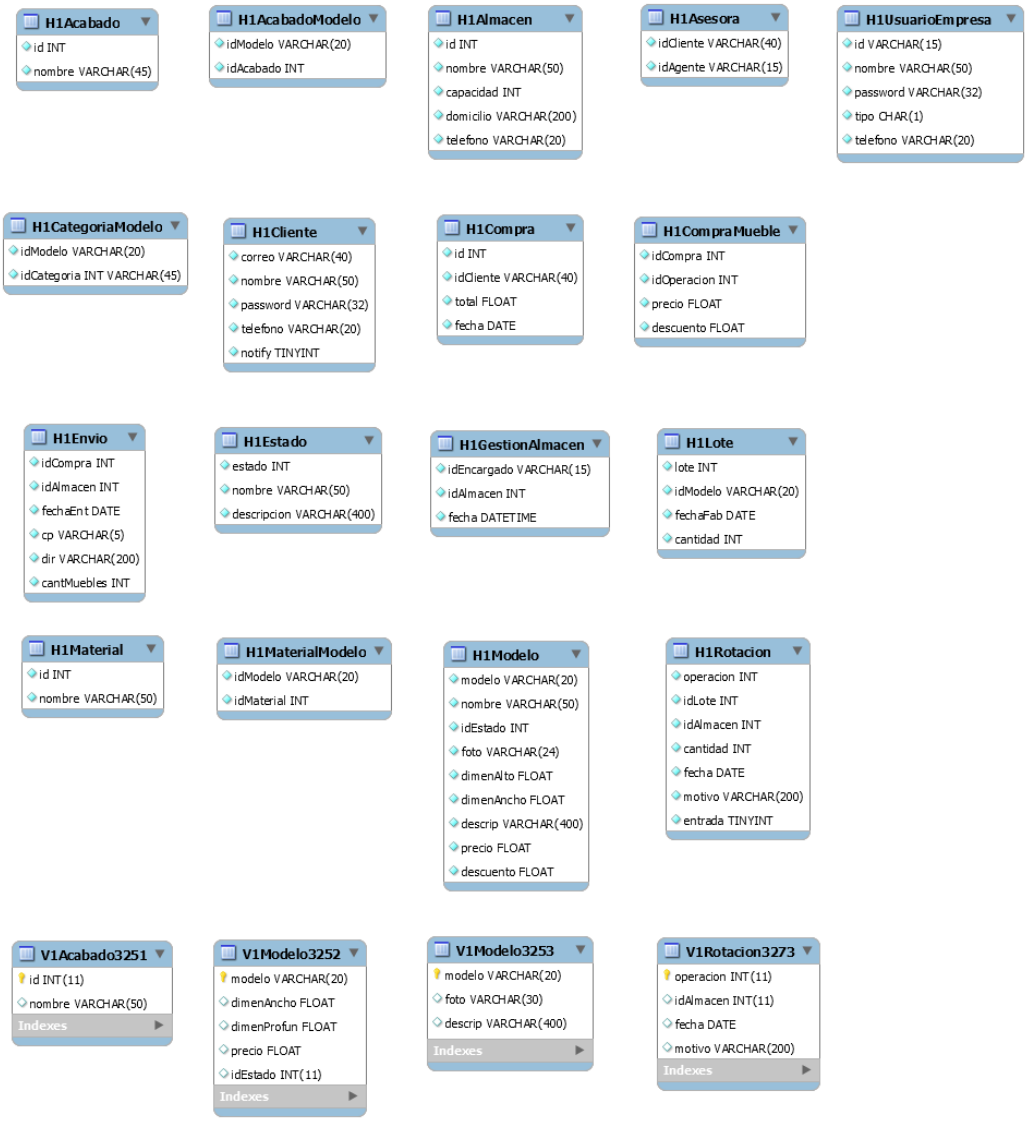
SGVI ENTITY - RELATION DIAGRAM

6 Relational Model

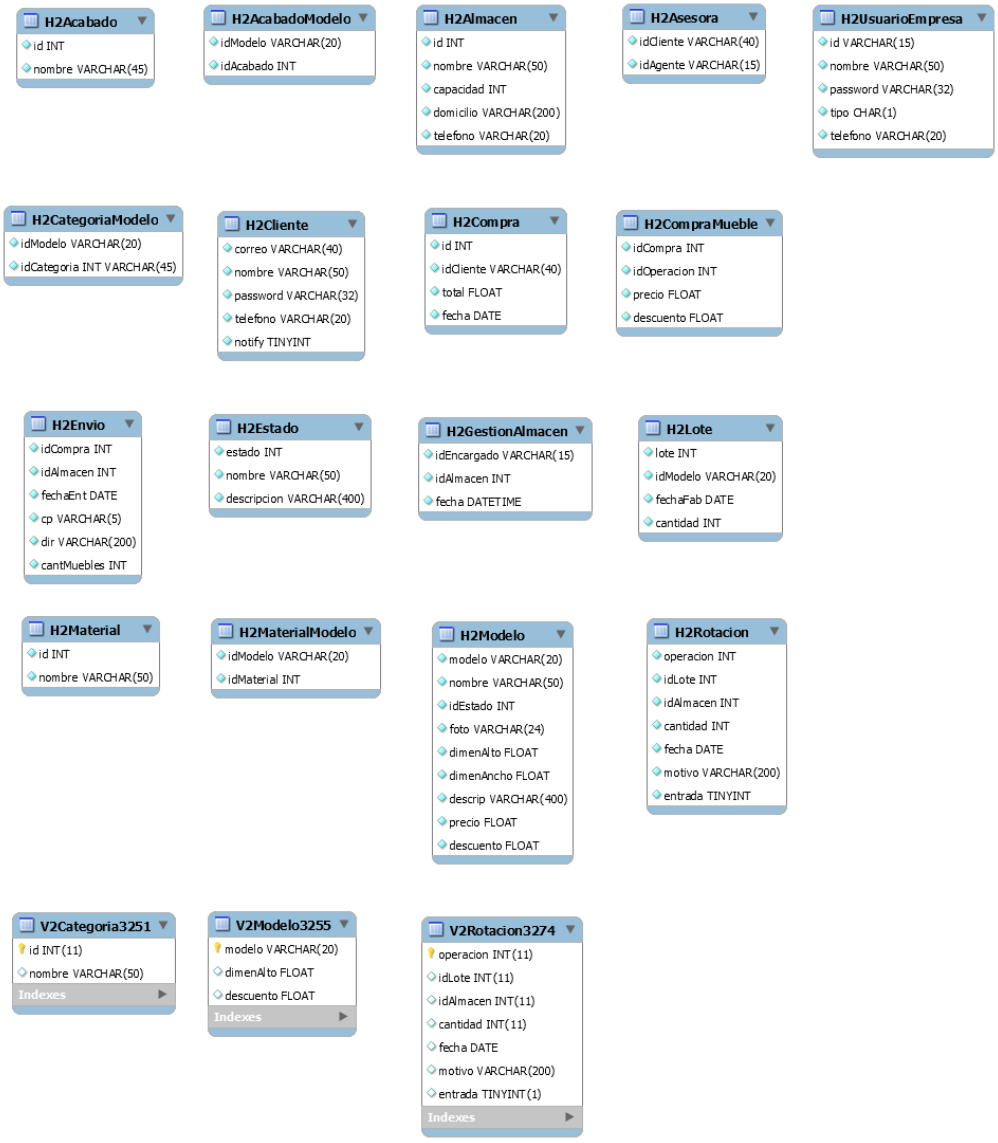
6.1 Original MQuetzal Database



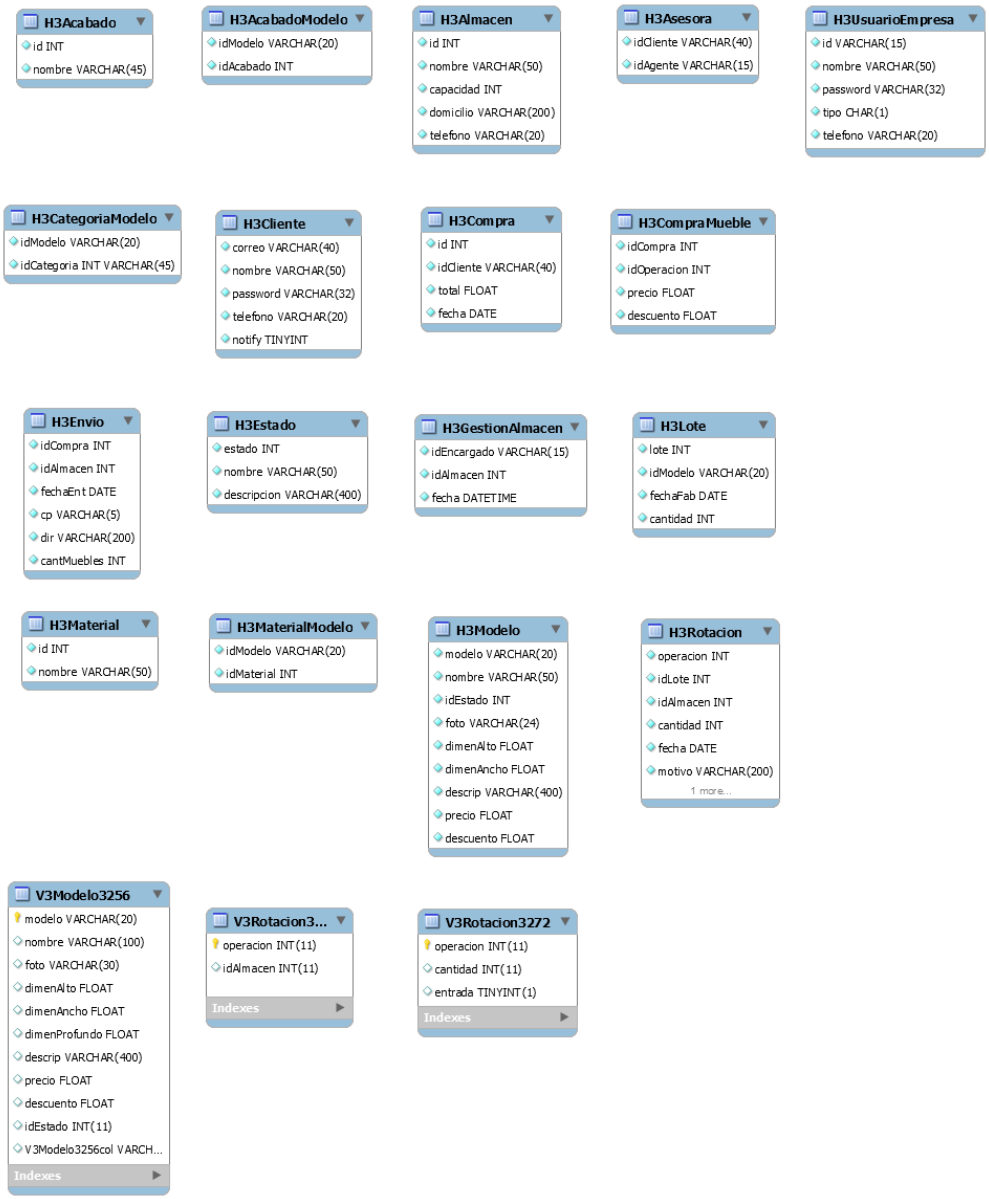
6.2 Site 1 Database



6.3 Site 2 Database



6.4 Site 3 Database



7 User Manual

7.1 Introduction

The purpose of this User Manual is to make known in a simple and easy way, the web structure of the DBFM system, as well how are used each one of its models by detail.

7.2 Objectives

1) Guide to the two types of users through all the process of using the application.

2) Give a graphical representation about the functionalities that the system has, as well an insight of the possible results that the system may have given the user actions.

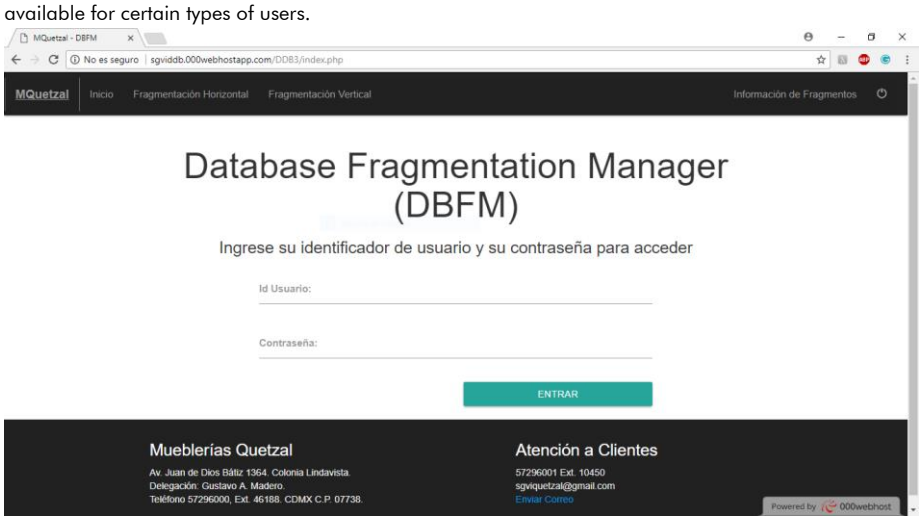
7.3 Requirements

1) A web browser that supports HTML 5 (We recommend Mozilla Firefox).
2) Internet connectivity.

7.4 DBFM Screens

1 Main Screen

Description: This is the main screen of our system, it contains the login module along with the other options that the user can do, even though they are not available until the user do login, and only some features are available for certain types of users.

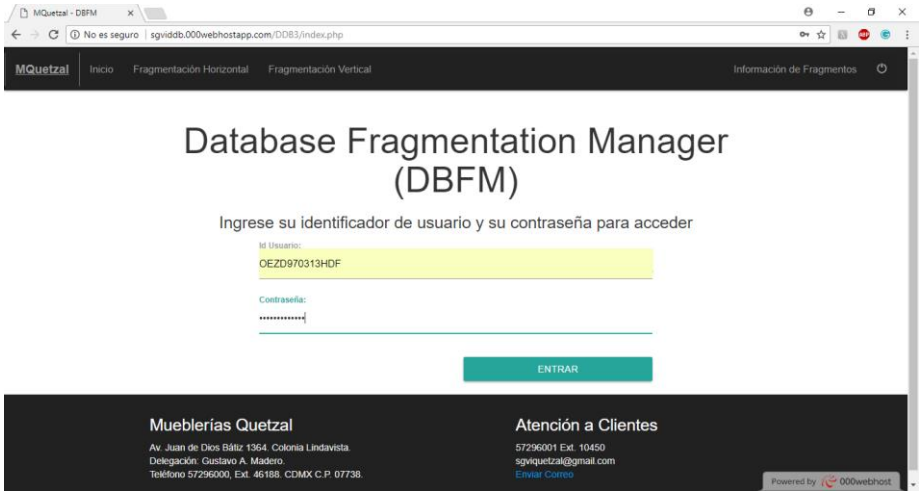


1.1 Login Process

A) Inserting user id and password.

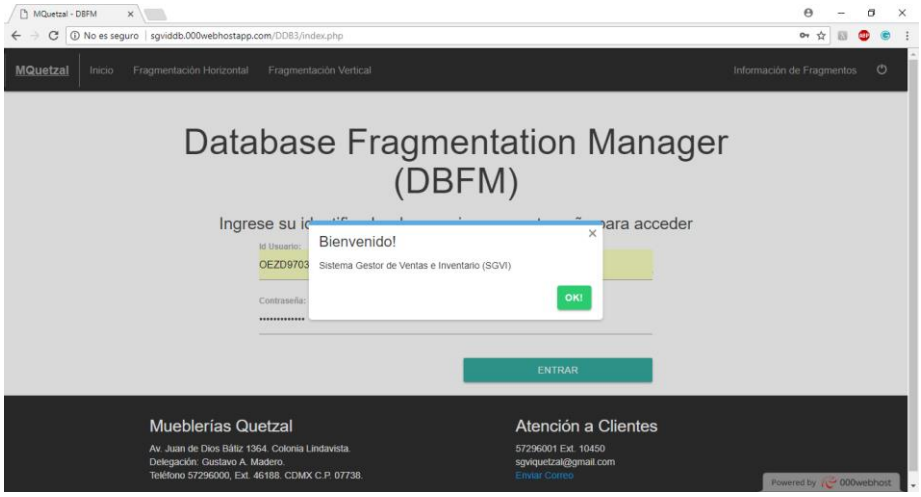
Description: The user must insert its user id in the "id Usuario" field, and its password in the "Contraseña" field.

B) Press "Entrar" button.



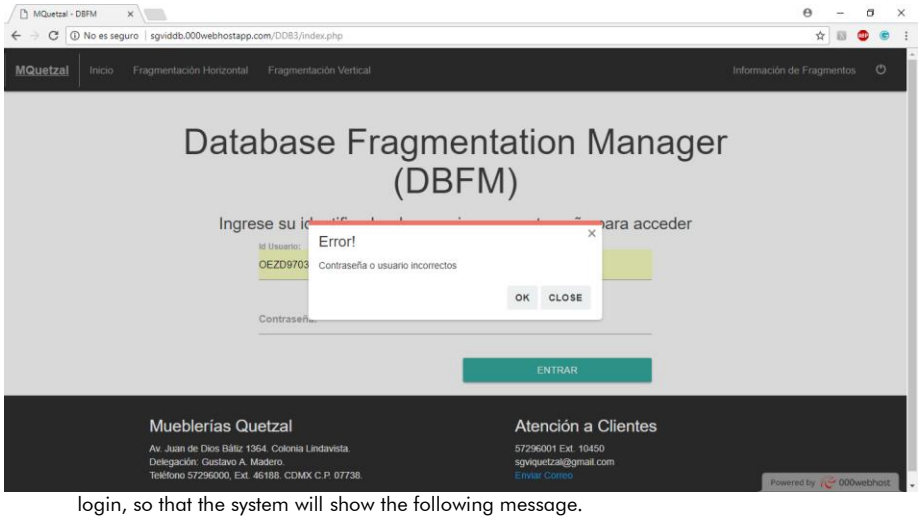
1.1.1 Successful Login

Description: If the user id and password that the user inserted are both correct then the user will do a successful login, so that the system will prompt the following message.



1.1.2 Unsuccessful Login

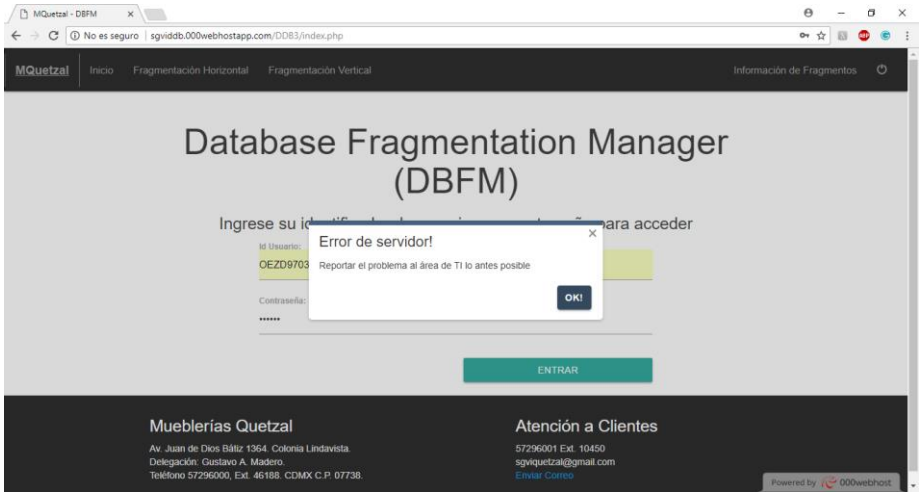
Description: If the user id or password or both are incorrect, then the user will do an unsuccessful



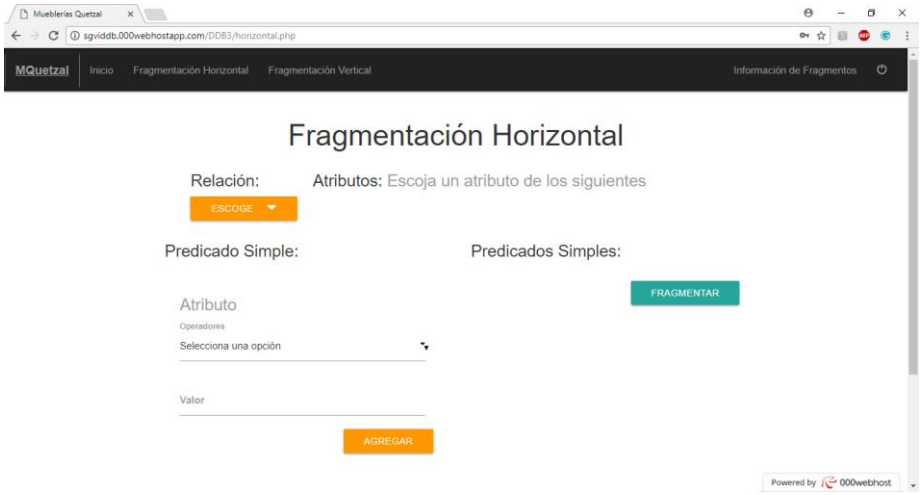
login, so that the system will show the following message.

1.1.3 Server Error

Description: If a server with the error occur, the system will notify to the user about this issue, then if the problem persists, the user shall put in contact with the IT area.



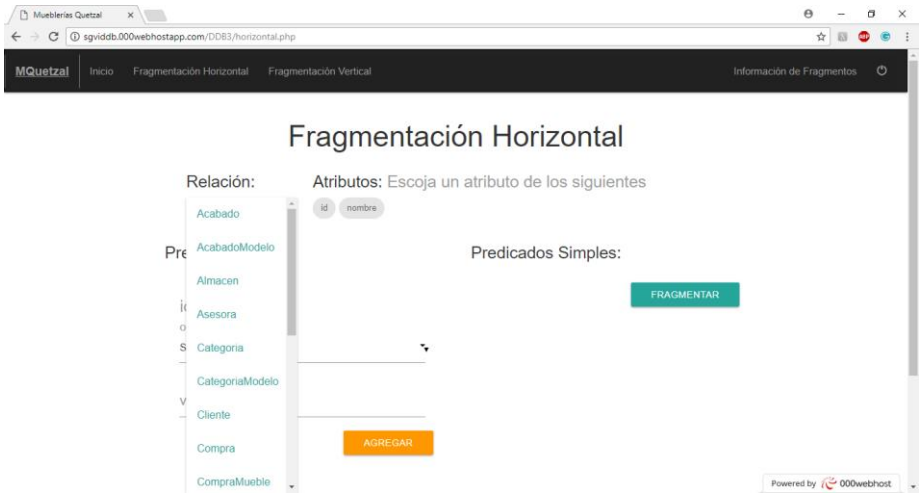
2 Horizontal Fragmentation Screen



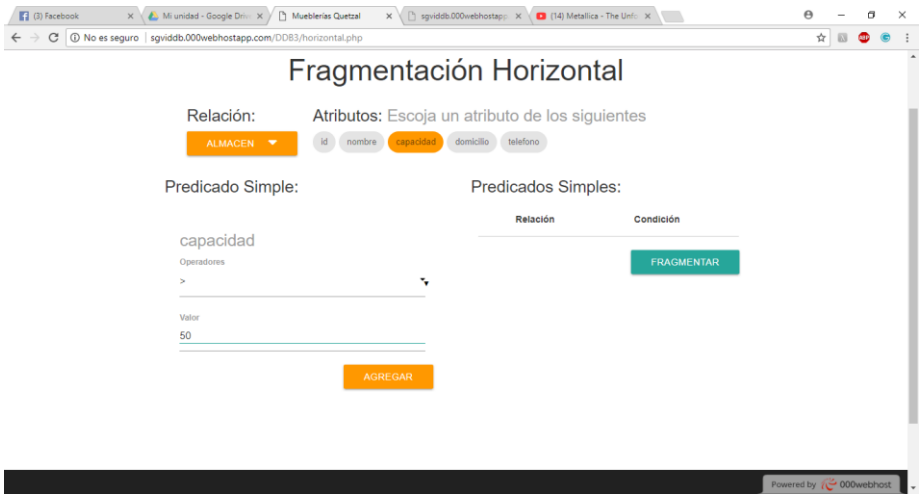
2.1 Horizontal Fragmentation Process

A) Choosing a relation.

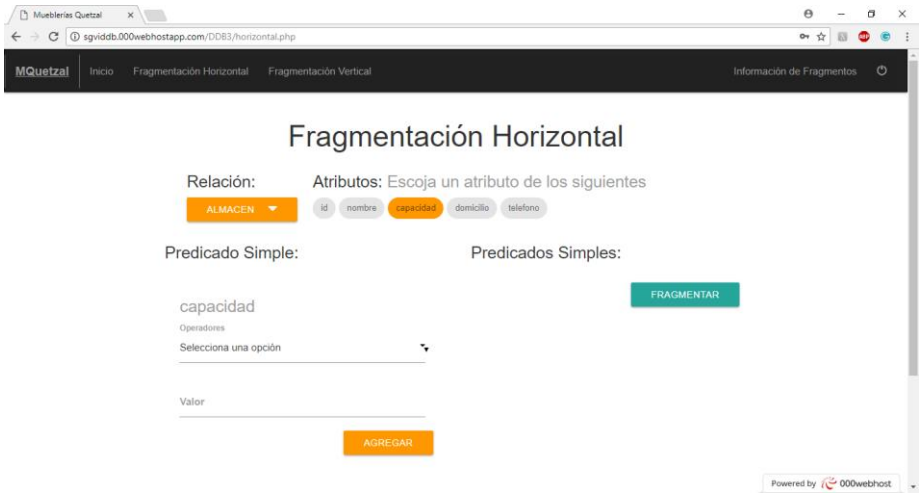
Description: When the user does click in the “relation” button, a list of all relations that exist in the original database base will be displayed, then the user will have to select one by clicking in one of them.



B) Choosing an attribute.
Description: Once the user has selected one of the relations of the database, a list of attributes that belong to that relation will be display, then the user will have to choose one of those attributes.



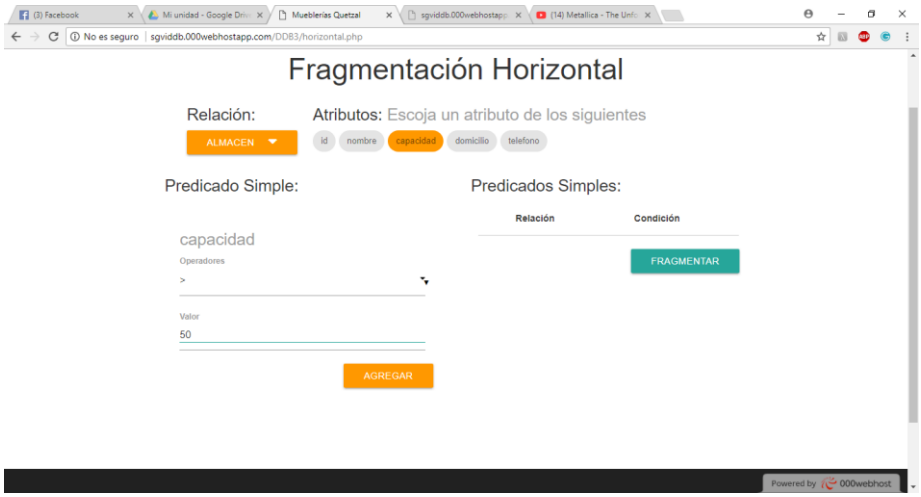
C) Choosing an operator and define its value.
Description: When the user does click in the "Operadores" field, a list will be displayed with all the operator that can be used for creating a single predicate, then the user will have to select one and then define its value in the "Valor" field.

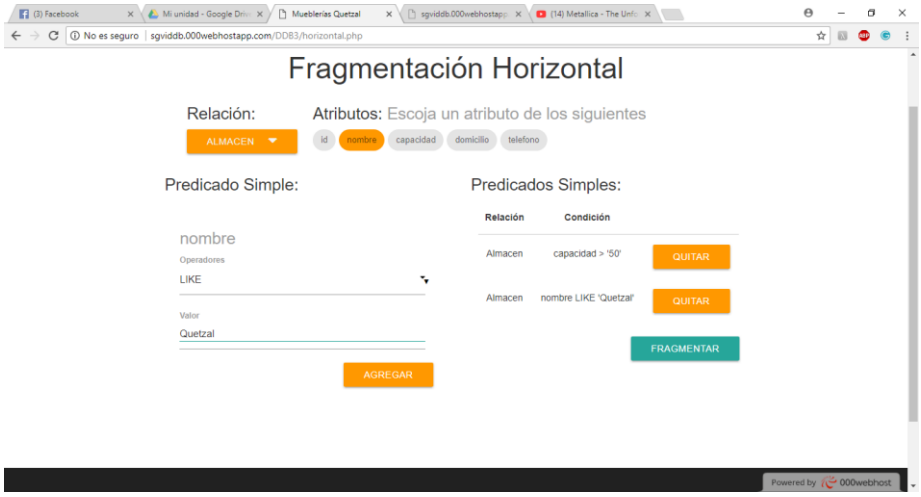


D) Creating fragments

Description: Once the operator and its value have been defined, then the user must press the "Agregar" button, the single predicate will, along with other single predicated that have been made before, appearing in a list at the right of our formulary.

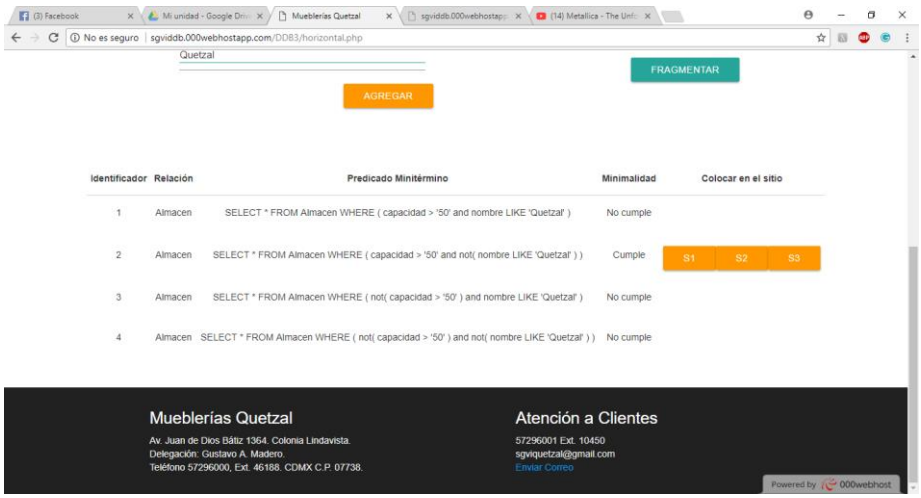
Once we have at least 2 single predicates per relation, we press the "Fragmentar" button.





E) Specifying the Site

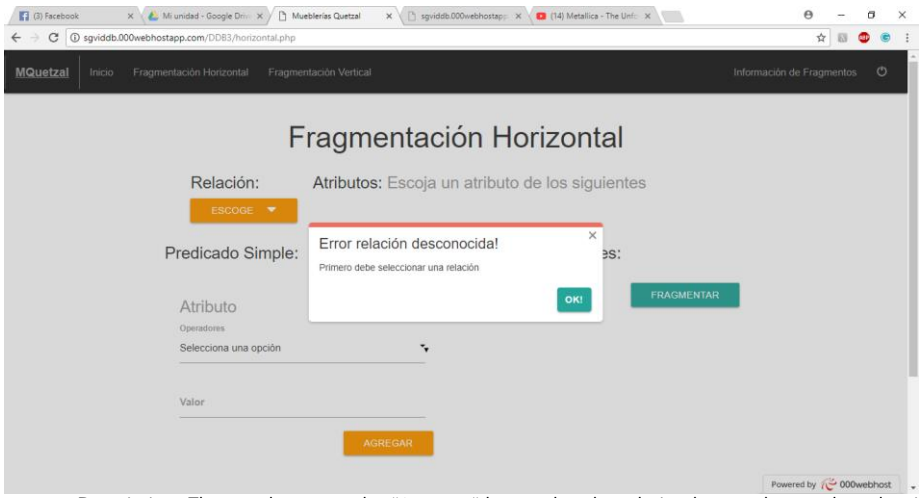
Description: Once the user has pressed the "Fragmentar" button, and all the mini-term fragments appear, the user must select in which site wants to save that fragment, there are only have 3 choices available to save that fragment: Site 1, Site 2 or Site 3.



2.1.1 Successful Fragmentation

Description: Once the site has been selected and all the previous points have been fulfilled, the system will show a message indicating that the horizontal fragmentation was successful, and it has been stored in the site correctly.

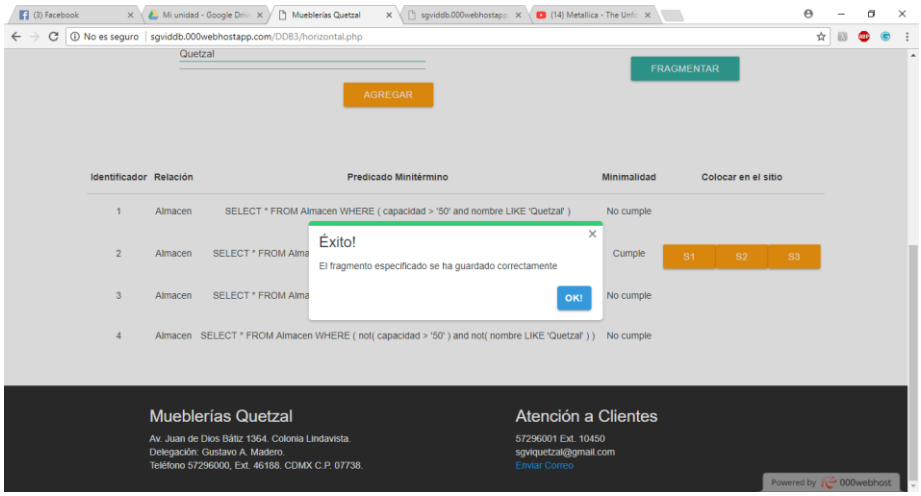
2.1.2 Unknown Relation

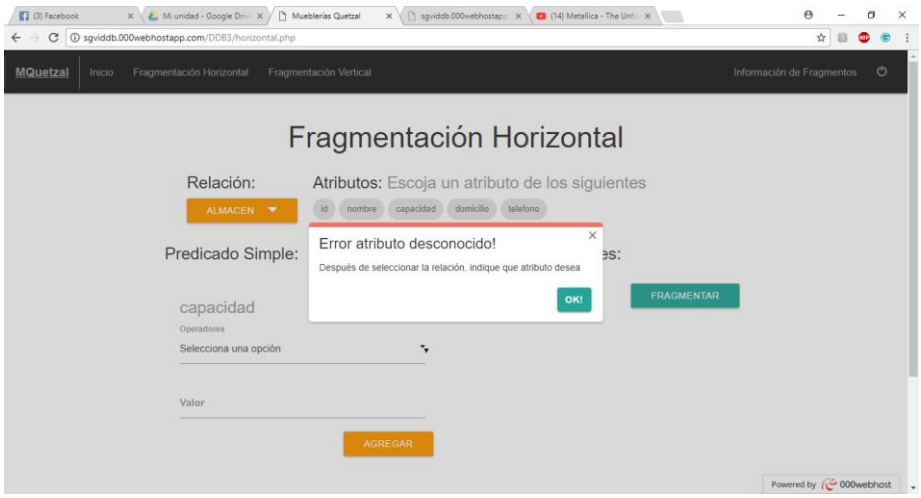


Description: The user has press the "Agregar" button, but the relation has not been selected or it is not founded.

2.1.3 Unknown Attribute

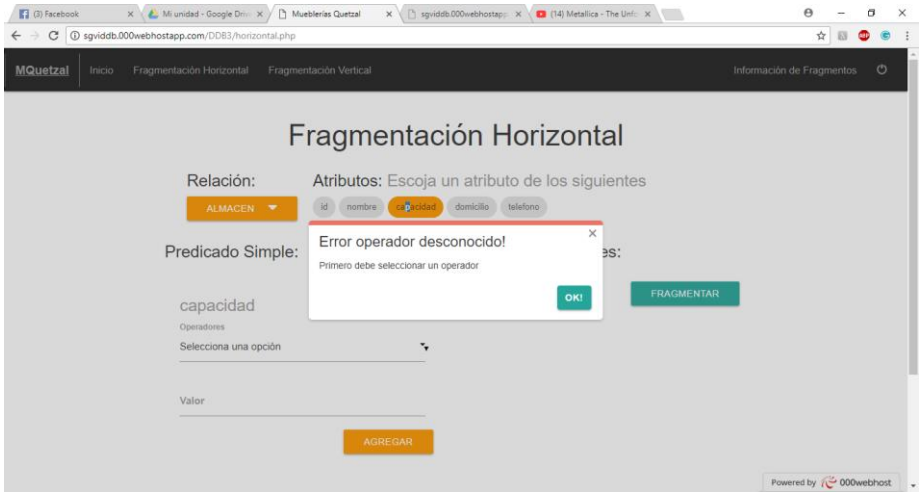
Description: The user has press the "Agregar" button, but the attribute has not been selected or it is no founded.




sgviddb.000webhostapp.com/DDB3/horizontal.php
MQuetzal
Inicio
Fragmentación Horizontal
Fragmentación Vertical
Información de Fragmentos
Fragmentación Horizontal
Relación:
ALMACEN
Atributos: Escoja un atributo de los siguientes
id
nombre
capacidad
domicilio
telefono
Predicado Simple:
Error atributo desconocido!
Después de seleccionar la relación, indique que atributo desea
OK!
FRAGMENTAR
capacidad
Operadores
Selecciona una opción
Valor
AGREGAR
Powered by 000webhost

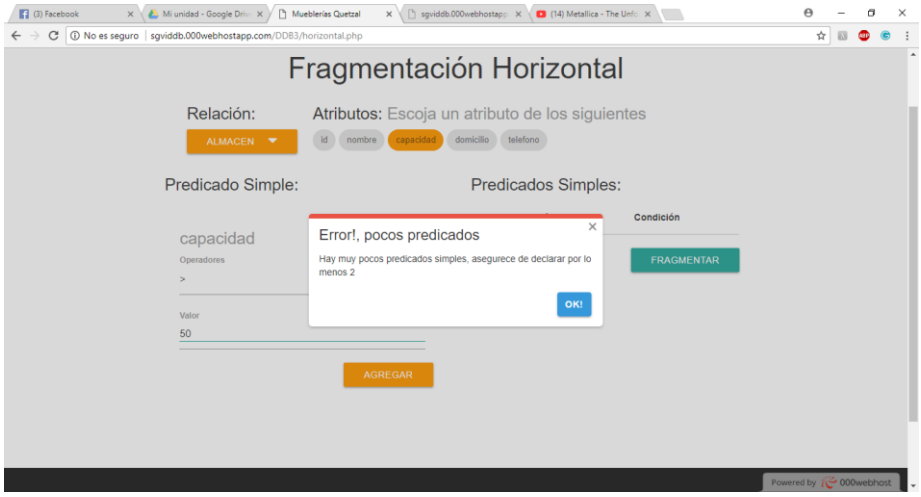
2.1.4 Unknown Operator

Description: The user has press the “Agregar” button, but the operator has not been selected or it is no founded.



2.1.5 Too Few Predicates

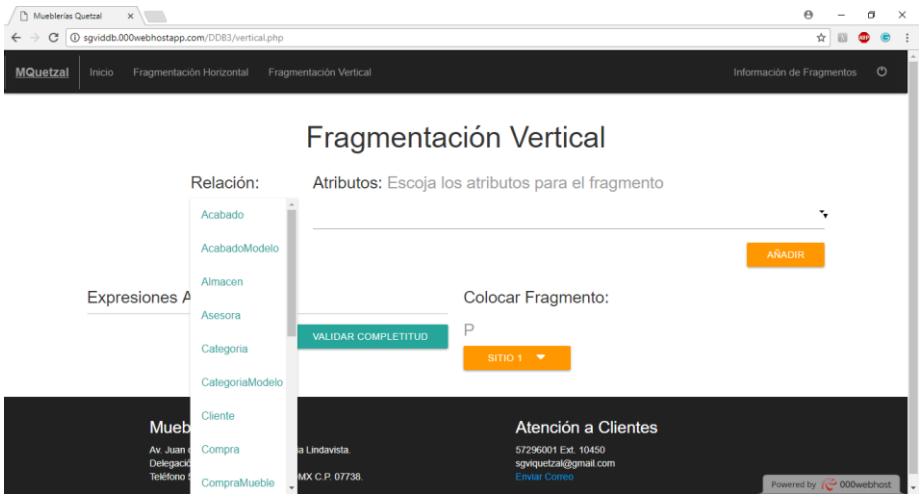
Description: The are less than 2 single predicates per relation, so the is no possible to make a proper fragmentation.



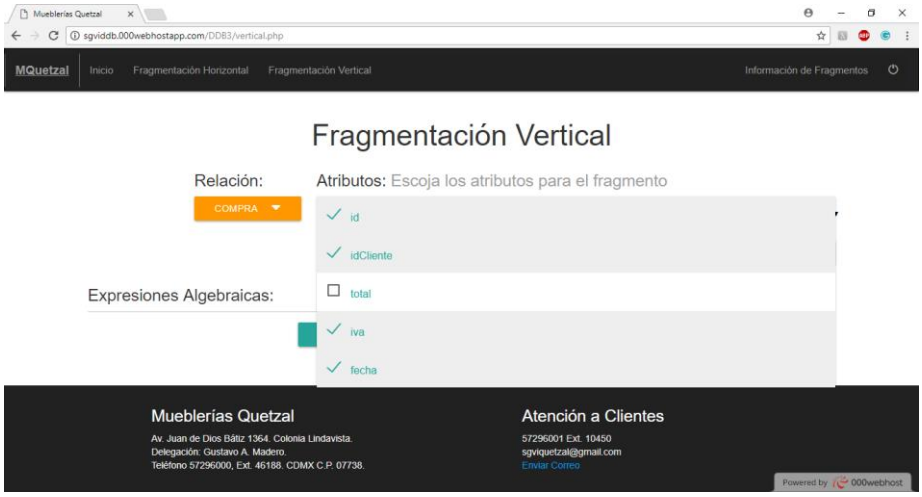
3 Vertical Fragmentation Screen

3.1 Vertical Fragmentation Process

A) Choosing a relation.
Description: When the user does click in the "relation" button, a list of all relations that exist in the original database base will be displayed, then the user will have to select one by clicking in one of them.


Mueblerías Quetzal
sgviddb.000webhostapp.com/DDB3/vertical.php
MQuetzal
Inicio
Fragmentación Horizontal
Fragmentación Vertical
Información de Fragmentos
Fragmentación Vertical
Relación:
Atributos: Escoja los atributos para el fragmento
Acabado
AcabadoModelo
Almacen
Asesora
Categoria
CategoriaModelo
Cliente
Compra
CompraMueble
AÑADIR
Expresiones A
VALIDAR COMPLETITUD
Colocar Fragmento:
P
SITIO 1
Atención a Clientes
57296001 Ext. 10450
sgviquetzal@gmail.com
Enviar Correo
Powered by 000webhost

B) Choosing attributes.
Description: Once the user has selected one of the relations of the database, a list of attributes that belong to that relation will be display, then the user will have to choose attributes from that relation. Note. The determinant attribute (primary key) is selected by default, since it is necessary for the vertical fragmentation process.

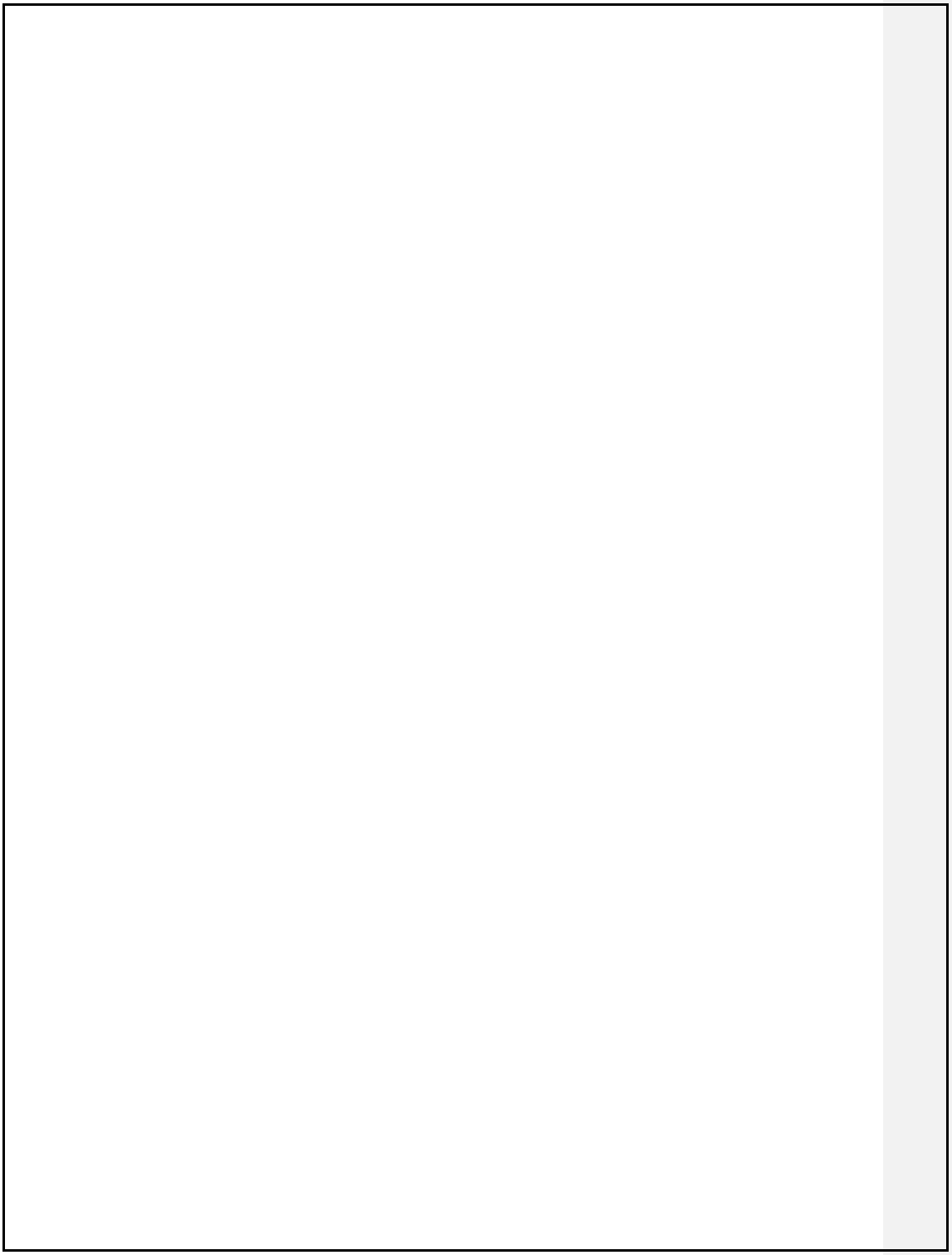


C) Validating completeness.
Description: Once the set has some expressions, the user must validate that the set is complete, this means that have all the attributes of every relation are distributed in one or more algebraic expressions, this is made by pressing the "Validar Completitud" button.

F) Specifying the Site
Description: Once the system has validated the completeness of the set, we must specify the site in which will be stored those algebraic expressions. Note: Only certain types of combinations can be saved in a specific site, this is because we have too many combinations that will result inefficient store dozens of tables, therefore we only save those expressions that match our business model.

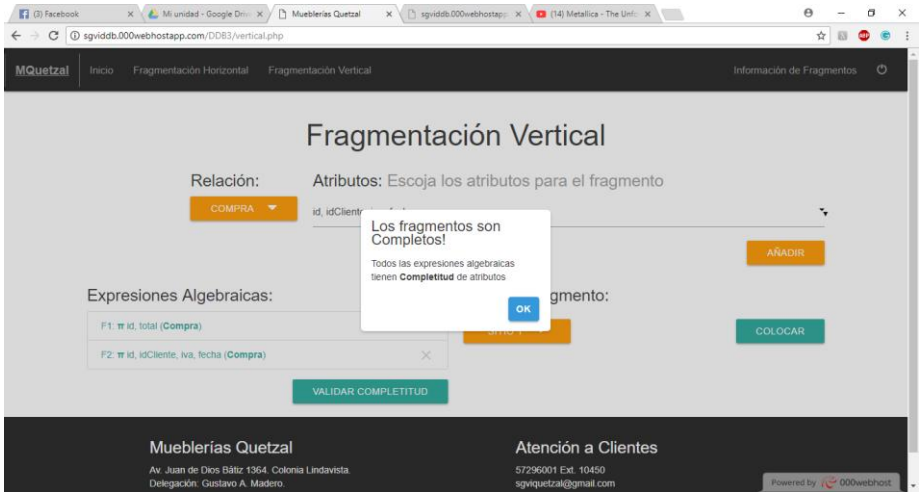
3.1.1 Successful Fragmentation

Description: The user has pressed the "Colocar" button and has made all the previous steps correctly, the system will notify to the user that the colocation was successful.



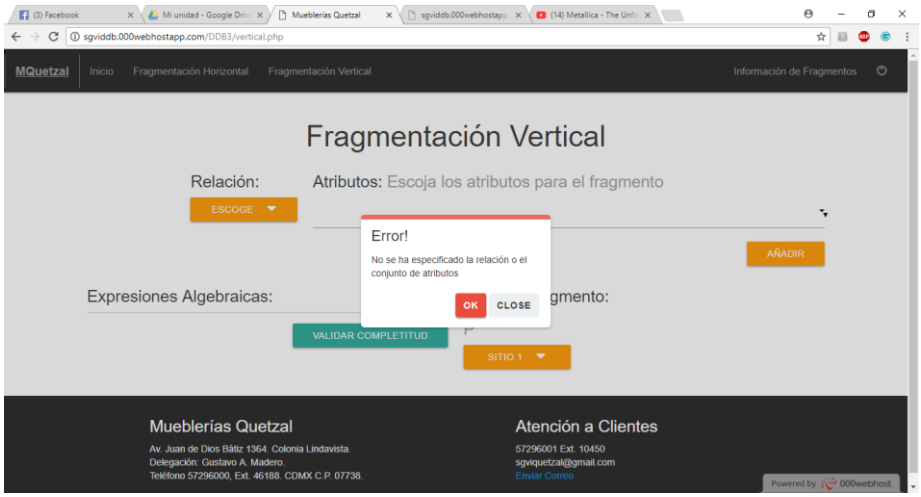
3.1.2 Valid Completeness

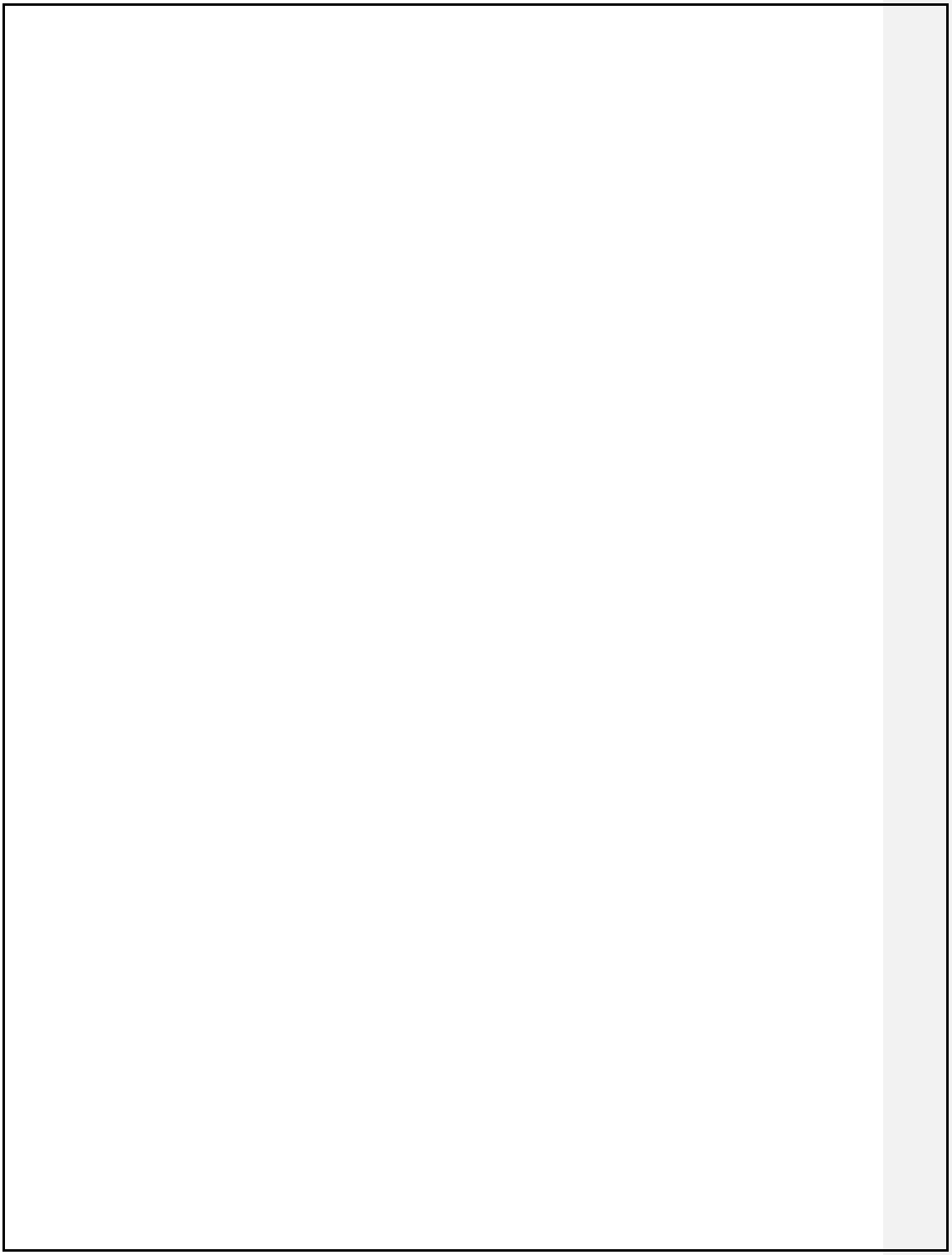
Description: The user has pressed the "Validar Completitud" button and has made all the previous steps correctly, then the system will notify to the user that the fragments are complete.



3.1.3 Unknown Relation

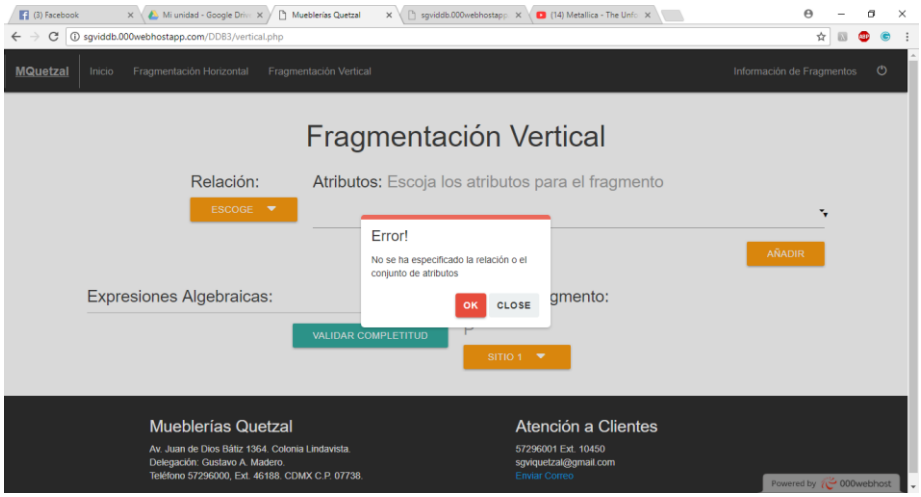
Description: The user has press the "Validar Completitud" button, but the relation has not been selected or it is not founded.





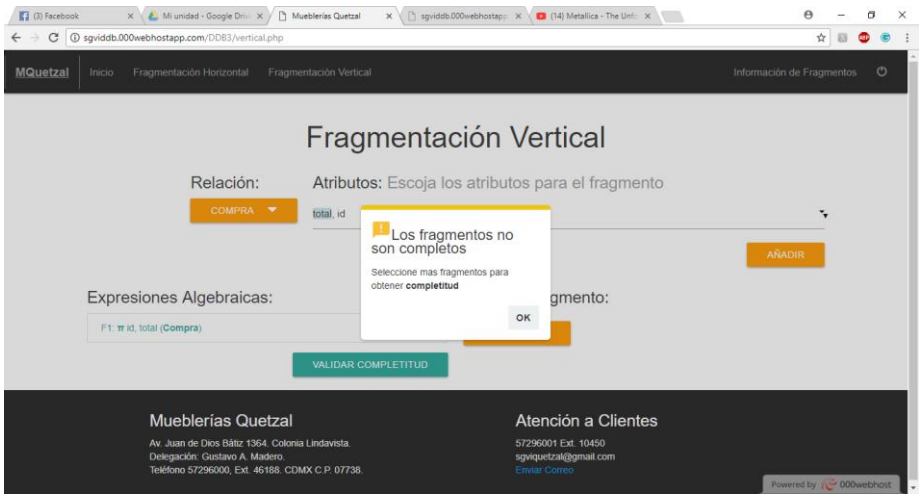
3.1.4 Unknown Attribute

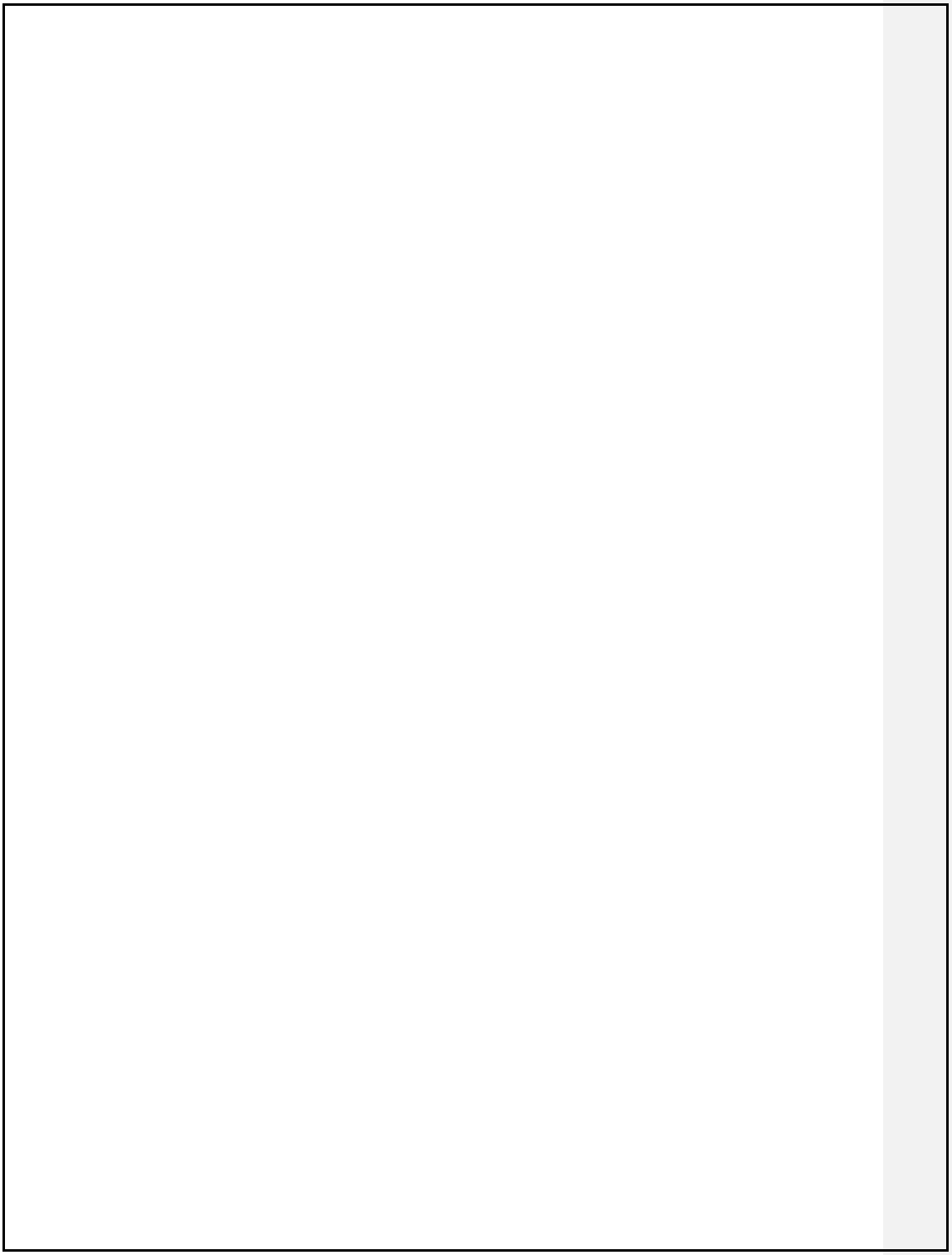
Description: The user has press the “Validar Completitud” button, but the attribute has not been selected or it is no founded.



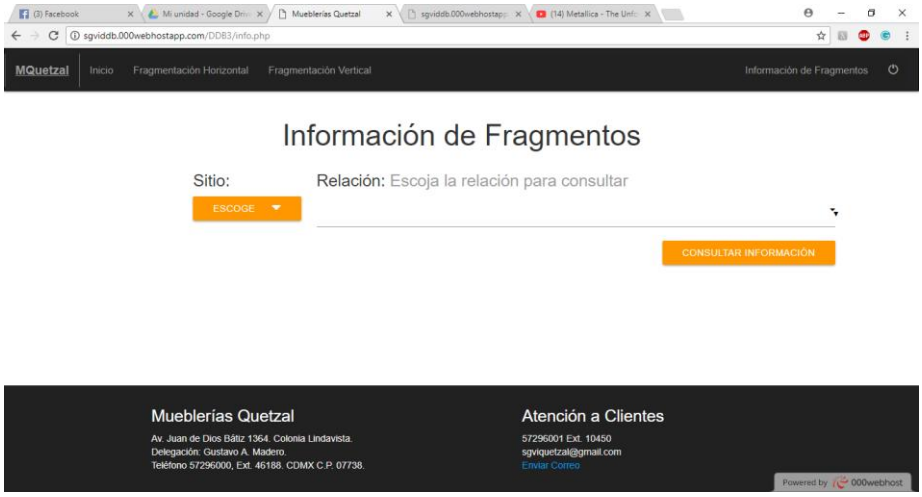
3.1.5 Invalid Completeness

Description: The user has pressed the “Validar Completitud” button, but the algebraic expressions it is not complete.



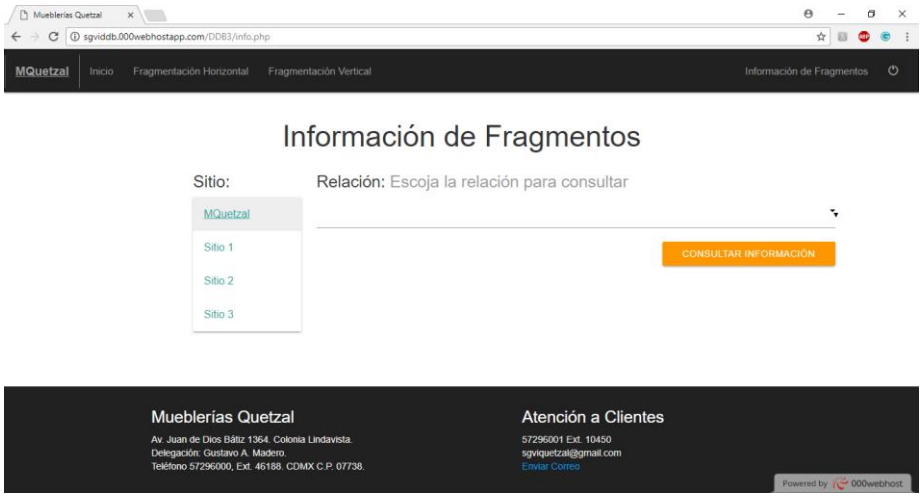


4 Fragments Information Screen

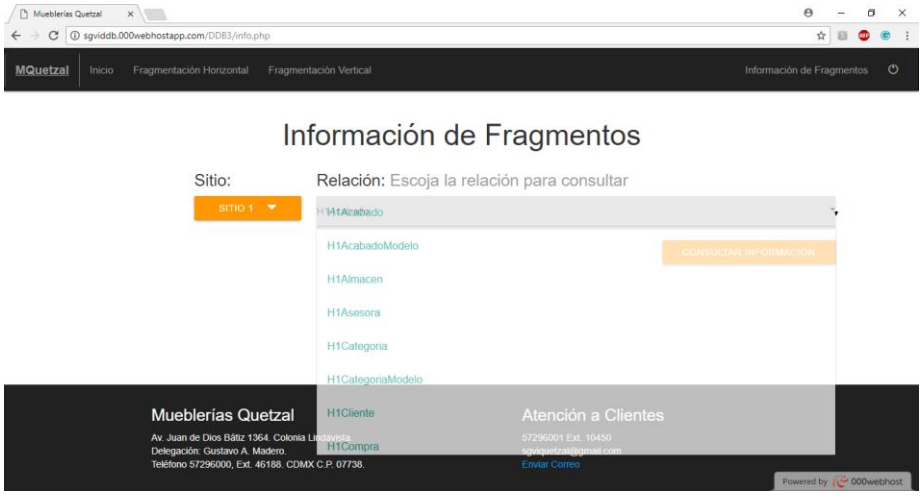


3.2 Consult Fragments Information Process

A) Choosing a site.
Description: When the user does click in the "site" button, a list of all sites available will be display, the user must select one, by clicking in one of them



B) Choosing a relation
Description: Once the user has selected one sites available, a list of relations that are stored in that site will be displayed, then the user will have to choose one of those relations, by clicking in one of them.



C) Displaying information
Description: All the tuples that are allocated in that relation will be displayed in table.