

# Comparison Factors between Relational and Non-Relational Database Models in the Design and Implementation of a Judicial Administration System for Statistics

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**Abstract:** *The definition of the database model to be implemented in technological systems today is a big problem for all companies, since databases integrate a fundamental role in the development of applications and computer systems. These define the form of storage and management of the information generated in organizations, which can be structured and unstructured, capable of being represented in different ways according to the chosen database model. Such is the case of relational and non-relational database models. Today the relational model is the most used for the development of computer systems and by managers due to the standardization of queries, however, non-relational models are currently the main tool in the development of BigData applications due to their characteristics. security, storage capacity and processing of large volumes of data. This publication shows the result of a comparative analysis between the Relational and Non-Relational Database Models for your choice as a management system in an information system.*

**Keywords:** SQL, NoSQL, Architecture, Development, Management

## 1. Introduction

Determine the selection of a database model for information management, today is of great relevance for the development of computer systems, since the database model determines the logical structure of the data and fundamentally the way to store, organize and represent data. This selection implies an analysis of the aspects that determine the model to be used, considering evaluation criteria such as architecture, development and management mechanisms.

Relational databases (SQL) are currently the main support for computer systems, since they work between related tables using primary keys and foreign keys that guarantee the integrity of the information.

Since the increase in data has been notable, non-relational databases (NoSQL) are the fundamental tool for the development of Big Data systems and applications, as they provide better information storage capacity with cloud technology than which can be represented in different ways. as key value databases, documentaries, graphics and memory.

Having said this, it is intended to carry out a comparative analysis in the design and implementation process in terms of architecture, development and administration mechanisms of a database, taking as a case study a system of administration of statistics in judicial matters that aims to administer 172 legal variables to subsequently generate statistical reports.

## 2. Methodology

The proposed methodology for the technological research process, in the design and implementation of the relational (SQL) and non-relational (NoSQL) databases for said system, is divided into aspects considered fundamental to enrich the content of this work. The activities are described below.

- 1) **Observation:** For the development of this research, this stage was of great relevance, since previous knowledge and experiences acquired in the management of computer systems and technological applications intervene.
- 2) **Determination of the problem:** In this stage we studied what is happening and how it is happening to establish a specific problem and to be able to provide a feasible solution to it.
- 3) **Documentation:** A detailed analysis of research related to the topic of this work was carried out to support it.
- 4) **Reflection:** Based on the documentation, at this stage a series of concepts related to the theme of this work were formulated to strengthen the content of this research.
- 5) **Project preparation:** In this stage, describe the development process for the comparative analysis between the relational and non-relational database models in the design and implementation of a statistics administration system in judicial matters.

This allowed a comparative analysis to be carried out in the development process that identifies the advantages and disadvantages of both database models in terms of their architecture, development and administration mechanisms.

## 3. Architecture

### 3.1 Topology

Database modeling was developed in MySQL managers for structured data and as a MongoDB case study for unstructured data.

Figure 1 shows the representation of the relational database (SQL) implemented in the judicial administration system of statistics, which is made up of tables that relate to each other such as users, types of users, districts, subjects, trials, courts, files, variables, variable values and their different capture modules.

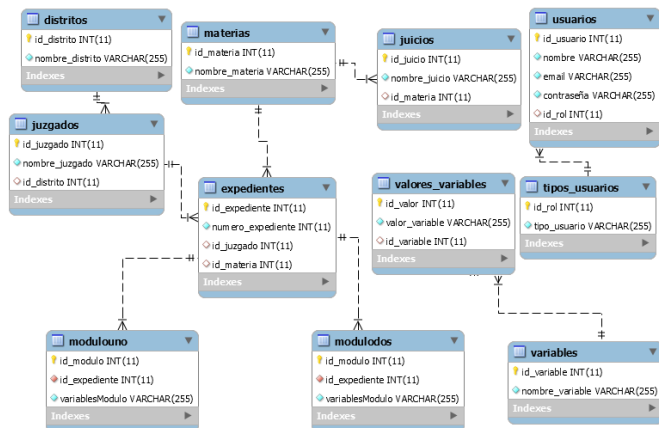


Figure 1: Esquivel, M.K. (2020). Image. Representation of the SQL database model

Figure 2 presents a representation proposal for the documentary-type database model (NoSQL) focused under the same requirements analysis, showing 4 collections of the 9 that make up the database.

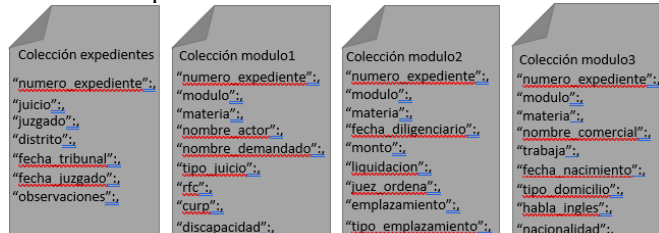


Figure 2: Esquivel, M.K. (2020). Image. Representation of the NoSQL database model

### 3.2 Scalability

Scalability was measured through the storage capacity of the records offered by each of the database models without compromising their operation.

Figure 3 shows the variable values module for the relational database model (SQL), where an example of scalability is described, since within the system there are variable records such as data of the parts and their initial values that they are actor and defendant.

Formulario Valores-Variables

Catalogos

Escribe un valor para el catalogo

Guardar

Nombre - Catalogo	Valor -Catalogo	Fecha - Registro	Actualizar	Eliminar
DatosPartes	Actor	2020-02-13 16:29:27	Actualizar	Eliminar
DatosPartes	Demandado	2020-05-04 15:43:21	Actualizar	Eliminar
Persona	Moral	2020-02-13 16:29:32	Actualizar	Eliminar

Figure 3: Esquivel, M.K. (2020). Image. Scalability results in the SQL relational database model

The non-relational database model (NoSQL) also turns out to be scalable since adding a new attribute with a new value within a collection does not compromise its operation. Figure 4 presents the scalability where initially the collection called Modulo1 has four attributes that are id, name, age and sex, when performing a new insert with a new attribute named curp it does not show any error.

```

db.Modulo1.insert({nombre: "Denisse", edad: "22", sexo: "Femenino"});
writeResult({ "nInserted": 1 })
> db.Modulo1.find().pretty();
{
  "_id" : ObjectId("5eb03b6ef9c63b61d6b30c84"),
  "nombre" : "Denisse",
  "edad" : "22",
  "sexo" : "Femenino"
}
db.Modulo1.insert({nombre: "Denisse", edad: "22", sexo: "Femenino", Curp: "DE553ADR33SDM"});
writeResult({ "nInserted": 1 })
> db.Modulo1.find().pretty();
{
  "_id" : ObjectId("5eb03b6ef9c63b61d6b30c84"),
  "nombre" : "Denisse",
  "edad" : "22",
  "sexo" : "Femenino"
}
{
  "_id" : ObjectId("5eb03ba8f9c63b61d6b30c85"),
  "nombre" : "Denisse",
  "edad" : "22",
  "sexo" : "Femenino",
  "Curp" : "DE553ADR33SDM"
}
    
```

Figure 4: Esquivel, M.K. (2020). Image. Scalability results in the NoSQL relational database model

## 4. Development

### 4.1 Integration

By integrating the relational (SQL) and non-relational (NoSQL) database models in the judicial statistics administration system, to link distributed computing solutions and to be able to track the capture of the different variables that make up a legal file. The integration of these database models was coded under the Laravel framework. Figure 5 shows the configuration that was made in the connection string to integrate the MySQL relational database manager, here the connectivity elements are configured: server name, database name, password and port.

```

'mysql' => [
  'driver' => 'mysql',
  'host' => env('DB_HOST', '127.0.0.1'),
  'port' => env('DB_PORT', '3306'),
  'database' => env('DB_DATABASE', 'forge'),
  'username' => env('DB_USERNAME', 'forge'),
  'password' => env('DB_PASSWORD', ''),
  'unix_socket' => env('DB_SOCKET', ''),
  'charset' => 'utf8mb4',
  'collation' => 'utf8mb4_unicode_ci',
  'prefix' => '',
  'prefix_indexes' => true,
  'strict' => true,
  'engine' => null,
  'options' => array_filter([
    PDO::MYSQL_ATTR_SSL_CA => env('MYSQL_ATTR_SSL_CA'),
  ]),
],
    
```

Figure 5: Esquivel, M.K. (2020). Image. MySQL connection string with Laravel

Figure 6 presents the connection configuration with the non-relational database model (NoSQL) under the MongoDB manager, where fewer parameters are configured such as the type of database manager, the name of the server, the port, database name, user, and passwords to ensure the same connectivity as the model (SQL).

```
'mongodb' => [
  'driver' => 'mongodb',
  'host' => env('DB_HOST', 'localhost'),
  'port' => env('DB_PORT', 27017),
  'database' => env('DB_DATABASE'),
  'username' => env('DB_USERNAME'),
  'password' => env('DB_PASSWORD'),
  'options' => [
    'database' => 'admin'
  ]
],
```

Figure 6: Esquivel, M.K. (2020). Image. MongoDB connection string with Laravel

## 5. Administration

### 5.1 Query language

The queries were executed by performing CRUD operations in the judicial statistics administration system, implementing both the relational (NoSQL) and non-relational (NoSQL) models.

Figure 7 shows the insertion of data in the dossier table with the **INSERT INTO** command and its properties under the MySQL manager.

```
INSERT INTO `expedientes` (`id_expediente`, `id_materia`, `id_juzgado`, `numero_expediente`,
`nombre_actor`, `nombre_demandado`, `fecha_en_tribunal`, `fecha_en_juzgado`, `id_juicio`,
`tipo_accion`, `user_id`, `created_at`, `updated_at`) VALUES (NULL, '2', '3', '100/89', 'Tania',
'Larissa', '2020-06-02', '2020-06-02', '2', 'accioni', '1', NULL, NULL);
```

Figure 7.- Esquivel, M.K. (2020). Image. SQL data insertion

As shown in Figure 8, the encoding used to insert data into the collection of files, where values are added to the fields defined as the file number, actor name, court date and court date, and the type can also be observed. of data to store.

```
db.expedientes.insert(
{
  "_id": {
    "$oid": "5ee8acef51221d0a14c20781"
  },
  "numere_expediente": {
    "$numberInt": "500"
  },
  "nombre_actor": "Denisse",
  "nombre_demandado": "Klissman",
  "fecha_tribunal": {
    "$date": {
      "$numberLong": "791445600000"
    }
  },
  "fecha_juzgado": {
    "$date": {
      "$numberLong": "793519200000"
    }
  }
}
```

Figure 8: Esquivel, M.K. (2020). Image. NoSQL data insertion.

The query of the files stored within the database encoded under the MySQL manager is shown in Figure 9, where

different attributes such as the file number, name of the actor, name of the defendant and the dates of entry of the file to the court and court.

```
SELECT numero_expediente, nombre_actor, nombre_demandado, fecha_en_tribunal, fecha_en_juzgado FROM expedientes
```

numero_expediente	nombre_actor	nombre_demandado	fecha_en_tribunal	fecha_en_juzgado
100/20	Klissman	Denise	1995-01-01	1995-02-01
100/95	Yadira	Tatiana	2020-02-07	2020-02-06
100/21	Carlos	Josefina	2020-02-15	2020-02-20
200/23	Perla	Larissa	2020-02-22	2020-02-21

Figure 9: Esquivel, M.K. (2020). Image. SQL query language

As can be seen in figure 10, a JSON type query of the files collection is presented, you can see the **find()** command that serves to obtain the data in general and the **pretty()** command that returns a more ordered query in JSON format.

```
> db.expedientes.find().pretty()
{
  "_id" : ObjectId("5ed841c9978f224c08bd99ce"),
  "numero_expediente" : 100,
  "nombre_actor" : "Klissman",
  "nombre_demandado" : "Denisse",
  "fecha_tribunal" : ISODate("1995-01-01T06:00:00Z"),
  "fecha_juzgado" : ISODate("1995-02-01T06:00:00Z")
}
```

Figure 10: Esquivel, M.K. (2020). Image. SQL query language

## 6. Results

During the development of this research, positive results were obtained from the comparative analysis in the design and implementation of the relational and non-relational database models for a statistics administration system in judicial matters in terms of its architecture, development and administration, which are summarized in the next table.

Table 1: Esquivel, M.K. (2020). Table. Expected results based on comparison criteria

Criterion	SQL	NoSQL
Topology	Relational model	Documentary model.
Scalability	New values can be added without compromising the performance of the database, resulting in vertical scalability by increasing storage capacity on the hard disk	Good performance is shown when adding new values within collections, obtaining horizontal scalability that makes it possible to increase system performance by implementing more nodes.
Integration	It occurs when integrating the relational model in the system under connection strings with the <b>MySQL</b> manager.	It is shown by integrating the non-relational model in the system under specific connection strings with the <b>MongoDB</b> document-oriented manager.
Query language	SQL statements under the relational schema such as <b>create, select, update, delete.</b>	Documentary model-oriented NoSQL statements: <b>createcollection, db.collection.find, db.collection.update, db.collection.deleteOne .</b>

## 7. Conclusions

The relational database model offers different essential features for working with statistical administration systems in judicial matters, but it faces a problem in terms of space

limitations as the volumes of information increase day by day and more is needed. Storage capacity however, the non-relational database model is also adapted to this type of technological system. In this case, applying a NoSQL model, the system can become a BigData application and take advantage of the possibility of working with nodes and technology in the cloud.

In conclusion, implementing a relational database (SQL) model in a judicial statistics administration system is feasible as long as a defined structure is maintained, since the growth of the information in this model is represented through records vertically, however, when working with large volumes of data the non-relational database model (NoSQL) adapts in the same way to this type of technological system that works with Big Data applications, which allows scalability to be expanded of the database horizontally.

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## Author Profile



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