Business process reengineering in UAE public sector
A naturalization and residency case study

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Abstract
Purpose – This paper seeks to reengineer the applications’ processes of the Naturalization and Residency Department in Al Ain city and to develop an electronic version of the reengineered processes.

Design/methodology/approach – The research approach used in this work is similar to the five-point redesign process. Also, this work is categorized as incremental as opposed to the radical way of change. The five steps are: establishment of the business vision and objectives; identification and focus on the core business processes that support them; modeling and analysis of the business environment; streamlining; and continuous control and improvement of the previous steps.

Findings – It is believed that the best possible solution for shorter and more efficient processing paths was achieved. Great savings in cost, time and human resources were achieved. Many factors have contributed to the success of the work. These include the efficient reengineered process, efficient database design, search facilities, electronic document archive and easy-to-use user interface.

Practical implications – There were some critical factors that had to be considered. Perhaps, one of the most serious obstacles was the reluctance of some key decision makers to cease or reduce some of their authorities. Those officers believe that a direct supervision or control on the different stages of the processes is essential. Special considerations may be required under certain circumstances and these are only dealt with by key decision makers. The absolute minimum of two approval points model has helped to eliminate those legitimate concerns. Other factors such as reluctance of the users to accept change, job redundancy resulting from the change and financial resources were important but less significant.

Originality/value – The paper is a case study that describes the reengineering processes in the public sector in UAE. This sector suffers from a great deficiency and this work represents a leading step towards improving its working practices. The value of the paper lies in the comprehensive study and analysis of this department and the efficient customized solutions it offered.

Keywords Business process re-engineering, Modelling, United Arab Emirates, Public sector organizations

Paper type Case study

Introduction
Business process reengineering has assumed a relevant role in most private and public organizations to improve existing information systems and software applications (Castano et al., 1999). Current organizations need a continuous and dynamic...
reorganization of their processes to allow them to be more efficient. The principal aim of business process reengineering (BPR) is to design techniques to allow simulate and check different sets of processes that could improve its own organization (Alera et al., 2002). In the past few years BPR has had a major impact on business management policies too. The opportunity that it offers to redefine an organization at a very fundamental level has had enormous impact. BPR means not only change – but also dramatic change. What constitutes dramatic change is the overhaul of organizational structures, management systems, employee responsibilities and performance measurements, incentive systems, skills developments, and the use of information technology. BPR, can potentially impact every aspect of how we conduct business today. Change on this scale can cause results ranging from enviable success to complete failure. Successful BPR can result in enormous reduction in cost or cycle time (Covert, 1997). It can also potentially create substantial improvement in quality, customer service, or other business objectives. The promise of BPR is not empty – it can actually produce revolutionary improvements for business operations. Reengineering can help aggressive company to stay on top, or transform an organization on the verge of bankruptcy into an effective competitor. The success has spawned an international interest, and major reengineering efforts are now being conducted around the word.

Hammer and Champy (1993) defined BPR as:

Business Process Reengineering is the fundamental rethinking and radical redesign of business process to achieve dramatic improvement in critical contemporary measures of performance such as cost, quality, service and speed.

They in fact did come up with seven “Principles” of reengineering: organize around results, not tasks, have those who use the output of the process perform the process, subsume information – processing work into the real work that produces the information, treat geographically dispersed resources as though they were centralized, link parallel activities instead of integrating their results, put the decision point where the work is performed and build control into the process, and finally capture information once and at the source.

Organizations react very differently to projects or attempts to renovation of business processes, though the purpose is clear: reduction of costs, shortening the business cycle, and improvement of quality of products and/or services (Kovačič 2000). The difficulties in the public sector are larger than those in the private sector. With increased practices of bureaucracies, the problems of efficiency are then most often solved through purchasing computer hardware and software. Moreover, if the top management of an organization feels it is successful at present time, they usually reject the idea of renovating business.

The important question that can be raised here is what to reengineer? According to many in the field, reengineering should focus on the processes and not be limited to thinking about the organizations. After all, the organization is only as effective as its processes (Hunt, 1996). So, what is a process?:

A business process is a series of steps designed to produce a product or a service. It includes all the activities that deliver particular results for a given customer external or internal (Mayer and de-Witte, 1998).
Processes may be invisible and unnamed because people think about the individual departments more often than with the process with which all of them are involved. So organizations that are currently used to talking in terms of departments must switch to giving names to the processes they do such as the beginning and the end states. These names should imply all the work that gets done between the start and finish (Hammer and Champy, 1993).

A single business process could be described by three basic elements: forms, application-specific business rules, and work flow (Jahnke, 1994). Forms are needed to collect or to provide data relevant to the application or business domain. Application or domain specific business rules reflect certain functional logic which adheres to a particular business domain. Workflow, on the other hand, is a technology whereby business process automation is successfully accomplished by means of an assembly of rules imposed by it. This process involves activities that can be performed in series or in parallel by one or more members of a work party for the purposes of accomplishing a common goal. Processes are monitored and coordinated through the automatic routing of documents to the user responsible for working with them (Pérez and Rojas, 2000). Some of the features in this process include the routing of tasks in different ways and towards different locations within and outside the organization, as well as the representation of the policies, techniques and procedures that aid in the integration of automated and human-performed work activities of the organization. Improved performance is thus achieved due to the permanent availability of information relating to the task being carried out and the integration of islands of information, which used to slow down the task.

To demonstrate the advantages of applying BPR to business we refer to the Prosci’s, 2002 Best Practices in Business Process Reengineering Report. This report is a study in a series conducted over a five-year period. 327 organizations from 53 countries participated in this study. The results of the 2002 study combine the most current findings with those of the past two studies to provide a comprehensive and comparative view of BPR projects (Prosci, 2002).

The goal of the study was to provide real-life lessons from the experiences of project teams recently or currently involved in projects. The comparison over time provides additional relevance and insight into the evolution of BPR methods. Figure 1 shows the breakdown of study participants by geographic location.

Participants represented a broad sampling of industry groups. Product development and manufacturing, finance and banking and consulting were the three largest sectors, accounting for over one-third (37 percent) of participants as shown in Figure 2. Approximately, 56 percent of participants were a team leader, a team member or a consultant. Customer service was the most frequently reengineered process while information services came as the second most targeted business process for reengineering.

The need to reduce cost/expense was the most frequently cited business driver for reengineering projects, 65 percent of participants stated that expense reduction was the primary driver. The other three business drivers were competitive pressure, poor customer satisfaction and poor quality of products and services.

Participants cited a number of obstacles during implementation. Resistance to change within the organization was cited six times more often than any other obstacle.
Resistance came in many forms, including organizational inertia, corporate culture, front-line resistance, and management resistance.

In the next section, the research methodologies and techniques that help in implementing this work together with a brief description about the nature of this work are described. The rest of the paper is as follows: a background about the Naturalization and Residency Department and its current business processes. The reengineered processes and the data model are then introduced followed by describing the new system implementation.
Research methodologies and techniques
As the application of BPR concepts can take different forms, methodologies that have been developed are often distinct from each other, as emphasis varies from one BPR project to another (Hesson et al., 2005). Several approaches and methodologies have been introduced by a number of authors (Yu and Wright, 1997; Kettinger et al., 1997; Davenport and Short, 1990; Petrozzo and Stepper, 1994; Klein, 1994; Barrett, 1994; Harrison and Patt, 1993, Guha et al., 1993; Johansson et al., 1993; Furey, 1993).

A methodology is an organized set of methods, techniques, and tools, developed to guide the whole life-cycle of a process to achieve its objectives. Despite the difference among these methodologies, they all confirm that some essential components must exist, such as (Al-Mashari and Zairi, 2000):

- strategies and goals setting;
- feasibility analysis of a BPR project;
- process analysis and visioning;
- top management commitment and sponsorship;
- understanding of customer requirements and performance measurement;
- integration with total quality management (TQM) and benchmarking;
- recognition of IT capabilities;
- cross-functional teams and communication;
- prototyping and process mapping techniques; and
- organizational change to reengineer management systems and organization.

Methodologies can be classified into two main categories depending on the perspective they take in BPR: the management accounting and the information system development categories (Valiris and Glykas, 1999). In the management accounting perspective the analysts attempt to reorganize business processes and use IT as an enabler in their effort. In the information system (IS) development perspective IS developers need to understand and possibly reorganize business processes so that the introduction of IT has the highest possible impact on them. More recently some methodologies that view BPR from an organizational theoretic perspective have started emerging. These concentrate more on the understanding and analysis of the organization based on principles like accountabilities and the roles of individuals that take part in business processes.

Selecting an appropriate method is not an easy task; however a general procedure for evaluating and selecting BPM methods includes the following steps (Luo and Tung, 1999):

1. identification of modelling objectives;
2. identification of required perspectives and desired characteristics;
3. identification of alternative BPM methods;
4. evaluation of methods based on required perspectives and characteristics; and
5. selection of the appropriate method(s).

Fortunately, if one would try to find a redesign process that satisfies most of the existing BPR methodologies the result would be as follows (Valiris and Glykas, 1999):
Redesign can be achieved in two modes: incremental and radical (Valiris and Glykas, 1999). The incremental approach aims at improving what already exists in the organization usually by eliminating non value added activities in order to achieve lower throughput times and best re-allocation of resources. In radical change, redesign will challenge the existing organizational framework and might request the introduction of new technology regardless of the impact this might have on the personnel’s behaviors and attitudes.

In the literature, there has been some confusion regarding the use of terms like re-engineering, process improvement and redesign. In the context of this paper, re-engineering is synonymous to both radical change and process improvement to incremental change. Both re-engineering and process improvement are included in the definition of redesign.

A number of case studies including e-government were investigated (McAdam and Corrigan, 2001; Gupta and Rohe, 1997; Silvestro and Westley, 2002; Mohanty and Deshmukh, 2001; Burn and Robins, 2003; Hill and Collins, 2000). Of specific interest is the paper written by Gunasekaran et al., 2000). This neatly written paper presents two case-studies for two British companies which we believe is presenting a good example for similar work.

In our work, we adopted an approach that is more or less similar to that described above in terms of the five-point redesign process and the work of (Gunasekaran et al., 2000). The work described in this paper is an example of BPR case study in the UAE public sector. As the work is a significant improvement to an already existing system, it is therefore considered as an incremental approach reengineering process.

**A UAE naturalization and residency case study**

**Background**

This work was done for the benefit of the Department of Naturalization and Residency in Al-Ain city, UAE. The Department of Naturalization and Residency, was established in 1971 and is divided into the following sections:

- Naturalization and passports section.
- Entry permits section.
- Residency section.
- Investigation and control section.
- Administration and finance section.
- Information technology section.

Each of these sections has specific duties. The Naturalization and passports section handles all transactions for nationals, such as the issuing of family books, passports and other relevant documents.
The Entry permits section issues visas of various types, including those of residence, visit, employment and housemaids.

The Investigation and control section is concerned with public transactions such as status change, determining people on overstay and closing of records.

The Administration and finance section manages human and financial resources and is also concerned with the issue of establishment cards for private companies and representatives of other organizations, and other relevant financial transactions for these services.

The Information technology section is responsible for the development of the computer applications that are required for the department’s activities. Section personnel also update programs in use by the department, to meet the latest developments in the IT field. In addition, the IT staff are responsible for the supply of software and hardware to other sections.

Applications process
To understand the complication of the current department processes, we need to know how the applications are processed. The department normally deals with 26 different types of applications (or forms). Each application requires a number of attached documents to process such as a copy of birth certificate, passport, residency permit, etc. There are a total of 67 different types of documents required by the different applications. Obviously none of these applications requires all types of documents, but rather each application requires a subset of these documents, some require more and some require less. Same documents may be required by different types of applications, and this is a factor of further complication. Table AI (Appendix 1) lists all these applications and the required documents for each.

The author and his research assistants have carefully observed and analyzed the processing of samples of the applications that the department deals with. They were also given the access to view a large number of archived folders for past processing of different applications. In order to explore the complexity of the current processes, the research team concentrated on a few samples that were considered very complicated. Complication here is a measure of the number of duplications in required documents for a single person or body who applied for similar and/or different applications through a period of at least five years. Complication is also a measure of alterations or modifications on same documents in different files of the same folder. It may not be convenient here to fully explain how the current system is working, instead let us consider an example. If one attempts to apply for a visit visa for resident’s employee of a government sector, he/she needs to provide copies of nine different documents including copies of the passports of the visitor and the sponsor. These documents are put in a file within a folder. If later the same applicant applies for a new visa of the same type he/she must provide fresh copies of the same documents.

If, however, the same applicant applies for resident visa for the family of the employee, he/she needs to provide copies of eight documents, some of them are the same as the previous one. Each application will be put into a new file that will be added to the same folder. Each file will have a name that is relevant to the type of application and is considered as an independent entity. This process may be repeated for other types of applications shown in Table AI and more files will pile up in the folder with time. One of the reasons that no attempt made to check for documents duplications is
that applications are processed in one department (the counter) while the archive is another one that is physically distant. When one applies for the first time, he/she will be given a unique reference number. This number is used for subsequent applications.

Once a file is created, i.e. an application is requested, the file is physically moved to a series of processing points. At each processing point, the application is subjected to a certain action. The number of processing points differs from one application to another and hence there is no single processing model can represent all applications. However, Figure 3 may represent a generic processing path.

At the counter, a file and/or a folder is open, an application is filled and documents are attached. No check or processing is done at this stage. Next, the application is moved to another department where the application is checked for completeness and documents are checked for authentication. Depending on its type, the application will pass through at different number of processing points. At each point the application is examined by different level of authorized personnel. It is then either approved and delegated to the next level or it is sent back to the previous level for further examination. It may also be rejected at any point and this clearly shown from the feedback paths of Figure 3. As the applications are physically moved between different processing points, i.e. by hand, and also because there is no defined time limit for an

Figure 3.
The generic processing path
application to remain at any processing point, the research team could not come up with a uniform range of time frame for the completion of each application. Therefore, the team noticed that the time required to process the same type of application may range from a couple of days to a few weeks. There are many reasons for that time difference such as lack or invalidity of some of the required documents. It may also depend on the number of applications arrive at a particular processing unit at one time and the availability and productivity of authorized personnel. Therefore, we can easily say that inefficiency and inconsistency are the main two features of the current system.

Process reengineering

The existing system was thoroughly examined and the core business processes were identified. Several meetings with the management and technical staff of the Naturalization Department were held in order to seek their vision, objectives and requirements of the new system. As a result, it has been agreed upon some wide guidelines for the new system requirements. These include the following:

1. A document that is needed by more than one application may not be duplicated.
2. Each applicant will have a folder. The folder is given a unique number which is the same as the NUN number of the applicant. If the folder is not existent, i.e. the applicant is new, the folder is created. The folder will contain files, with no more than one file for each type of applications. Each file is given a name that is the same as the application number. Therefore, the combination of the folder and file names will be unique throughout the whole system.
3. Images of documents are stored in the database under the folder name not the file name. A file may not contain copies of documents’ images but rather references to those images in the database.
4. A document is expired after five years of first use.
5. Expired documents are moved from the main database and stored in an auxiliary storage for five more years for possible future reference.
6. A document may be considered expired even before the five years period if:
   - the original has expired or became invalid for any reason; or
   - a change or addition has been made on the original.
7. A change occurs on any document must be reflected on all applications that require the same document.
8. An application must not pass through more than two processing points of approval type.
9. The new system should be fully electronic.

Based on these guidelines we could draw up the new processing path as shown in Figure 4. This path significantly reduces the number of steps required to process an application and fix it to only four in all cases. A number of redundant processing points were removed. Perhaps, one of the most important one is the removal of the archiving department from the path. Archiving of the applications, the images of required documents and all actions taken upon the application is being done implicitly at each of the four stages of the processing path. In this model, more emphases were given to the
first stage, i.e. the counter. Consequently, adequately authorized and well-trained personnel have to run the counter. As will be seen in the next section, most of the work is done at the counter. Filling the application, checking the completeness and the validity of the required documents are done here. Also at this stage, the creation and maintenance of folders and files are performed. The number of the approval processing points is kept to the absolute minimum of two. The reason for this absolute minimum is that approvals of issues, some of them are related to national security must not be left to only one authorized body. Issuing department is the place where the final action on the application is taken such as issuing a passport, a visa, residency permit, etc.

Feedback paths are maintained between the four stages as these may be required at particular stages. For example, the initial approval personnel may ask the counter for extra documents or may ask to see the originals. Final approval personnel may ask clarification or more details about a specific action taken by initial approval personnel. Final approval authorized personnel also have to sign the final documents prepared by the issuing department and so forth. Finally, all actions taken at all the four stages are fully transparent to the final approval personnel. These actions are less transparent and with different levels of transparency at the remaining three stages.

**Data modeling**

Based on the system requirements, the main entities of the data model were identified. These entities are listed below:

- **Department.** It means the department where application should go for processing.
- **Application.** Application entity will contain information about the different types of applications.
- **Applicant.** It is the person who owns the application.
- **Applicant applications.** These are the total number of the applications owned by a single applicant.
- **Reference.** Contains documents codes which are needed for each application.
More details about these entities are given in Appendix 2.

The conceptual data model is shown in Figure 5 while the physical data model is shown in Appendix 3.

**Implementation**

In implementing the system, we had to observe all the requirements stated in the process reengineering section. Another important issue we had to consider in implementing systems like this is the efficiency of the database management system. Since, all documents are stored as images and these consume a considerable amount of memory, it was clear from the beginning that efficient use of storage is a key factor to improve performance in this type of applications. The system is based on the four-stage processing path described in the previous section. Different levels of accessibility and privileges of actions are assigned to each stage. The authorized personnel at the final approval level (stage 3) are given the unrestricted access to the system. Those personnel will have the privilege to endorse or overrule actions taken by

![Diagram showing the conceptual data model](image)

Figure 5. The conceptual data model
the personnel of initial approval stage (stage 2). They also have the rights to approve or reject applications, or to request further details. The authorized personnel at the initial approval have similar access rights but with less privileges in taking actions. They can see all the documents, progress of an application processing and the actions taken by others. However, they cannot object or overrule actions taken by final approval personnel.

The system is designed for ease of use. The authorized user can move between different screens in any order, can see any information, manipulate documents and then take any action. This is clearly shown in the operation flow diagram of Figure 6. To explore this design further, we will follow the procedure of an applicant who applies for different types of applications over a period of time. But, before we do that we need to re-emphasize that the job of the counter personnel is a major one in this design. This is not in terms of the authorities and privileges given to those personnel but rather in terms of the amount and importance of work done at this stage.

**Figure 6.**
The operation flow diagram
When an applicant applies for any application, his/her National Unified Number (NUN) is used to access his personal folder in the database. If a similar application has been filed before, i.e. the required documents are already available in the database; a check is made only on the validity of these documents. Otherwise, if the application is new, a search will be made based on the reference number whether the required documents, or a subset of them, are used by other applications of the same person and hence are available in the system database. If a required document is already there and it is still valid, a new scan will no longer be required. This check is made for all other required documents. At the end of this process a new file will be created which contains the application and all its attached documents. It is important to emphasize here that these files do not actually contain duplicate copies of the same document but rather references to the only copy of it in the database.

On the other hand, if the applicant is applying for the first time, a new folder will be open and is given a name that is the same as the applicant NUN. A new file will also be created and is given the name that is the same as the application number. Whether the applicant is new or not, all required new documents will be checked for validity, scanned and stored in the database under the folder name. This does not imply that this new document is tied to this specific application but rather is stored as one of the available documents of the applicant. This means, that documents are not tied to applications but are rather tied to the applicants to the same degree as the applications are tied to the applicants. This process is diagrammatically explained in the counter processing flowchart of Figure 7.

One immediate and important implication of using this system is that the huge and highly inefficient archiving department will disappear.

**Conclusion**

Reengineering is the key that every organization should possess to achieve reliable, efficient and cost effective operations (Parys and Thijs, 2003). It has been considered as an important way to reshape business organizations for achieving breakthrough improvements in performance (Wu, 2002).

In process reengineering, as in so many human endeavors, real success is dependent on implementation (Clegg, 2000). In this paper, we have presented the work we did to reengineer and automate the applications process and electronic document archiving in Al-Ain Naturalization Department.

In the old system, the work used to be done in separate departments. Applicants had to present their original documents every time they fill in a form for a specific application even if valid copies exist in their folders. Once these are checked for authenticity, copies are taken and a new file is created. The application is then processed and it ends up in the archive department. That was quite inefficient and time-consuming process, beside no attempts were usually made to check for duplicate documents. The reason is that the counter and the archive departments were physically distant and any attempt to check for duplicates would not improve the process but rather makes it worse. The obvious result of the old process was that files used to pile up in the archiving department with large number of duplicate documents. Different applications used to take different processing paths and hence some needed longer time to process than others. The research team could not identify a uniform processing pattern and the required processing time even for the same type of application.
We noticed that the time required to process the same type of application may range from a couple of days to a few weeks. There are many reasons for that time difference such as:

- lack, or invalidity, of some of the required documents;
- the number of applications arrive at a particular processing unit at one time;

Figure 7. The counter processing flow chart
the long overall processing path and the frequency of feedback paths for different reasons; and

• the availability and productivity of authorized personnel.

In our work, we adopted an approach that is more or less similar to the five-point redesign process described earlier in this. This approach satisfies most of the existing BPR methodologies. This work is an improvement to an already existing system, not a complete replacement and therefore it is characterized as incremental as opposite to radical. The non-uniform long process has been reengineered. The new process is well-defined as a fixed four-stage process. The use of the new system makes it possible that most of the processing work is done at the counter in a smooth and efficient manner. Applicants are not required to present documents that were presented in previous applications as long as they are still valid. Therefore, there will be no more duplication in documents and no duplication in files for the same applications. As a result, an application may take a couple of hours to a few days to process and this depends on the some of the reasons above. This is considered as a remarkable achievement by all means. We believe that, the main benefits of the new system as listed below fully satisfy the objectives set for this work:

• Fully automated process with efficient database utilization.

• No documents duplications. One copy of the same document may be used by different applications as long as it is valid.

• Long-term electronic archiving system that keeps track of documents history.

• Shorter processing path results in substantial reduction in the processing time. This in turns leads to increased processing capacity of the department in terms of the number of applications that are processed in a given time.

• Significant reduction in processing cost in terms of human and financial resources. This is a natural result of the fact that fewer employees are required to process the applications and the less use of other department resources.

• Customer satisfaction. Less time and efforts are required to get their applications done. Besides, applicants are no longer treated as new customers every time they apply for new applications nor they are required to present new personal documents as long as they have presented similar valid ones in the past.

Finally, the work was not problems-free. There were a number of some critical issues had to be dealt with. One of the most serious problems was the reluctance of some key decision makers to cease or reduce some of their authorities. Those officers believe that a direct supervision or control on the different stages of the processes is essential. The justification given is that special considerations may be required under certain circumstances and these are only dealt with by key decision makers. The absolute minimum of two approval points’ model has helped to eliminate those legitimate concerns. Other factors such as reluctance of the users for change, job redundancy resulting from the change and financial resources were important but less significant.

References


Further reading


About the author

Mihyar Hesson is an experienced Engineer in Computer Systems and Software Engineering. He has more than 17 years of post doctorate academic experience in universities of different countries. During this period he taught advanced courses in the field, supervised post graduate students and carried out research work in the domain. He also has intensive industrial experience working in American and Canadian companies. He was involved in projects for major companies like Ford Motors, Nortel Networks, Honda North America and Clarica of Canada. He played a variety of roles such as a consultant, a team lead, a quality control specialist and a project manager. Type of work he was involved in varied from engineering to web-based applications. He is currently working as an Associate Professor and Dean of the College of Information Technology, Al Ain University, UAE. His interests include software design, management of information systems, and real-time and web-based software applications. Mihyar Hesson can be contacted at m.hesson@alainuniversity.ac.ae

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Figure A1.
Applications and their attached documents

(Continued)
Appendix 2. Entities of the adopted data model

1. **Department.** It means the department where application should go for processing. Each department will have two attributes:
   - Department number.
   - Department name.
   Both of them are mandatory.

2. **Application.** Application entity will contain information about the different types of applications. It has three mandatory attributes:
   - Department number.
   - Application code.
   - Application type.

3. **Applicant.** It is the person who owns the application. It has two mandatory attributes:
   - Applicant ID (the NUN of the applicant).
   - Applicant name.

4. **Applicant applications.** These are the total number of the applications owned by a single applicant. This entity has eight attributes:
   - Application code: each application has a unique number (mandatory).
   - Applicant ID: the applicant NUN number (mandatory).
   - Year: year of application (mandatory).
   - Application type: represents the type of the application.
• Reference: references to the documents that must be provided for a specific application (mandatory).
• Date: date of the application (Mandatory).
• Sponsor type: who is the sponsor, is it a person (citizen or resident) or a company (Mandatory).
• Sponsor ID: is the NUN of the sponsor.

(5) Reference. Contains documents codes which are needed for each application:
• Reference: it is the number which points to the same reference in applicant application table.
• Document code 1-20: refers to the needed documents of the application.

(6) Documents. Contains images of the needed documents for the application:
• Document code.
• Document type (mandatory).
• Applicant ID: the NUN of the applicant who owns the document (mandatory).
• Image 1: image of the document (mandatory).
• Image 2: another image if the document that has more pages (optional).
• Image 3: another image if the document that has more pages (optional).
• Image 4: another image if the document that has more pages (optional).
• Image 5: another image if the document that has more pages (optional).
• Scan date: date of scanning the document (mandatory).
• Valid: acts as a flag if the document has expired or not (mandatory).
• Last reference: it is a date points to the last time this document is used/references (mandatory).
Appendix 3

Figure A2. The physical data model.