The SIM card: An exercise of Technology Watch chasing state of the art and new opportunities.

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Abstract

The SIM card has become, thanks to its embedding in Mobile Handsets of GSM and other systems, the permanent companion of the subscriber and the more spread Smart Card of the world. In this work an exercise of Technology Watch has been done on the developments around the SIM Card along with a theoretical and literature review on the TW process.

Technology Watch, and the broad concept of Competitive Intelligence, are introduced from a scholarly point of view and a review of literature on TW from the year 2003 to the present is done. This Theoretical Framework is then put on test with a Case Study about the SIM Card.

Using sources and data at three levels: Research, Development and Innovation and having in mind the corpus of the Technology Watch discipline, an analysis is done finding interesting knowledge, qualitative and quantitative, on the recent past and present development of the SIM card. This information is also used to do some prospect on the subject.

Some of the findings have been to identify the main publications at the research level, the Relevant International Patent Classifications and interesting sources for Market analysis for SIM Development. Moreover, a list of Institutions and Companies working in the subject is provided as well as the 2008 more published topics in the industry. The system and techniques used to do all this process are also described in detail.

This work is a start point in order to construct a system for continuous environmental scanning on SIM card developments as to detect weak signals and early trends to take advantage of them. Thus, it must be considered as a seminal work of a broader approach to Technology Watch in the SIM card business. It may be of interests of scholars, because the broad review on the literature, as well as practitioners, because the practical orientation of the Case Study, and managers of related industries because the information extracted from the data analysed.
Chapter 1

Introduction

“All men by nature desire knowledge.”
– Aristotle. (384 - 322 BC)

Technology transfer and the ways that research becomes innovative products and services is a hot issue at present. In the present work the aim is to do a Case Study on Technology Watch in order to do explicit this process, establish what has been done on this determined area of knowledge and try to figure out which will be the next steps in the development of such area. These steps may help to find out new opportunities and niches to exploit on the Innovation field.

The linear model of technological development (Escorsa and Valls, 2003) states a three layer framework where Research is the base where all the further knowledge stands. Development is the actual process to take this knowledge in a practical field and make direct applications of it as to solve some problem. Finally, Innovation is the way that the developments are applied as to produce brand new products and services that fulfil the expectations, or create new, of the market and thus, become economic value. Although these model has been overtaken by more elaborated models, it is a good starting point for an analysis on this subject.

The goal, then, is to analyse a focused area of technology, Security Identity Module (SIM) cards, and get information at the Research, Development and Innovation layers as to analyse the area from different points of view (Escorsa et al., 1998) (Escorsa et al., 2000). This activity is usually referred to as Technology Watch, although it is not a generalised term. Other ways to refer to it are Technology Screening or Monitoring (from the French Veille Technologique) or Technological Environmental Scanning. It is identified as a component part of the Competitive Intelligence.

These are, then, the theoretical framework this work is be based on. The approach will be further discussed in the section 1.4 and in the chapters 2 and 3 deeper explanations on the matter will be done.

The main topic of study is the SIM card developments and more specifically, development toward the improvements of communications of the SIM card with devices and entities that stand in the external environment of the handset, either using the present interfaces of the card or any other advance that may be used. From inside the Mobile Handset the SIM card acts as a user interface, with the Toolkit applications

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that may be accessed from the Mobile handset menu, and as a Network system that helps in the management of the network and also on its monitoring.
In the present days big developments are done in order to provide the SIM card with more connectivity with the outside world. Recent developments on Near Field Communications (NFC) and on the Universal Serial Bus (USB) interface have increased the actual possibilities for the SIM card to interact with its environment. In the section 1.1 a deeper discussion will be held regarding the technical and technological foundation of the present work.

This work is addressed to a heterogeneous audience. First to the scholar, because the theoretical framework presentation and the literature review that is done represents a brief state of the art. Second to practitioners that may find interesting and helpful the approach of the Case Study. Finally, managers that can support the decision making process with the analysis data of the work.
Those are also the major findings of the work, a state of the art, supported with a deep review of the literature on the topic, a Case Study to test the theoretical framework introduced and finally information about the present trends on SIM developments helpful to do prospect.

1.1 Technical Introduction

In fixed telephony the device to identify and verify a subscriber is quite simple: The wire. If a user has access and is connected to a wire it is automatically, at least in the most simple case, identified with the subscriber of the wire line. In the Mobile telephony environment there is no wire connecting to the telephony Base Station and a way to identify the user and relate it to the subscriber must be established. In early systems this was done with the only use of an Electronic Serial Number (ESN) that was transmitted to the Base Station. From then on it was considered any communication done by the user equipment as related to the subscriber identified by the ESN.

Notwithstanding, it is easy to see that this system lacks of an elemental feature, that is how is verified that the user is the subscriber that pretends to be. For instance, a user could be receiving the communication of its neighbour, capture the ESN and start doing communications with the neighbour's ESN. This would mean that these communications would be charged to the neighbour's subscription.
To avoid these situations and prevent fraud, a second procedure was introduced. Along with the ESN, that is transmitted over the air, a common Key shared between the user's device and the network was used to calculate, via an algorithm, a response from something that was transmitted over the air. As an example, imagine that a subscriber has associated a Key with the value 5 and that the algorithm is "The integer part of: Adding the Key and then Divide by the Key". If once the Base Station has received the ESN, and thus knows that the Key of the user is 5, sends the number, called Challenge, 56, the user, if it is actually the subscriber, would reply with the result of the algorithm calculation:

$$\text{Integer_part_of}[(56 + 5)/5] = 12 \quad (1.1)$$

So the user, as it is the subscriber and knows the Key, would reply with a 12. If someone receiving the communication would try then to do a communication via the Base Station with the ESN of the other subscriber, it would receive a different challenge, say 90, and as does not know
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1.1. TECHNICAL INTRODUCTION

the secret key, would reply with a wrong answer, say 12, showing the network that it is not the subscriber pretending to be.

These examples shown are, of course, really simplified. In a real case the algorithm would be a much more complicated calculation and the Keys would be longer than the presented. Anyhow, knowing the algorithm and having a large sample of pairs Challenge-Response could enable an attacker, a user pretending to fake a different subscriber, to deduce the Key and then being able to commit fraud. And this actually happened.

To prevent this to happen, one solution was to use a tamper resistant device to calculate by its own the responses to the challenges done by the network, keeping the secrecy of the Key and the Algorithm. Actually this is the main reason why the Smart Cards were introduced in the Mobile Telephony environment, becoming the SIM. The fact that is a simple, logistically convenient and cheap device were additional factors that made the SIM card suitable.

From a Technical Point of View the SIM card is a microcomputer that has its own microprocessor, input-output interface, volatile and non-volatile memory. All this components meet together to mainly calculate the responses to the challenges presented. In the figure 1.1 can be seen the functional and logical structure of a SIM card.

![Functional and Logical structure of a SIM](image)

Figure 1.1: Functional and Logical structure of a SIM.

The way that the SIM Card interacts with the Mobile device is via a serial Input/Output connexion that serves as a link for the Mobile phone to handle commands to the SIM card and get a response. The most widely used protocol is T=0 that defines exactly the APDU (Application Protocol Data Unit) electrical coding for each command and the responses (Status Words) that the SIM card can return (Rankl and Effing, 2000). It must be said that at this level the SIM Card is a totally passive element, that is, holds a slave position and can not initiate the communication with the handset, just reply Status Words to questions (APDUs) from the handset.

Within this technical framework, several advances have been implemented. In addition to the Secure Element Function, the SIM card is also used to store some of the Network parameters necessary to configure the radio link of the Mobile device to the Network serving the subscriber. Thus it is a Network Element and is integrated with it. From what is called Phase 2+ SIMs on, a way to access via OTA (Over-The-Air) to the information inside the memory of the SIM card is established (GSM, 1997). At a higher protocol level a way to initiate Proactive Commands from
1.2. OBJECTIVE

the SIM card with destination to the Mobile handset is also introduced, enabling the SIM to show texts in the Mobile handset screen, interact with the user and the Network, for instance sending messages or dialling calls.

Along with it, the structure of the SIM has been standardised and logically de-coupled the components as to create a standardised cross platform capable of executing applications on it. This means that like computers, an application can be developed on a determined hardware but can be executed onto many, for instance with the Java™ technology (SUN, 1999).

More lately, ways to extend the domain of the SIM card have been introduced. First to enable it to interact via radio frequency with the environment of the handset, for instance using the handset to wave it over a contactless reader in order to pay a ride in the train. On the other hand introducing high speed protocols to do it able to serve contents requiring bigger memory amounts, like music or videos, to the handset (ETSI, 2008).

A mention must be done to the way the SIM card has evolved in the past until now. As it was conceived to be used initially within the GSM system, it was defined in the standardisation bodies of the 3GPP group. So, most of the developments were introduced after a hard work towards consensus and trying to cover the most of the interests of the group members. This influenced a lot the changes that could be introduced on the platform because, although this is not a new topic on technological evolution (Noble, 1985), (Winner, 1987), decisions depended mainly on the consensus than on the technical side.

Summarising one can say that the present SIM cards are devices able to execute applications onto them with a series of resources comparable to small computers and that can interact with the user, the Telecommunications Network and the environment of the Mobile Handset. Additionally, is the most extended tamper resistant device, covering the highest security standards and able to perform complex cryptography calculations. This makes it a very convenient system to introduce new services by the Mobile Network Operators. Thus, developing it and introducing innovation in this computing platform may foster innovation for Mobile services.

1.2 Objective

As has been already introduced, the main objective of the work is to do an exercise of Technology Watch and try to identify the hot points on it, analyse the recent evolution of the developments on SIM cards and find possible trends of evolution. It is considered that having a wide range of publications related with the topic of study and analysing them at the quantitative, qualitative and relational levels may help in the extraction of the information about the developments of the SIM card.

Along with it, another objective to be covered is to find sources and techniques to enable future studies like the present one as to follow up the evolution and detect weak signs and cover early opportunities in the innovation field.

An objective that will also be covered is to study the state of the art of the Theoretical Framework that supports the exercise, that is, Technology Watch and Competitive Intelligence as a broader discipline. Summarising the objectives can be enumerated in:

- Find a Theoretical Framework for practical works on Technology Watch
• Find present literature on Technology Watch
• Put the framework on test with a Case Study
• Find sources for Technology Watch on SIM development
• Establish mechanisms to systematise data query
• Find trends and hot topics on SIM Innovations

These objectives cover each a series of specific objectives that are expanded in the following section.

1.2.1 Specific Objectives

Specific objectives are related to research results directly. They are summarised in the following lines:

• Find Relevant Sources for Technology Watch on SIM cards.
• Determine the key terms to get the data from the Sources.
• Establish a way to systematically query these sources and store the retrieved data.
• Do a quantitative analysis on SIM card related activities to determine:
  1. Total number of patents and journal articles per year
  2. Total number of patents and journal articles per company / institution
  3. Number of patents and journal articles per author
  4. Number of patents and journal articles per author
  5. Top publications for journal articles.
  7. Geographical distribution of records
• Follow a descriptive Analysis on SIM card related activities to determine:
  1. Type of patents for SIM card related activities
  2. Type of journals for SIM card related activities
  3. Type of articles for SIM card related activities
  4. Topics of articles for recent SIM card related activities
• Relational Analysis for the found records to find:
  1. Relationships between records at different levels (Research, Development and Innovation)
  2. Relationships between authors / applicants of records
  3. Relationships between authors / applicants and institutions and companies
All these objectives are complemented with minor findings that are noted along the text.

1.3 Structure

The structure of the Master Thesis work is divided, beside this introduction, in two main parts. The first one introduces the Theoretical Framework of the question and the second one is a Case Study applied to an area of knowledge as to test the theoretical framework. In specific terms is divided in the following chapters.

1. Introduction
2. Theoretical focus
3. Related Literature
4. Method and Techniques
5. Research Results
6. Conclusion
7. Bibliography
8. Appendix

The Introduction is an explanation of which are the main objectives of the work, the motivation, to whom it is addressed, which will be the method and a review of the structure and major findings. Additionally it includes a brief technological introduction to the topic of study, this chapter can be considered common to both parts.

The First Part of the thesis starts with the Theoretical Focus section, that is a compendium of the scholar doctrine on the field, Competitive Intelligence and more particularly, Technology Watch. In the Related Literature chapter a review of similar works in the same area and also with the same methodology in near fields is done as to complete the framework for the work.

The Second Part of the work starts with the chapter Method and Techniques that presents the Case Study, the sources used for it and the techniques used for the data retrieving and analysis.

In the Research Results chapter a raw exposition of the results of the study will be presented that finally in the Conclusion chapter will be summarised. The work will end with a list of Bibliography with all the references used and the Appendices needed.

1.4 Research Approach and Methodology

The approach to the topic is mainly analytical. From the establishment of the sources for SIM cards Technology Watch, a list of document records is extracted. These records belong either to one of the three defined layers: Research, as scientific papers published in the literature, Development, as patents registrations in the corresponding databases, and finally Innovation as articles in regular magazines and any market news or any market information that may be done public.

The data retrieved is stored in a local Database with a predefined structure. From there can be queried to do the suitable analysis covering the several objectives of the work.
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1.5. HYPOTHESIS

These data are analysed in several dimensions. From the quantitative point of view a study of the type of documents and the different uses that they have. From the qualitative point of view, a descriptive analysis and a mining for the key and hot issues on the topic. Finally a relational analysis on the relationships between the different records as to establish a map of the topic. All this work is complemented with a state of the art for related literature and previous works on the same area of knowledge. This information is used to define the Theoretical Framework for the practical work of the Case Study.

1.5 Hypothesis

The main hypothesis to be tested is that doing an exercise on Technology Watch can provide relevant information that may help decision-makers on its duty. The main outcomes of such an exercise are:

- Information about Who is working on the topic
- Information about When have been working and Which have been the outcomes
- Information about What the players plan to do
- Information on Which are the players that may interest to collaborate or compete with
- Information for decision-making about Which are the Technologies to invest on
- Benchmarking information about the performance on Technology Development of our own company or institution

An additional minor hypothesis is that it is possible to establish a Technology Watch system with a high degree of automation as to gather the data from the sources and be ready for analysis. Such a system would ease the iterative nature of the Technology Watch process and be helpful to reduce the costs of its implementation and maintenance.
Part I

Theoretical Framework
Chapter 2

Theoretical focus

“It takes all the running you can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast as that!”
– Queen of Hearts (Carroll, 2004)

In the present business world some facts have altered both qualitatively and quantitatively the way that companies perform in the market arena. Competition is higher in the present times than has been in the previous because some factors, like globalization and Information and Telecommunication Technologies application.

In the last third of the past century some facts affected the world organisation. First the collapse of one of the blocks that were fighting in the Cold War. Second, the rise of, until then, irrelevant countries boosted by the increasing dependence of the industrialised countries of the fossil fuels. This was the political and social environment where an improvement in communications, telematic and also physical, represented an organic change of enterprises. These changes represented the entrance of heterogeneous stockholders in multinational operations companies and also the integration of markets within the NAFTA, European Union and MERCOSUR trade agreements. Moreover, the World Trade Organization created and prepared a world size market. In this market companies from all over the world must compete in order to sustain and increase their revenues and thus their survival as enterprises (Castells, 1996).

From the point of view of competition (Porter, 1980) and with the model of figure 2.1 in mind, these changes comported the reduction of the entrance barriers to competitors and the increase of threats of substitute products and services, because the improvement of communications. Also the increasing bargaining power of buyers and suppliers, because the increasing of the market size. Although some of these changes neutralise each other and on each industry has a different effect, an overall increase of competition is detected in all the market arenas.

This increase of competition has consequences on the way enterprises deal with how they develop and launch new products. Appears a need to focus on successful technologies as well as to allocate resources on them and to know what are the competitors working on. This situation creates the need to systematically get information on these subjects as to take the right decisions at the managerial and strategic levels.

Even in frameworks that consider competition a process, where the temporal aspects such as learning, discovery and selection processes are its components (Kraftt, 2000), the new technological and social paradigm affects it. Mainly reduces the time frame of each of the processes
increasing the clockspeed (Fine, 1998) at which each of them are accomplished. These new needs, again, claim powerful solutions to deliver clear information in a systematic basis to the decision-makers.

![Figure 2.1: The Porter Five Forces of competition (Porter, 1980).](image)

### 2.1 Competitive Intelligence

One way to address this new scenario with increased competition is through Competitive Intelligence. CI refers to insights about competitors that are derived from primary or secondary data (Jaworski et al., 2002). A broader definition of Competitive Intelligence (CI) would be: The action of gathering, analysing, and applying information about products, domain constituents, customers, and competitors for the short term and long term planning needs of an organisation. It represents a process that companies can perform, with the help of thirds, as to make explicit and set under a domain available throughout the company all this information (Wikipedia, 2008b). This information, of course, must not be a raw flux of unconnected data but a filtered and previously structured set of information that stick out noise. So CI goes further than just gathering and distributing data. In the figure 2.2 can be seen how data is converted in exploitable information through the use of the analysis. This is the goal of the CI program, to establish the process to be able to provide this useful information.

![Figure 2.2: From data to exploitable information (Archard and Bernat, 1998).](image)
CHAPTER 2. THEORETICAL FOCUS

2.1. COMPETITIVE INTELLIGENCE

Intelligence in the information context, as defined for instance by old Intelligence services like CIA (United States Central Intelligence Agency) is then "Information that has been analysed to the point that a decision can be made" (Fuld, 1994).

2.1.1 Intelligence Cycle

There is what is considered sometimes the Intelligence Cycle, showed in figure 2.3, that would be the different steps that cover the Competitive Intelligence process. It must be noted that it is indeed a cycle and not only a linear process so it feeds back itself to excel in time.

![Figure 2.3: The Intelligence Cycle (Mether, 2004).](image)

This proposed Cycle is divided in several steps, ranging from four to eight depending on the scope and activities that each one want to relate to each step. As a brief description they are explained in the following sections.

Planning and Direction

This first step may be considered the most important. Is in this step where are defined the needs for the Intelligence process and where the scope and objectives are established. It is clear that all the questions of the addressees of the Intelligence process must be clearly defined as to take the best advantage of the Intelligence exercise.

The usual addressee will be decision-makers of the organisation that have needs to cover as to reduce the uncertainty of the decisions they have to take. In this way one can define the success of the Intelligence when reduces the range of possibilities that the decision-maker has, improving the possibility to succeed on the election.

So, the decision-makers must be involved in this step and committed in defining as well as possible the actual needs. This is not easy as sometimes the needs are not conscious but unconscious. One way to help in this definition is using the result of a previous intelligence action as feedback for the new one, improving it and easing the definition.
Collection

The second step is the collection of data that is the main focus. This implies selecting the sources, implementing the collection methods, retrieve the data and store it accordingly. There are two main objectives in this step. The first one is to select the best sources that fit the needs defined in the Planning and Direction phase. The second one is to get the data that is needed from the sources and keep it in a useful format.

It is clear that a lot of sources can be queried, not only document databases, also experts, peers, autogenerated data and thus the format that the data is collected may change also: recorded interviews, written questionnaires, computer databases. So, it is clear that this step requires the most of the technical preparation of the exercise.

In considering Sources one has to do the distinction between Primary and Secondary sources. It is clear that the most trustful data always come from Primary sources, but also that usually it is the most difficult kind of sources that are available for the collector.

Organisation and Processing

The next natural step once information is collected is Organisation and Processing. It is clear that this step is tight to the previous one because depending on the nature of the data the way it is organised and processed will change.

In particular this step deals with filtering the data, and giving it a suitable form for the next step, analysis. Thus, the reduction of noise and the highlighting of relevant data must be performed as a pre-analysis process.

If we would be talking about personal interviews, here all the irrelevant information should be eliminated and data presented in a suitable way. For instance, summarising reports for each question or any other format to display the information to the analysts.

Analysis

This should be considered the core process of the intelligence. In this step is where the most of the information is extracted to make it become exploitable information and, thus, Intelligence. As can be seen in figure 2.4 the Analysis must look not only for the information that the decision-makers acknowledge as needed but also must serve the information that is needed but is not acknowledged. This is rather difficult and is one of the reasons that to excel on this is quite related to experience (Jaworski et al., 2002)

To perform this activity several tools and techniques may be used depending, again, on the nature of the information. One extended way (Courseault, 2004) is Text Mining that is mainly the use of techniques to show and highlight trends or even unexpected information (Jaquenet and Largeron, 2004) among noise.
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2.1. COMPETITIVE INTELLIGENCE

Figure 2.4: The actual information needed. A is the information available. B is the information acknowledged as needed. C is the information actually need. The Analysis must look for getting as close as possible to D (Palop and Vicente, 1999).

Dissemination

The final step of this cycle is Dissemination of knowledge. Once the Intelligence activity has finished, its outputs must be first delivered to the addressees and afterwards spread among the organisation. This presents two challenges. Decision-makers have to make strategic decisions that may have a big importance in the developing of an organisation and thus the results of the Intelligence activity must be objective and unbiased. They should not present opinions and not be influenced by the kind of decisions that may suggest as this decisions should be made always in an ulterior time than the preparation of the report. Additionally, decision-makers very often have to make the decisions based on intuition and guided by environmental signs (Johnson and Scholes, 1997) so the nature of the reports presented should meet their expectations. The second challenge is spread and disseminate the results among the organisation. Only confidentiality or security reasons should make the result of an Intelligence activity restricted. The reports and results should always not only be presented to the addressees, but to all the people and units of the organisation that may benefit of having this information from a competitive point of view. So, a mechanism to distribute and make available all the results must be implemented. This is not an easy duty, but knowledge creating companies have demonstrated as the best prepared for the competitive arena (Nonaka and Takeuchi, 1995) (Choo and Bontis, 2002).

2.1.2 Types of Competitive Intelligence

CI can be divided in several disciplines depending on the type of the information they focus. First one would be Competitor Intelligence, when the main aim is to gather all the possible information regarding the competition position, products and moves. The second one would be Technology Intelligence, that is related to the scan of all possible technologies and scientific de-
Technology Watch

From the seminal work of François Jakobiak (Jakobiak, 1991) this discipline has received several names in different languages. We here decide to use the term Technology Watch because the similarity with the Francophone original denomination “Veille Technologique”. Notwithstanding we acknowledge the existence of the following terms, ordered by the number of appearings in the revised literature:

- (Competitive) Technical (also Technological) Intelligence
- Technological (also Technical) Environmental Scanning
- Technology (also Technological and Technical) Scanning
- Technology (also Technological) Watch
- Technology (also Technological and Technical) Monitoring

Although each of these terms may include some small variations on its use, we consider them equivalents and them all refer to the same process that we define here as Technology Watch. These differences relay mainly on nuances about the process. Some authors point that the Technology Intelligence goes a step forward than just Watching or Monitoring the environment (Salvador, 1999) but this differences have practically disappeared in present literature, even though must be kept in mind when revising old literature. As has been already introduced, as Technology Watch we understand not only the fact of gathering data and process it as information, but also the filtering process of making this information become relevant information and finally knowledge.

1http://www.scip.org/About/content.cfm?ItemNumber=578&navItemNumber=504
CHAPTER 2. THEORETICAL FOCUS

2.2. TECHNOLOGY WATCH

In the figure 2.5 can be seen which is the process considered as TW within the work. This schema is from a defined norm by AENOR, and ISO associated organisation, that has established a standardised process to the image of other standard norms like 9001 for Quality or 14001 for Environmental Issues. In this figure we can see how the process is divided, close to the cycle of figure 2.3, in four different parts.

2.2.1 Process of Needs, Sources and Means Identification (7.2)

In this subprocess is produced the identification of the needs of information of the organisation. This can be done with information from the customers, the experts in the organisation or even with the evolution of the products or environment of the organisation. From the acknowledgement of the needs one can start with the identification of the sources for the data to be watched. Again, as was introduced in section 2.1.1, the nature of the sources will depend on the nature of the needs. Finally the means to obtain the data will be tightly linked to the needs and the sources identified and chosen.

2.2.2 Process of Search, Treatment and Validation of the data (7.3)

In this stage, and based on the outcomes of the subprocess 7.2, the TW system will include a mechanism to search for the data and store it in a form that may be retrieved when needed and accessible within the organisation. The selection of the information will follow an strategy also distilled from the outcomes of the subprocess 7.2, being this search terms, organisations or
systems to be queried. The information will be treated and analysed as to be in an accessible format, categorised and with the relevant facts highlighted. An example of this kind of process is patent measurement, that is a way to extract relevant information from the statistical study of patents (Hall and Trajtenberg, 2006).

2.2.3 Process of Value providing for the Information (7.4)

Once the data is collected and treated the information will be set in a form of reports or summaries to the disposal of the decision-makers. The key factors that will be considered in the relevance of the information will be: Awareness, risk reduction, required developments, innovation and cooperation and fit with the organisation strategy. Not only will the information treated individually, but also synergy between different areas of knowledge should be explored. A close look will be held to change signs and factors that can impact the organisation.

2.2.4 Process of TW derived actions (7.5)

Here are distinguished three different kinds of derived actions

General

Within the General outcomes are included all the knowledge extracted of the TW exercise as to improve the awareness level as well as the risk reduction. This asset will be usually intangible and thus, difficult to evaluate. On the other hand the TW has to be an iterative process as to excel and create an awareness culture of the environment.

Derived Actions

As derived actions is understood: Actions to increase Awareness and Foresight to changes detected, capitalisation of new opportunities, actions to reduce risk, improvement actions for weaknesses, new ideas for Innovation and proposal of Cooperation with identified potentials.

Areas of Interest

Another outcome of the TW action might be the identification of new areas of interest for the organisation, as markets, technologies or businesses. This identification should be presented along with an analysis of evaluation of options, accessibility and prospect and perspectives.

2.3 Theoretical Background

Technology Watch, and for extension Competitive Intelligence, has several theoretical foundations. To identify them one can divide the Technology Watch process into the four parts introduced in the section 2.2. By one side there is the Needs Identification that would be related with the decision-making theory for strategic management (Drucker, 1954), (Rockart, 1979) and (Johnson and Scholes, 1997). The Source selection and Data retrieving would be dependant on the nature of the Needs, but regarding TW it would mainly be founded on Scientometrics (Bibliometrics, Citation Indexes and Impact Factors) and also on Patentometrics, both linked to the
discipline of Informetrics (also Infometrics). For the analysis and value providing, mainly Data Mining techniques, Statistical Processing, co-word analysis, Information Categorisation are used.

Figure 2.6: The Technology Watch Theoretical Background. (Own preparation)

As can be seen TW has strong theoretical foundations that are complemented with a corpus of theory dedicated to it. Starting with Environmental Scanning in 1968 (Aguilar, 1967) and (Aaker, 1983) and TW early appearance in scholarship (Martinet and Ribault, 1988) and (Jakobiak, 1991) including the historical TW systems that appeared in the XVIII century (Palop and Vicente, 1999). Into account must be taken a transverse supporting theory that is that of Knowledge Management that supports all the TW process. From the Identification of Needs and Sources, to the Data treatment, Information Analysis and finally Intelligence and Knowledge diffusion and application to the decision making of the organisation. Here all the theoretical work from the origins (Polanyi, 1958) to the application to the organisations (Nonaka and Takeuchi, 1995) apply. Finally, and as complements to the corpus of theory for TW must be included the Technology Transfer and Development models (Godin, 2005) and the Science and Technologies Social Constructivism (Kuhn, 1962) (Winner, 1987) (Rosenberg, 1974) that help to understand the way technologies evolve. In the figure 2.6 a summary of the expressed is showed.
Chapter 3

Related Literature

“It is wiser to find out than to suppose.”
– Mark Twain (1835 - 1910)

Due to the strategic nature of Competitive Intelligence and Technology Watch, finding literature on the subject is not an easy task. If we consider TW literature, we can distinguish between three types of literature: Scholarship, Practitioner and Practical.

On the Scholarship we refer to articles published on peer-reviewed journals, articles presented in proceedings and congresses, manuscripts with a substantial set of bibliographical references, master thesis and dissertations. Those are not only scholarly written articles but represent what would be considered the formal corpus of literature.

On second place, about Practitioners we refer to manuals and guides written by experts but with an action focus in mind. That is, articles and books mainly oriented to executives that do not extend on the formal theory but on the tangible results of the TW. These two kind of literature are mainly written and published by public or private organisations that their main focus is to support the TW theory as to ease the actual implementation of it.

Finally, we consider the Practical literature as those articles and works that focus on getting TW intelligence from a sector or business area. This kind of works will be mainly undertaken by organisations seeking their own competitive advantage and usually will be left unpublished. Nevertheless some organisations undertake these kind of works (Izquierdo and Larreina, 2005) and publish them to contribute to the competitive development of a cluster of companies or as an academic exercise like the second part of the present work.

This, then, will be the categorisation considered for the Literature review on TW. The time frame to do it will be 2003 to the present. The reason to take this recent time frame is that in the previous chapters some basic and fundamental references have been introduced, as well as similar works that may serve as a reference for older bibliography (Mether, 2004) (Courseaut, 2004), and thus we think that we must focus on more recent works as to give originality to the review. Additionally we must acknowledge the useful contribution of some bibliography survey works that serve as an starting point for the search (Fleisher et al., 2007). This search has been undertaken using Business Source Elite1, Elsevier - ScienceDirect2, Emerald Management Xtra3 and Google Scholar search4 engines.

1http://www.ebscohost.com/thisTopic.php?topicID=4&marketID=1
2http://www.sciencedirect.com/
4http://scholar.google.com/
3.1 Literature on Technology Watch

In this section we have a look to sources oriented to the first two categories we have distinguished. That is, generic literature about Technology Watch and the systems that support it. First Master Theses and PhD Dissertations will be introduced and after them the scholarly works.

3.1.1 Theses and Dissertations

Some Master’s Theses and PhD Dissertations have been found on the Technology Watch topic. Most of them are from Technical Universities and have been undertaken by students after getting a degree on Engineering.

- Thesis (Mether, 2004) on the implementation and deployment of a TW program in an SME. Main outcomes are that the processes and roles must be tailored to fit the size and organisation where it is implemented.

- Dissertation (Courseault, 2004) on Text Mining techniques where an algorithm is developed as to extract relevant information of data queried to publication databases.

- Dissertation (Kongthon, 2004) similar to the previous but more focused on algorithms for data cleansing and intelligence extraction.

- Thesis (Brockley, 2004) on the set of tools that support strategic technology planning, including a detailed coverage of TW techniques.

- Degree research work (Aguilera, 2005) on the development and implementation of a TW system for a small enterprise.

- Thesis (Cavaller-Reyes, 2006) on the strategic analysis of the information with a Case Study on TW for the wine industry.

- Thesis (García, 2007) with some Case Studies of Technology Intelligence programs.

- Degree research work (Martínez, 2008) on the development of a TW system for a Molding and Matrice Guild.

As can be seen, several works have been done from the academic point of view on the TW topic, covering areas such as Techniques and Implementation of TW programs and all of them with a survey on the models and literature available at the moment, with a deeper work in dissertations and more light in degree researches. It must be said that this list does not pretend to be complete as only referenced works have been included and Theses and Dissertations form part of a grey literature always difficult to find from common search engines (MacColl, 2002).

3.1.2 Articles

Regarding articles, we do believe that this is a more complete survey, as the mentioned databases used to get the articles cover a big stake of the published literature, at least in English, and citations and references by articles have been scanned. We have an extensive list of articles and we will jointly cite them by topic of research.
Starting with Techniques, and mainly on Text Mining, we must cite (Kostoff, 2003), that includes a state of the art on the topic, (Jaquenet and Largeron, 2004) with results and development of algorithms to discover relevant information, ontology-based information extraction (Maynard et al., 2005), application of Text Mining techniques to Hotel Industry (Lau et al., 2005), Patents Analysis for TW results (Dou et al., 2005) (Shih et al., 2008) and a model to explain the success and improvements that may be introduced by a TW program (Fleisher, 2006).

We continue with theoretical models for TW (Kerr et al., 2006) and the way it is related with Technology Management (Savioz and Sugasawa, 2006) and its usefulness for Technology Planning and Brokering (Lichtenthaler, 2006b) (Antunes and Canongia, 2006).

Additionally some Case Studies on different industries, chasing empirical evidences of TW and its challenges, (Lichtenthaler, 2003) (Ta$kin et al., 2004) (Nosella et al., 2004) (Lichtenthaler, 2004a) (Lichtenthaler, 2004b) (Lichtenthaler, 2005) (Lichtenthaler, 2006a) as well as some regional studies on the advantages of TW in Indonesia (Ilan et al., 2004), Thailand (Ngamkroeckjoti et al., 2005) (Ngamkroeckjoti and Speece, 2008), Japan (Sugasawa and Takahashi, 2006), the Navy of the U.S. (Kostoff, 2004) and finally a Case Study similar to the second part of the present work (Kaur and Prakash, 2008).

On Sources for TW we have found an exercise for electronics industry identifying the most used sources at present (Vojak and Suarez-Nunez, 2005) and the use of the Internet as to mine for useful and relevant information (Porter et al., 2007) (Rajaniemi, 2007) and not only Abstract Databases.

To end with, and as unique topics we must cite one about the link between the Technology Intelligence programs a company has and the number and value of the Patents it produces, with a strong support for the positive effect (Peter J. Lane, 2005). Another one on the role of Intermediate Centres for TW (Izquierdo and Larreina, 2005). A directory for CI and TW professionals in Spain (Ediciones, 2007) and finally an already introduced survey on CI literature (Fleisher et al., 2007).

As we can see there has been a moderate activity on this topic and if we present the information regarding number of articles per year, like in table 3.1 we observe that the year 2005 has eight articles published becoming the year of more activity. Actually it is also observed how the year that the articles about theoretical models of TW and its usefulness for Technology Planning are published the year 2006, just after 2005.

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003</td>
<td>2</td>
</tr>
<tr>
<td>2004</td>
<td>7</td>
</tr>
<tr>
<td>2005</td>
<td>8</td>
</tr>
<tr>
<td>2006</td>
<td>7</td>
</tr>
<tr>
<td>2007</td>
<td>5</td>
</tr>
<tr>
<td>2008</td>
<td>3</td>
</tr>
</tbody>
</table>

Table 3.1: Number of Articles per Year.

It is worth to mention once more that this list covers only Technology Watch articles, so any kind of discipline related, like Competitive Intelligence, Technology Planning and Foresight are not covered in this list. Even though we acknowledge the existence and importance of such
disciplines for the sake of simplicity we focused on Technology Watch, and the synonym concepts introduced in section 2.2, literature only.

3.1.3 Books

To end with the present section we add a brief note about three books published in this period about TW. The first one dedicated to Text Mining (Porter and Cunningham, 2005), the second one to Patent Search (Hunt et al., 2007) and the third one a book in Spanish about the different models of TW and analyses the activities and flavours of CI and TW programs in the countries with the most activity on the topic (de Innovación BAI, 2007).

3.2 Literature on Mobile TW

Mobile Technology is a leading industry at present for innovation and change in the society (Castells et al., 2007) so competition on the technology arena is very important and tough. Been able to foresee which will be the trends of evolution of present technologies is key for success. This makes this kind of information sensitive and not publishable. These may be the reason as to not find TW studies in this sector published by private Enterprises. Nevertheless, some international organisations have established mechanisms for their own interests and of their associates. In this particular business sector we must mention some activities by these organisations. The International Telecommunication Union - Sector Standardisation (ITU-T) Technology Watch initiative5, the Joint Technical Comitee 1 (JTC1) Special Working Group for Technology Watch6, the International Organisation for Standardisation (ISO) Hot Topics site7, the European Telecommunication Standards Institute (ETSI) Technologies site8, Light Reading Reports9 and the Organisation for Economic Co-Operation and Development (OECD) What’s New site10.

5http://www.itu.int/ITU-T/techwatch/index.html
6http://jtc1tw.logti.etsmtl.ca/
7http://www.iso.org/iso/hot_topics.htm
8http://www.etsi.org/WebSite/technologies/Technologies.aspx
9http://www.lightreading.com/section.asp?section_id=8,37&section_name=Reports
10http://www.oecd.org/department/0,3355,en_2649_34223_1_1_1_1,00.html
Part II

Case Study
Chapter 4

Method and Techniques

“Invention is 1% inspiration and 99% transpiration.”
— Thomas A. Edison (1847 - 1931)

In this Part of the work a Case Study on Technology Watch applied to an area of study is done. It is focused in the SIM Card evolution and developments and more particularly in the ways the SIM card can connect to the devices that are outside the Mobile Phone. Thus, these are the type of records that we will collect as to do an analysis of them afterwards.

4.1 Sources Selection

Finding the suitable sources for a work like the one is proposed is always a difficult task. But in this particular case, the SIM card, is even more difficult. The reason is that the SIM card is a technological device that is subject to a strong constraint: Standardisation. The key point in the final success of the GSM system, and eventually the SIM card, is the deep commitment in the use of standardised technologies with defined behaviour and integration that allow the entrance of any player in the telecommunications industry at a low entry cost. This fosters the competition and enables companies to build economies of scale as to reduce costs. (Hernandez-Pena, 2007)

Because this, it is not possible to leave this asset aside and should be considered, we acknowledge this fact. It is as important as the sources that will be introduced for the innovation on the field, but as is an accessible and well known asset for the players in the area, it would not be considered in the present work.

4.1.1 Research

For Research Sources we refer to any document that may include basic or applied research on the field of study. Thus, any scholar article published, PhD. theses and even technical journal articles are considered of this kind of source.

The best way to have access to this kind of information is through Article Databases (de Torres Ramirez, 1999). The present work is more focused on methodology than on completeness, and only three Databases will be considered in this area and will assume that using more would increase the results accuracy but would not change the process methodology. The databases
chosen for this work, because their accessibility and cover of the field of study are *Academic Search Elite* through *EBSCOHost*, *IEEE Xplore* and *ISI Web of Knowledge*.

### 4.1.2 Development

In this kind of sources we include, mainly, patents. Some of the documents included in the previous section could be included in this one, but again, as we are considering a way of systematically perform this process and in a first approximation, only patents will be included in the Development type of sources.

Moreover, and considering that the SIM card is a worldwide spread product, only the worldwide registered patents would be taken into account. The reason for this, as introduced, is that the SIM card has worldwide applicability and developments and inventions must be able to be applied everywhere to mean a significant steering force in its evolution. Notwithstanding, it is acknowledged the limitation of such approach as developments with a regional class patent can indicate emerging changes that can facilitate prospective views.

### 4.1.3 Innovation

In this last type of sources we include references to final products and services that may appear in the market: Press releases, market journals and any kind of market document that may include information related to a product or a service that may be linked to the previous sources entries.

Here, like in the first kind of documents to be studied, the Article Database is the reference for mining the regular publications. Additionally, and in the same way of the Research sources, only one source will be used for the sake of simplicity. The databases chosen here are *Business Search Elite* and the *Electronic Journals Service* both through *EBSCOHost*, and the Emerald Management Xtra as references of this kind of documents.

### 4.2 Data Retrieving and Storage

In this section a brief look to the techniques used to retrieve and store the data is held. Basically, the sources that have been mentioned in the previous sections are sources that are accessed by Web Pages. There, one can query and retrieve the articles and references that meet the query criteria. The result page, thus, is another Web Page. In some of the sources the result page can be downloaded in a text-based format to a file in the querying client computer. In other cases it is provided just a human-readable format page that is difficult to automatically process in order to get quantitative and structured information from it.

---

For doing the suitable calculations and obtain relevant information from the results, data must have a convenient format. It is needed too, to establish with the same aim in mind a clear and functional way to store the data retrieved for performing calculations, analysis and interpret the data retrieved. The present section is aimed to describe the solutions found for the two needs described, the Retrieval and Storage of data.

4.2.1 Retrieval of data

As has been established the main sources for this work are:

- Academic Search Elite
- IEEE Xplore
- ISI Web of Knowledge
- World Intellectual Property Organisation
- Business Search Elite
- Electronic Journals Service
- Emerald Management Xtra

From these sources a clear distinction between two types can be made. The Articles Databases, Research and Market, have a search engine that retrieve result pages with a list of the articles that meet the query criteria. This information can then be downloaded in a BibTex (Wikipedia, 2008a) format that is field based, i.e. there are several standard fields and each one has a value. In the table 4.1 an example can be found. The data retrieved in this format must be stored in a database that keeps the same field information but spread in two tables, as will be explained in the section 4.2.2

Table 4.1: Example of a BibTex record.

```latex
@article{2496958620070401,
  Abstract = {In another SIM-related deal...},
  ISSN = {09652590},
  Journal = {Card Technology Today},
  Keywords = {CONTRACTS, SMART cards, DIGITAL signatures, MOBILE communication},
  Number = {4},
  Pages = {p6},
  Title = {...and Turks with mobile signature programme.},
  Volume = {19},
  Year = {20070401},
}
```

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The second one has also a search engine and the result page is a list of the patent entries that meet the query terms. To be able to store this information from the web page some scripts based on Web Scraping techniques (Schrenk, 2007) have been implemented to query the WIPO Web Page and temporarily store the retrieved data in a CSV (Comma Separated Value) format. Each column has one field of the information provided by the WIPO web page, plus some custom ones. In the Table 4.2 the list of fields on each record can be found.

<table>
<thead>
<tr>
<th>Query Params (Custom field)</th>
<th>Record Id. (Custom field)</th>
<th>Patent Code</th>
<th>Publication Date</th>
<th>Description</th>
<th>International Class</th>
<th>Application Number</th>
<th>Applicant Name</th>
<th>url</th>
<th>Abstract</th>
</tr>
</thead>
</table>

Table 4.2: List of fields retrieved in a query to the WIPO database.

In figure 4.1 an example of a query results web page for the WIPO site can be seen. As is easy to see, it is difficult to process manually the information provided by the site. Additional Web Scraping techniques are used afterwards to increase the information retrieved from the WIPO site, see section 4.2.2

Figure 4.1: Example of a results page of the WIPO website.

The next step is to import these data into a database. For doing this, just a simple script is executed that gets the fields information and stores it in the database with the format explained in the section 4.2.2.

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4.2.2 Storage of data

The design of the storage of data is a key decision because it influences the later retrieve and analysis processing of data as it will be done off-line with the data previously stored from the public databases. In the present section we will briefly describe first the technical architecture of the system used and secondly the logical structure of the Database used for the storage of data.

From the technical point of view there are four main elements used. A database based on PostgreSQL \(^6\) version 8.3 and running on a Linux Kubuntu \(^7\) 8.04 system. The set up is completed with a client running Python \(^8\) 2.4, for the scripting language, and a Python module, PyGreSQL \(^9\) version 3.8.1 to access the database hosted in the server. All these tools are Open Source and available for the community.

The structure of the database is divided in three sets. Two of them are identical, Research and Market Articles, were the documents in BibTex are imported to the database. The Third contains the Patents information, resulting from querying the WIPO site.

Tables for Article Storage

The two tables structure for the storage of Articles data is intended to divide between the entry of the article itself, the inherent data, and the keywords information, that is a classification and thus an ad hoc characteristic of the articles. The first table contains eighteen fields and the second one three fields. Them all can be checked in table 4.3

As can be easily seen, the link between the two tables is the art_id field. And the relationship is clear, each article can have one or more records related in the keywords table, one corresponding to the each keyword associated to this article. This way of storing the information will be useful afterwards for analysing the keywords that appear related to the subject of work and doing some quantitative calculations about them.

In addition to this field, two very important fields for the analysis of the relationship with other records, let them be on the Research, Development or Innovation domains, will be the Author, Journal, Title and Year. For a further analysis a Full Text Search \(^10\) could be applied to an additional field, the Abstract field. This Full Text Search could give the possibility to do intensive qualitative analysis of the information stored in the database.

Tables for Patent Storage

In the case of patents there are five tables. The first one, the Patents table has the header information about each patent. It is formed by the fields that appear in the table 4.4. The second table, Patent_Query includes a record for each of the query terms that have resulted on the retrieve of this patent record. That is, if the terms “SIM” and “SIM&Card” have both resulted on a set containing a determined patent, among others, this patent will have two records associated in the table Patent_Query.

With these two tables a second retrieve process is done. As has been introduced the table Patents

\(^6\) PostgreSQL Global Development Group, http://www.postgresql.org/
\(^7\) Canonical Ltd., http://www.kubuntu.org/
\(^8\) Python Software Foundation, http://www.python.org/
includes information about the Header of the patent, but there is some additional information that
is not within this header information. Because this, a post-processing of each Patent record is
done as to get the information that is included in the three additional tables. These tables can be
checked also on the table 4.4 and are Patent_IPC, Patent_inventor and Patent_Applicant.

<table>
<thead>
<tr>
<th>Table</th>
<th>Articles</th>
<th>Keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>art_id¹</td>
<td>recid¹</td>
<td>abstract</td>
</tr>
<tr>
<td>author</td>
<td>keyword</td>
<td>issn</td>
</tr>
<tr>
<td>number</td>
<td>pages</td>
<td>title</td>
</tr>
<tr>
<td>volume</td>
<td>year</td>
<td>author_affil²</td>
</tr>
<tr>
<td>industry²</td>
<td>entrytype²</td>
<td>peopleref²</td>
</tr>
</tbody>
</table>

Table 4.3: List of fields for the tables for Articles storage. ¹ are Custom Fields, added to the original
database data for integrity. ² are available only in some Databases and are not included in all the
articles retrieved from all the databases selected.

<table>
<thead>
<tr>
<th>Table</th>
<th>Patents</th>
<th>Patent_Query</th>
<th>Patent_Applicant</th>
<th>Patent_Inventor</th>
<th>Patent_IPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>p_id¹</td>
<td>recid¹</td>
<td>app_id¹</td>
<td>inv_id¹</td>
<td>ipc_id¹</td>
<td></td>
</tr>
<tr>
<td>p_code</td>
<td>patent_id¹</td>
<td>patent_id¹</td>
<td>patent_id¹</td>
<td>patent_id¹</td>
<td></td>
</tr>
<tr>
<td>pub_dated</td>
<td>query_terms</td>
<td>applicant_name</td>
<td>name</td>
<td>ipc</td>
<td></td>
</tr>
<tr>
<td>description</td>
<td>applicant_country</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>applicant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>intl_class</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>appl_number</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>url</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>abstract</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4: Fields for the storage of Patents Records. ¹ are Custom Fields, added to the original
database data for integrity.

The Patents table, as can be seen, contents all the information of a patent, including a link
to the original article in the Wipo site. This is actually used in the post-processing of the data in
order to get additional information, like all the Applicants, Inventors or IPC claimed. Additionally, a Full Text search could be also implemented.

4.3 Data Querying and Analysis

The process of querying the Database has been briefly introduced in the previous section. Now it will be explained more in detail which have been the terms and parameters considered for the retrieval of information as to prepare the data for the Analysis. Moreover, it is also introduced the techniques used for the analysis of the data once is on the local Database, although the actual analysis tasks are covered in the chapter 5.

4.3.1 Data Querying

On first place, the time for which we will analyse records will be from 2000 to the present (November 2008). Although the SIM card has a long history (Hillebrand, 2002) we focus on the recent years as we have a prospective position more than a historical one.

On second place, we introduce the query terms for the databases. As has been also mentioned previously, the Technology focus is new developments and ways for the SIM to communicate with the world outside the Mobile handset. So, the query terms beside of including the terms SIM card will also include the terms that relate to this Technical possibilities. In the table 4.5 can be checked which have been the terms used. As can be seen they all are quite restrictive, in the sense that do not include generic terms that may introduce noise in the data retrieved.

<table>
<thead>
<tr>
<th>Query Terms</th>
<th>CDMA SIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIM Card</td>
<td>CDMA SIM</td>
</tr>
<tr>
<td>NFC SIM</td>
<td>Removable UIM</td>
</tr>
<tr>
<td>SIM Bluetooth</td>
<td>Smart Card Web Server</td>
</tr>
<tr>
<td>USB SIM</td>
<td>Smartcard Web Server</td>
</tr>
<tr>
<td>USIM</td>
<td>Host Controller Interface</td>
</tr>
<tr>
<td>Single Wire Protocol</td>
<td>UICC</td>
</tr>
</tbody>
</table>

Table 4.5: Terms used to query the Databases, the Articles and Patents Databases. For the Patents Database is added the query for IPC IC.H04Q.7.32

Once the data is retrieved and incorporated to the Databases, an additional post-processing is undertaken. Regarding Articles, a fast look is done and is detected that some of the articles retrieved from the Research databases would fit on the Market type of articles, and the other way around, so it is done a selection of the articles from the tittle and the abstract to select them. Regarding Patents a first analysis was done to check the IPC of the patents retrieved and a first selection was done only keeping Patents with an IPC of sections G (Physics) and H (Electricity). Additionally, it was obtained the most frequent IPC and an additional query to the WIPO database was done as to get all the Patents of this class.
4.3.2 Analysis

The performing of the Analysis of the data is divided in three sections, Quantitative, Descriptive and Relational. The techniques for each of these levels are quite similar and basically deal with SQL queries over the Database as to get a dataset that could be presented showing some indicators.

The queries can be executed directly over the database administrator software. In some cases, were there is a complex dataset to get, a short Python script has been used as to obtain it. Once the dataset is ready, with a regular spreadsheet and a graphical software, in our case Microsoft Excel® has been used, the analysis can be perform as to obtain the key indicators and the final results.
Chapter 5

Research Results

“If we knew what it was we were doing, it would not be called research, would it?”
– Albert Einstein (1879 - 1955)

In this part of the work the results of the analysis are presented. The data from the sources will be presented here following the selected indicators to be used for the intelligence analysis and extraction of relevant information. These results are divided in the three categories that were already introduced.

5.1 Quantitative Analysis

5.1.1 Number of Records

We will start with the gross data that was available in the databases. In the Table 5.1 are presented the total data available for the three different types of data retrieved from the databases. Additionally, it is presented the corresponding data for each of the years that has been taking into account.

The main finding is that the Development records are, by far, the most numerous, followed by the Market Articles and, closely, the Research Articles.

As can be seen in the plot of figure 5.1 all the three types show a positive mean slope beside the point that for Research and Market Articles there is a reduction in the number for year 2008. This may be related to the fact that the data cover up to November in 2008, but it should be a fact to be checked and considered in new studies to confirm whether there is a decrease in the publishing of Articles related to the SIM Card.

<table>
<thead>
<tr>
<th>Type</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
<th>2008</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Articles</td>
<td>9</td>
<td>9</td>
<td>8</td>
<td>8</td>
<td>14</td>
<td>15</td>
<td>23</td>
<td>41</td>
<td>34</td>
<td>161</td>
</tr>
<tr>
<td>Patents</td>
<td>610</td>
<td>835</td>
<td>808</td>
<td>871</td>
<td>896</td>
<td>1018</td>
<td>1157</td>
<td>1396</td>
<td>1731</td>
<td>9322</td>
</tr>
<tr>
<td>Market Articles</td>
<td>11</td>
<td>17</td>
<td>14</td>
<td>25</td>
<td>35</td>
<td>28</td>
<td>32</td>
<td>40</td>
<td>12</td>
<td>214</td>
</tr>
</tbody>
</table>

Table 5.1: Number of records per Type. ¹ 2008 data is up to November.

The reduced number of Research Articles detected may be related to the fact already introduced in section 4.1 about the need to include among the sources the Standardisation documentation. The study of this kind of sources may show a relationship on the standardisation activities...
and the development publication activities. We leave this possibility for further study.
Regarding the Market Articles we see again a big difference between its number and the one of
development entries. This would recommend to explore the use of additional sources for this kind
of records, as the ratio of Development entries per Market Articles is 50/1, what is a big figure.
Nevertheless we must bear in mind two facts, that a regular ratio of success for Development
Projects is 10% of Projects (Scherer and Harhoff, 2000) and that several Patents my be implied
in a single product. That is in line, at least in order of magnitude, with the 50/1 relationship found.

![Figure 5.1: Records per Year in a semi-log plot.](image)

### 5.1.2 Research Articles

In table 5.2 can be seen the number of Research articles published per Journal. From a first
look to the list it can be inferred that most of the Research publications are done via Confer-
ences and Workshops. This is very important data in order to plan a Technology Watch program,
as these conferences should be attended, or at least, prompt information from them should be
gathered.

<table>
<thead>
<tr>
<th>Journal</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer</td>
<td>10</td>
</tr>
<tr>
<td>Pervasive Computing and Communications Workshops, 2007.</td>
<td>4</td>
</tr>
<tr>
<td>PerCom Workshops *07. Fifth Annual IEEE International Conference on</td>
<td>4</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>4</td>
</tr>
<tr>
<td>Telektronikk</td>
<td>3</td>
</tr>
<tr>
<td>Elektron</td>
<td>3</td>
</tr>
<tr>
<td>IEEE Transactions on Vehicular Technology</td>
<td>3</td>
</tr>
<tr>
<td>Pervasive Computing Technologies for Healthcare, 2008.</td>
<td>3</td>
</tr>
<tr>
<td>PervasiveHealth 2008. Second International Conference on</td>
<td>3</td>
</tr>
<tr>
<td>Communications Engineer</td>
<td>2</td>
</tr>
<tr>
<td>Communication Systems, Networks and Digital Signal Processing, 2008.</td>
<td>2</td>
</tr>
<tr>
<td>CNSDSP 2008. 6th International Symposium on</td>
<td>2</td>
</tr>
</tbody>
</table>
CHAPTER 5. RESEARCH RESULTS

5.1. QUANTITATIVE ANALYSIS

<table>
<thead>
<tr>
<th>Journal (Continued)</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer Communications</td>
<td>2</td>
</tr>
<tr>
<td>Computer Standards &amp; Interfaces</td>
<td>2</td>
</tr>
<tr>
<td>Consumer Electronics, 2006. ICCE *06. 2006 Digest of Technical Papers. International Conference on</td>
<td>2</td>
</tr>
<tr>
<td>Convergence and Hybrid Information Technology, 2008. ICHIT *08. International Conference on</td>
<td>2</td>
</tr>
<tr>
<td>Elektronik Praxis</td>
<td>2</td>
</tr>
<tr>
<td>IBM Systems Journal</td>
<td>2</td>
</tr>
<tr>
<td>Mobile and Wireless Communications Summit, 2007. 16th IST</td>
<td>2</td>
</tr>
<tr>
<td>Mobile Networks and Applications</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5.2: Top 20 Publications for Research Articles.

Second, we present the Authors that have a bigger number of articles. The affiliation of the Author has been found manually as most of the Databases do not include this information in the records downloaded. It is easy to observe in table 5.3 that most of the publications come from Scholars working in Technical Universities. From private owned companies there is one entry for a Mobile Network Operator and the rest are from NOKIA Corporation and subsidiaries.

<table>
<thead>
<tr>
<th>Author</th>
<th>#</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hervas, R.</td>
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<tr>
<td>Chavira, G.</td>
<td>5</td>
<td>Autonomous Univ. of Tamaulipas, Tampico</td>
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<td>Nava, S.</td>
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<td>Bravo, J.</td>
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</tr>
<tr>
<td>Nava, S.W.</td>
<td>4</td>
<td>Autonomous Univ. of Tamaulipas, Tampico</td>
</tr>
<tr>
<td>Noll, J.</td>
<td>4</td>
<td>Telenor R&amp;D, Fornebu</td>
</tr>
<tr>
<td>Urien, P.</td>
<td>3</td>
<td>Dept. Computer Science and Networks, ENST Paris</td>
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<tr>
<td>Sanchez, C.</td>
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<td>Autonomous Univ. of Tamaulipas, Tampico</td>
</tr>
<tr>
<td>Madlmayr, G.</td>
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<td>Univ. of Applied Sciences of Upper Austria, Hagenberg</td>
</tr>
<tr>
<td>Langer, J.</td>
<td>3</td>
<td>Univ. of Applied Sciences of Upper Austria, Hagenberg</td>
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<tr>
<td>Scharinger, J.</td>
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<td>Johannes Kepler University</td>
</tr>
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<td>Ahmavaaraa, K.</td>
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<td>Nokia Corporation</td>
</tr>
<tr>
<td>Haverinen, H.</td>
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<td>Nokia Corporation</td>
</tr>
<tr>
<td>Pichna, R.</td>
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<td>Nokia Corporation</td>
</tr>
<tr>
<td>Antoniou, Z.</td>
<td>2</td>
<td>Nokia Res. Center, Burlington, MA</td>
</tr>
<tr>
<td>Benyo, B.</td>
<td>2</td>
<td>Budapest Univ. of Technol. &amp; Econ., Budapest</td>
</tr>
<tr>
<td>Vilmos, A.</td>
<td>2</td>
<td>Budapest Univ. of Technol. &amp; Econ., Budapest</td>
</tr>
</tbody>
</table>

Table 5.3: Top 20 Authors, the Number of Research Articles published and Affiliation.
To end with the Research Articles data we consider the possibility of doing some analysis on the Keywords of the Articles, but its complexity forced to leave it for a future research. We can advance that there were 2327 Keywords entries for 1510 distinct Keywords. This increases the difficulty to do a regular analysis so we should use some Data Mining techniques with the help of specialised software and the preparation of a Thesaurus.

5.1.3 Patent Entries

From the header information of Patents one can identify the first Applicants of each patent. Usually they are subsidiaries or group companies of a bigger brand. We have grouped them and presented in the figure 5.2 the Top 20 Group Applicants for SIM Related Patents. Note that this Top 20 account for 45% of all the Patents presented.

Additionally, in figure 5.3 can be seen, from the Top 50 Applicants, the percentage of Patents presented for each of the Industry Players groups identified.

From these two graphics we can extract some interesting information. First, from the figure 5.2 the most active company in Patent filling in the areas studied is NOKIA Corporation, doubling the number of patents filled by the second one. The first SIM Card manufacturer that appears in the top 20 list is Gemalto, where have been included all the companies that merged to form the present company. It is interesting also to see how a newcomer to these business industry, Apple Inc. is also situated among the top 20 applicants. The first Mobile Network Operator to appear in the list is TIM Italy, partly owned by Telefonica Group.

Only two Card Manufacturers, Gemalto and Giesecke & Devrient, appear in this list. This is reflected on the figure 5.3 where Card Manufacturers occupy the fifth group of Patents applicants in the Top 50 applicants. This list is leaded by the Handset Manufacturers, followed by the Semiconductor and Chipset Manufacturers. Just in front of Card Manufacturers stand the Mobile Network Operators. It is interesting to see how another industry player, Financial Services providers like Visa, American Express, are also included in this list.

The data extracted now are the Group Applicants that a bigger Grow have had in the past years. This grow is calculated as mean grow since the first Patent that appears in the records. That is, it will have a bigger grow figure a company that has applied for more number of Patents in the more recent years. This will give the idea of which are the newcomers to the SIM Arena.
Two indexes have been calculated, the Absolute and the Relative one. The first one represents the Mean Growth per Year in number of Patents that the number of patents filled by the applicant has suffered. The second one is the same value but in percentage with respect to the year 2008. In table 5.4 can be seen which have been the Applicants that have showed a biggest mean grow per year in relative and absolute terms.

<table>
<thead>
<tr>
<th>Abs</th>
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<th>Rel</th>
<th>Applicant</th>
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</thead>
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<tr>
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<td>100.00%</td>
<td>Smart Technologies Ulc</td>
</tr>
<tr>
<td>19,67</td>
<td>Apple Inc.</td>
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<td>Solicore, Inc.</td>
</tr>
<tr>
<td>8,00</td>
<td>NXP B.V.</td>
<td>100.00%</td>
<td>Marvell World Trade Ltd.</td>
</tr>
<tr>
<td>7,00</td>
<td>Viasat, Inc.</td>
<td>100.00%</td>
<td>Avocent Huntsville Corporation</td>
</tr>
<tr>
<td>7,00</td>
<td>Sony</td>
<td>100.00%</td>
<td>Ascendent Telecommunications, Inc.</td>
</tr>
<tr>
<td>6,25</td>
<td>RIM</td>
<td>100.00%</td>
<td>Kaba Ag</td>
</tr>
<tr>
<td>5,63</td>
<td>Qualcomm</td>
<td>100.00%</td>
<td>Semtek Innovative Solutions</td>
</tr>
<tr>
<td>5,50</td>
<td>LG Electronics</td>
<td>100.00%</td>
<td>Navento Technologies, S.L.</td>
</tr>
<tr>
<td>5,25</td>
<td>Zte Corporation</td>
<td>100.00%</td>
<td>Viasat, Inc.</td>
</tr>
<tr>
<td>4,50</td>
<td>Huawei Technologies Co., Ltd.</td>
<td>50.00%</td>
<td>Panasonic</td>
</tr>
<tr>
<td>4,38</td>
<td>Motorola Inc</td>
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<td>Palm Inc.</td>
</tr>
<tr>
<td>4,00</td>
<td>Smart Technologies Ulc</td>
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<td>Solicore, Inc.</td>
<td>50.00%</td>
<td>Remotemdxa</td>
</tr>
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<td>4,00</td>
<td>Interdigital Technology Corporation</td>
<td>50.00%</td>
<td>Ubiquisys Limited</td>
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<td>4,00</td>
<td>Visa</td>
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<td>Mavenir Systems Inc</td>
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<td>3,13</td>
<td>Gemalto</td>
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<td>Bundesdruckerei GmbH</td>
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<tr>
<td>3,00</td>
<td>Kaba Ag</td>
<td>50.00%</td>
<td>Emdo Ab</td>
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</tbody>
</table>

Table 5.4: Top 20 Applicants with biggest mean grows along the period, in Absolute terms, left, and relative terms, right.

From these lists there are some points to highlight. Again, we see how NOKIA Corporation tops the list of Applicant with the most absolute growth. On the other side we see how Smart Technologies Ulc tops the relative grow, as all its patents (4) have been presented in the year 2008. The same case is for the nine following companies in the list, but with smaller number of patents.

Regarding Card Manufacturers, only Gemalto appears in the top 20 with the sixteenth greatest absolute growth but overtaken by several Handset, Semiconductors and Chipset Manufacturers. Moreover, VISA, a Financial Services provider is also performing better growths in the time frame selected than Gemalto.

Must be mentioned that some companies that are not among the biggest players of the industry. For instance, Viasat Inc. provides Satellite and Wireless communications to Governments and the Private sector. The aforementioned Smart Technologies Ulc is dedicated to Learning Systems Technology. Marvell World Trade Ltd., a subsidiary of Marvell Technology Group Ltd., Avocent Huntsville Corporation and Ascendent Telecommunications, Inc. are dedicated to Hardware and Network equipment. KABA Ag. is a security company focused on Physical and Logical Access. Within the list of biggest relative growth, Solicore Inc. is a flexible battery solutions company,
Semtek Innovative Solutions and Magtek Inc. provides card readers and other related hardware. Navento Technologies, S.L., Remotemdx and Trueposition Inc. are positioning and tracking services providers. Kestrel Wireless Inc. is a radio frequency based security provider. Ubiquisys Limited and Mavenir Systems Inc are Network equipment providers and finally Emdo AB, a mobile entertainment company.

After focusing on Patent Group Applicants now the focus is set in all the applicants of the Patents. As we have mentioned, a patent can have several Applicants. Additionally, there is a list of the inventors of the system or mechanism covered by the patent, that usually is the same as the applicants but it may not. This list inventors are the responsible of the invention itself and thus it may be interesting to know them. Regarding applicants, in table 5.5 can be seen which are the top countries of the applicants for Patents. Actually it contains the country from which the application is done and also the nationality of the applicant himself. The list is topped by the US, followed by Finland and Germany. It is interesting to see how Japan and China exchange their position depending on whether is considered country of application and nationality. As an added data to the list, it is important to bear in mind that while the US has gone six fold from the 2000 to the 2008 in number of applicants, China has gone 70 fold and Germany just two fold. To end with, just to mention the twelfth position of Israel and the nineteenth of Spain.

<table>
<thead>
<tr>
<th>Pos</th>
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<th>Nat.</th>
<th>Inventor</th>
<th>Number</th>
<th>Company</th>
</tr>
</thead>
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<td>IN</td>
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</tr>
</tbody>
</table>

Table 5.5: Top 20 Country and Nationalities for Patent Applicants (Left). Top 20 Inventors, the number of Patents published and the Group Applicant (Right).

Regarding the inventors, just to mention that these are the top 20 names that figure as inventors in all the patents analysed. As useful information it is included the company that figures as
CHAPTER 5. RESEARCH RESULTS

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the group applicant. Again, the list is controlled by NOKIA Corporation with six entries (VERTU is totally owned by NOKIA) and, surprisingly, by a newcomer to the industry, APPLE Inc., what shows its commitment with the industry it has just recently, two years ago, entered.

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<th>Rel(%)</th>
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<td>100.00</td>
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<tr>
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<td>100.00</td>
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<tr>
<td>H04L 29/06</td>
<td>951</td>
<td>9,63</td>
<td>H04L 29/06</td>
<td>100.00</td>
<td>G06F 3/044</td>
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<td>6,63</td>
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<td>G08B 23/00</td>
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<td>G06F 21/24</td>
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<td>G09G 3/36</td>
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<td>G06F 21/22</td>
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<td>3,67</td>
<td>G06F 21/20</td>
<td>33.33</td>
<td>G08C 17/00</td>
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<tr>
<td>G06F 1/00</td>
<td>137</td>
<td>3,50</td>
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<td>33.33</td>
<td>H04B 13/00</td>
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<tr>
<td>H04M 3/42</td>
<td>140</td>
<td>3,13</td>
<td>G06Q 40/00</td>
<td>33.33</td>
<td>G06F 21/02</td>
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<tr>
<td>H04N 7/16</td>
<td>191</td>
<td>3,13</td>
<td>G06Q 30/00</td>
<td>33.33</td>
<td>G06Q 90/00</td>
</tr>
<tr>
<td>G06K 19/07</td>
<td>285</td>
<td>3,13</td>
<td>G06F 21/00</td>
<td>33.33</td>
<td>A61B 5/00</td>
</tr>
</tbody>
</table>

Table 5.6: Top 20 International Patent Codes and the number of patents that include them. Note that a Patent can include several codes (Left). Top 20 IPC with biggest mean grows along the period, in Absolute terms and relative terms (Right).

Continuing with the patents data analysis, we finish with a look to the IPC information of patents. The IPC follows a hierarchical denomination and it is easily accessible from the WIPO website. Nevertheless, in the section 5.2 a deeper look will be held to the meaning of the IPC themselves. Now we centre on quantitative data regarding the IPC. First of all, from the total number of patents published under each of the available IPC we have extracted which are the top ones. Those are showed in table format in table 5.6. In figure 5.4 one can see the evolution of the top 20 patents along the years studied. Additionally, in table 5.6 can also be seen the IPC that suffered a bigger mean growth in the period. Growths are calculated like in the table 5.4 and cover the relative and absolute growth. We would like to highlight that there are some patent IPC that appeared in the year 2008, like the top four in table of relative growth. Additionally, the IPC with the top absolute growth, H04Q 7/32, is also among the ones with the most relative growth. To end with, we see how the top patent in number of patents is also the second with the top absolute growth, what gives an idea about its importance, not only in volume but in present activity. Actually, if we have a look to the figure 5.4

\[^{1}\]http://www.wipo.int/classifications/ipc/ipc8/?lang=en
we see how this IPC and the second one in volume terms, both suffered a change of trend in the year 2008 after a two years trend of negative growths.

![Figure 5.4: Evolution of the Top 20 IPC claimed by patents in 2008. Semi-log plot.](image)

### 5.1.4 Market Articles

In this part of the Research Results, a similar analysis to the one done in section 5.1.2 will be held, given that the structure of the information retrieved is quite similar. In table 5.7 can be seen which are the journals that most articles published during the period established. It is not surprising that the reference in the sector, *Card Technology Today* tops the rank. It is interesting to see how some of the publications are intended for a general audience. This information is quite useful in order to establish a TW program, as gives information about which are the subscriptions that a bigger Return On Investment will perform.

In table 5.7 can also be seen which are the companies most cited in the articles. In this kind of articles, Market ones, it is more important which is the company cited, or to which company belongs the product cited, than the author himself that may be an editor of a newspaper with no relationship with the company.

In this case we see how Gemalto and Oberthir Card Systems top the rank of the most cited companies. This is a change respect to all the ranking we have seen until now, as most of them were topped by Handset and Semiconductor manufacturers, and from them, mainly NOKIA Corporation, fifth in this case. Again, we see Apple Inc. in a good position, eighth.

Like in the case of the Research Articles we have collected a list of keywords that may be of capital importance to mine as to get useful information. Nevertheless, the elaborated techniques are beyond the scope of this introductory Case Study and are left for future research. Just to mention that a total of 852 keywords have been found related to the articles where 352 are distinct.

To end with the present section, we acknowledge a lack of coverage of this kind of sources because catalogues, whitepapers and press releases from the actual companies have not been
included because the difficulty to find generic tools to gather the data. Of course, we have found atomic sources of this kind of data and leave for future research the possibility to include them.

<table>
<thead>
<tr>
<th>Journal</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Card Technology Today</td>
<td>47</td>
</tr>
<tr>
<td>Time</td>
<td>17</td>
</tr>
<tr>
<td>Telecommunications</td>
<td>9</td>
</tr>
<tr>
<td>Electronic Engineering Times</td>
<td>8</td>
</tr>
<tr>
<td>Marketing Week (01419285)</td>
<td>7</td>
</tr>
<tr>
<td>New Scientist</td>
<td>7</td>
</tr>
<tr>
<td>Telecom Asia</td>
<td>7</td>
</tr>
<tr>
<td>Telecommunications - International Edition</td>
<td>7</td>
</tr>
<tr>
<td>Total Telecom Magazine</td>
<td>6</td>
</tr>
<tr>
<td>Wall Street Journal - Eastern Edition</td>
<td>6</td>
</tr>
<tr>
<td>Communications International</td>
<td>5</td>
</tr>
<tr>
<td>EDN</td>
<td>5</td>
</tr>
<tr>
<td>Electronic Design</td>
<td>5</td>
</tr>
<tr>
<td>Marketing (00253650)</td>
<td>5</td>
</tr>
<tr>
<td>New York Times</td>
<td>5</td>
</tr>
<tr>
<td>Wireless Review</td>
<td>4</td>
</tr>
<tr>
<td>Electronic News (10616624)</td>
<td>3</td>
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<tr>
<td>Global Telephony</td>
<td>3</td>
</tr>
<tr>
<td>MEED: Middle East Economic Digest</td>
<td>3</td>
</tr>
<tr>
<td>Occupational Health &amp; Safety</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Company</th>
<th>Number</th>
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<tbody>
<tr>
<td>Gemalto</td>
<td>12</td>
</tr>
<tr>
<td>Oberthur Card Systems Sa</td>
<td>5</td>
</tr>
<tr>
<td>Vodafone Group Plc</td>
<td>5</td>
</tr>
<tr>
<td>Orange Plc</td>
<td>4</td>
</tr>
<tr>
<td>Nokia Corp.</td>
<td>4</td>
</tr>
<tr>
<td>Cybird Co. Ltd.</td>
<td>4</td>
</tr>
<tr>
<td>Bill Sims Co.</td>
<td>4</td>
</tr>
<tr>
<td>Apple Inc.</td>
<td>4</td>
</tr>
<tr>
<td>Virgin Mobile Telecoms Ltd.</td>
<td>3</td>
</tr>
<tr>
<td>Sun Microsystems Inc.</td>
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<tr>
<td>Silicon Storage Technology Inc.</td>
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<tr>
<td>AT&amp;T Inc.</td>
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<tr>
<td>Visa International Inc.</td>
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<tr>
<td>T-Mobile Usa Inc.</td>
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<td>Teliasonera Ab</td>
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</tr>
<tr>
<td>Sk Telecom Co. Ltd.</td>
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</tr>
<tr>
<td>Sierra Wireless Inc.</td>
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<tr>
<td>NXP Semiconductors</td>
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<td>Mtn Group Ltd.</td>
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<tr>
<td>Easygroup Ip Licensing Ltd.</td>
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</tbody>
</table>

Table 5.7: Top 20 Publications for Market Articles (Left). Top 20 companies cited (Right)

5.2 Descriptive Analysis

After the Quantitative Analysis done in the previous section, now it is intended to do a more detailed descriptive analysis of the records. First we are going to start analysing the type of Research publications that have been found. Some records are analysed in depth as to find some common characteristics between them.

Second, we will get into the Patent records as to describe the main and more relevant International Patent Classes under which the most number of patents related to SIM technology are filled. A presentation of the Query Terms and the results that each had is held.

Finally, in the same way as with the Research sources, a brief description of the type of sources as well as the main characteristics of them is done.

5.2.1 Research Articles

Regarding Research articles, and from table 5.2 we can infer that most of the publication on this business area is done through Congresses and Workshops. This fact is backed by the point that of the 161 Articles found, 99 are Conference Papers and the rest Journal Articles, what makes a 61% of records.

From the Author affiliations, and as has been also already introduced for the top 20 authors, the
main contributors are scholars of technical universities. Unfortunately, the affiliation of all the authors is not available, but from those which it is available we can say that the trend of the top 20 authors is confirmed and most of them are linked to universities and technical institutes. A small amount of them are linked to private owned companies.

Now we do a manual inspection of the records corresponding to 2008 as to get some descriptive information. The top keyword for these records is NFC that is one of the technologies that enables the SIM Card to communicate with devices close to the Mobile Phone. This fact states the present importance of these technology. Beside this, Authentication to networks within and outside the owned by the Mobile Network Operators, for instance web-based and for Open Wireless Networks, is also a hot topic, accounting for a dozen of articles, including one supported by biometric means. To end with, just to mention some entries about the Internet of Things and Interaction between SIMs, RFID tags and NFC devices, DVB-H key management and Virtual (Software based) SIMs.

5.2.2 Patent Entries

In this section we will centre on the description of the relevant IPC for the SIM card development activities. This information is useful as to focus future TW activities in the relevant areas of growth of the business industry. Additionally, some information regarding the search terms that gave result to the patents published in 2008 is given. First the most important IPC and its description. This list cover the top IPC in 2008 as well as the IPC with the biggest growths in the period studied. In the Appendix I a list with the main IPC descriptions is given. Briefly we would like to comment that among the IPC that experimented a biggest growth within the results we find topics like Navigation systems, WAN and LAN Access, Payment Systems, Television Subscription Systems and Computer Protection, beside the common Subscriber Identification and Management systems.

<table>
<thead>
<tr>
<th>Query Terms</th>
<th>Number</th>
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</thead>
<tbody>
<tr>
<td>SIM Card</td>
<td>679</td>
</tr>
<tr>
<td>IC/H04Q-7/32</td>
<td>386</td>
</tr>
<tr>
<td>NFC</td>
<td>277</td>
</tr>
<tr>
<td>USIM</td>
<td>240</td>
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<td>Smartcard</td>
<td>196</td>
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<tr>
<td>UICC</td>
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<tr>
<td>Smart Card Web Server</td>
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<tr>
<td>Host Controller Interface</td>
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<td>SIM Bluetooth</td>
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<td>SIM CDMA</td>
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<td>Smartcard Web Server</td>
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<tr>
<td>Removable UIM</td>
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</tbody>
</table>

Table 5.8: Number of Patents that resulted from the corresponding Query in year 2008. Note that a patent could be retrieved by several queries.

To follow with the descriptive analysis, in table 5.8 can be found which are the Query Terms used that gave as a result the set of entries of patents for the year 2008. Like in the case of the
CHAPTER 5. RESEARCH RESULTS

5.3. RELATIONAL ANALYSIS

Research Articles, the NFC term is one of the hot topics in the records retrieved. It is important to highlight the fact that the term Smart Card Web Server was also among the Query Terms that resulted in some entries.

5.2.3 Market Articles

To end with the descriptive analysis we now centre on the Market Articles records. In this case, in clear difference of the Research Articles, the main entry type are Journal Articles, that account for the 90% of the entries in the database. Some minor types are Editorials and Product Reviews.

Like in the case of Research Articles we do a manual inspection of the records corresponding to the year 2008. The list totals twelve articles so the inspection is easy to be done. The biggest number of articles is about the NFC market possibilities and products that support it, so well in line with the results for Research and Patents. The second one in number of articles is a commercial trend that started some time ago but that got a big momentum the past year, the Mobile Virtual Network Operators. Finally, an article about Automatic Translations from the mobile phone.

5.3 Relational Analysis

The Relational Analysis is done at the Authors and Applicant levels. The First one is between Authors of Research records and Inventors of published Patents. This first relationship shows several coincidences that should be further developed. At a second level, Patents’ first Applicant, generally a Company, is related to the Innovation records found.

In the table 5.9 can be seen which are the Authors that account for Research Articles and also appear as Inventor of a Patent of the database. The analysis has been done by similarity, but in the table have been presented the matches that totally coincide. Nevertheless, there is a possibility that beside the coincidence of the name there could by two different people holding the Inventor and Author identity. Some other matches have been left aside because the doubts about the actual coincidence. A further task, out of the scope of the present work, could be creating a people directory as to get complete this information with more accurate results.

One interesting fact to highlight is that in most of the cases the publication dates of the articles are previous to the filling of the patents, supporting the lineal model of R&D that is first the research activity and second the Development activity. Anyhow, some other cases show the contrary, what could be caused because the need of the researcher to cover the possibility of any other person filling for his invention.

The second relational analysis done is regarding Patents and Market articles. As have been mentioned, in Market articles the Author is not as relevant as in the Research articles. Here we concentrate on the companies cited by the articles. Some of the articles in the database contain information about the companies that are cited or of which product is mentioned in the articles. Unfortunately not all the Articles Databases provide this information so only partial matching could be done.

In figure 5.5 can be seen a plot of the results. We have presented the number of records about a company in the market articles on the x axis and the number of records in the patents on the y axis. In an ideal situation one would expect that at bigger number of patents filled by a company,
5.3. RELATIONAL ANALYSIS

CHAPTER 5. RESEARCH RESULTS

more success and impact on the market should have, but the situation is far from that. We see very low correlation between the data.

<table>
<thead>
<tr>
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<td>Afifi, H.</td>
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<td>Kumar, K.A.</td>
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<td>Zheng, Yu</td>
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<td>1</td>
<td>2006</td>
<td>2005</td>
</tr>
</tbody>
</table>

Table 5.9: Authors with entries in the Research and Patent records.

Considering that the data covered by our research is perfectly showing the actual performing of a company on the market, and thus its market success measured as a highest number of market articles, we see two explanations to this result. First one is that there is not a correlation between the patents filled by a company and the number of products that arrive to the market. Second one would be that there are companies that beside the filling patents in order to protect the IPR about their developments, skip this step and focus only in launching the products to the market and try to keep the protection via obfuscation or other kind of procedures. We have no data now to extract a conclusion and leave the resolution of this fact for future research.

Beside this fact we see how there are companies that are highly cited in market articles but have a low effort in filling patents. From a simplistic point of view one would say that they profit the
development activities to the maximum as to get market advantage. On the other side we see companies that have a big activity in filing patents and also a good impact on the market. We can mention here Apple or TIM that account for a ratio below 10/1 about patents/market articles and topping the list of Market Articles. In the opposite situation than the first ones, there are companies which impact in the market is not that good. Gemalto or Philips, with 5 and 4 articles respectively, have a ratio over 50/1. With the worst ratios, the Handset Manufacturers, like RIM, Ericsson or Motorola, that have ratios over 100/1.

Figure 5.5: Relation between Market Articles and Patents filled, showing low correlation.
Chapter 6

Conclusion

“Economic progress, in capitalist society, means turmoil.”
— Joseph A. Schumpeter (1883 - 1950)

In the present work we have pretended five objectives, introduced in the section 1.2. The first one is to find a theoretical framework for practical works on TW. This objective has been covered with the chapter 2 where we have introduced the needs for a TW program, the fit of TW within the Competitive Intelligence activities and the theoretical hooks that this fit provide and a vast set of recent references that were put in context of the theoretical framework that was presented. As a summary we would like to highlight:

- TW is a need for present companies competing on a global market
- TW forms part of a broader concept that is Competitive Intelligence that processes data as to have enough entity to support a decision.
- TW, and CI, have a cyclic nature, where feedback represents a key input for the start of each iteration
- There exists a theoretical framework that gives a support to the deploying of a TW program, its assessment and improvement
- Although the activity is moderate, there still exists activity in developing this framework, and thus, room for research on the topic

Second objective is to put on test this theoretical framework and this has been done in the second part of the present work, with a study on the Research, Development and Innovation activity on SIM card related technologies between the years 2000 and 2008. This framework has served as a guide for the case study and showed that fitted within it. Anyhow, it is worth to mention that some of the activities and techniques provided by the corpus of literature could not be put on test because scope restrictions. Notwithstanding, this points have been highlighted along the text and could be explored in future research.

Among these we acknowledge the need to apply data mining techniques to the amount of data retrieved from the databases as well as recursively apply several full intelligence cycles to the data as to see the changes that happen on the evolution of the subject.
Third objective was to find sources for TW activities on SIM card development activity. This objective has been completed in three stages. First we have used several Articles databases as to get raw information about the topic. Second, we have identified which are the publications were the hot topics about the SIM card developments are published and the Patent IPCs under which most of the new Patents on SIM developments and its related technologies have been published. Third, we have identified the lack of coverage on determined areas of the Sources selected, as well as the limitations explained and acknowledged in the section 4.1. We suggest further work on the line of including new research articles sources, through the inspection of the Articles Databases that have the best coverage of Conferences, Workshops and Proceedings on the areas of study. Include patent sources that may give additional information, like the Japan Patent Office, the European Patent Office and the US Patent Office. Finally, we have suggested the possibility in section 5.3 that on Market Articles the coverage may not be the best, so additional efforts should be done in order to exploit other sources that provide information of catalogues, whitepapers and press releases.

Fourth objective is establish mechanisms as to automate the data querying, retrieval and analysis. We think that we have met this objective in the first two areas with highest standards, but some more work should be done on the analysis one. We have set up a client server system capable of querying some of the databases automatically, and some others with some human interaction. We have also defined a way to store the retrieved information in a convenient format as to ease the analysis process. All this software and tools will be of capital importance in subsequent phases of the TW process.

Fifth objective consisted on been able to find trends and hot topics on the SIM developments. Although we have not found a new hot topic on the area, we have identified information that supports the present trends of evolution of the SIM card. Mainly on the NFC developments as to enable mobile payments, but also on Navigation and Location Based services, Mobile TV protection and heterogeneous network access and authentication. Moreover, we have identified the key players in the industry as well as the newcomers and rising players that will play a role in the future. Another conclusion of the work regarding this objective is the realisation that the SIM card development is of increasing activity, if the slump detected in table 5.1 for research and market articles is confirmed to be caused by the lack of consideration of the full year. Additional work should be held in the future in order to confirm the topics identified in the present research as hot topics and emerging trends and find then key information for decision making and technology planning.
Bibliography


ETSI. Smart cards; uicc - contactless front-end (clf) interface; part 1: Physical and data link layer characteristics (release 7). Technical specification, European Telecommunications Standards Institute, 2008.


Appendix I

This appendix lists some of the IPC found as relevant in the Patents Quantitative Analysis and are here listed to support section 5.2.2. Texts are literally extracted from WIPO IPC listing.

- **H04Q 7/32** Selecting arrangements to which subscribers are connected via radio links or inductive links - Mobile subscriber equipment [6]
- **H04Q 7/38** Arrangements for completing call to or from mobile subscriber [6]
- **H04L 29/06** Arrangements, apparatus, circuits or systems, not covered by a single one of groups Fulltext...characterised by a protocol [5]
- **H04L 12/56** Data switching networks Packet switching systems [5,6]
- **H04L 12/28** Data switching networks - Characterised by path configuration, e.g. local area networks (LAN), wide area networks (WAN) [5,6]
- **H04Q 7/22** Selecting arrangements to which subscribers are connected via radio links or inductive links - using dedicated mobile switching centres, e.g. cellular systems
- **H04M 1/725** Substation equipment, e.g. for use by subscribers... Cordless telephones
- **G06F 21/00** Security arrangements for protecting computers or computer systems against unauthorised activity
- **G06Q 20/00** Payment schemes, architectures or protocols (apparatus for performing or posting payment transactions)
- **H04L 29/08** Arrangements, apparatus, circuits or systems, not covered by a single one of groups Fulltext...Transmission control procedure, e.g. data link level control procedure
- **G06Q 30/00** Commerce, e.g. marketing, shopping, billing, auctions or e-commerce
- **G07F 7/10** Mechanisms actuated by objects other than coins to free or to actuate vending, hiring, coin or paper currency dispensing or refunding apparatus - together with a coded signal [2]
- **G06F 17/30** Digital computing or data processing equipment or methods, specially adapted for specific functions... Information retrieval; Database structures therefor [6]

1. http://www.wipo.int/classifications/ipc/ipc8/?lang=en
- **H04L 9/32** Arrangements for secret or secure communication... including means for verifying the identity or authority of a user of the system

- **H04Q 7/20** Selecting arrangements to which subscribers are connected via radio links or inductive links in which the radio or inductive links are two-way links, e.g. mobile radio systems

- **G06K 7/00** Methods or arrangements for sensing record carriers

- **G06F 1/00** Details not covered by groups G06F 3/00-G06F 13/00 G06F 21/00

- **H04M 3/42** Systems providing special services or facilities to subscribers (specially adapted for wireless communication networks H04W 4/00)

- **H04N 7/16** Television systems Secrecy systems; Subscription systems

- **G06K 19/07** Record carriers for use with machines and with at least a part designed to carry digital markings with integrated circuit chips [5]

- **G06F 3/048** Interaction techniques for graphical user interfaces, e.g. interaction with windows, icons or menus

- **G06F 3/01** Input arrangements or combined input and output arrangements for interaction between user and computer (G06F 3/16 takes precedence)

- **G06F 21/24** Security arrangements for protecting computers or computer systems against unauthorised activity by protecting data directly, e.g. by labelling

- **H04N 13/00** Stereoscopic television systems; Details thereof (specially adapted for colour television H04N 15/00)

- **H05B 37/02** Circuit arrangements for electric light sources in general, Controlling

- **G06F 3/044** Input arrangements for transferring data to be processed into a form capable of being handled by the computer; Output arrangements for transferring data from processing unit to output unit, e.g. interface arrangements by capacitive means

- **G01C 21/36** Navigation; Navigational instruments not provided for in groups G01C 1/00-G01C 19/00 (measuring distance traversed on the ground by a vehicle G01C 22/00; control of position, course, altitude or attitude of vehicles G05D 1/00; traffic control systems for road vehicles involving transmission of navigation instructions to the vehicle G08G 1/0968) Input/output arrangements for on-board computers

- **H04H 60/33** Arrangements for broadcast applications with a direct linkage to broadcast information or to broadcast space-time; Arrangements for monitoring the users’ behaviour or opinions

- **G08B 23/00** Alarms responsive to unspecified undesired or abnormal conditions

- **G06F 3/041** Input arrangements for transferring data to be processed into a form capable of being handled by the computer; Output arrangements for transferring data from processing unit to output unit, e.g. interface arrangements Digitisers, e.g. for touch screens or touch pads, characterised by the transducing means
• **G02F 1/167** Devices or arrangements for the control of the intensity, colour, phase, polarisation or direction of light arriving from an independent light source based on electrophoresis

• **G09G 3/36** Control arrangements or circuits, of interest only in connection with visual indicators other than cathode-ray tubes using liquid crystals