Tiago Gil Fachada Nunes

Licenciado em Ciências da Engenharia e Gestão Industrial

A STUDY ON REDUCING DIGITAL PIRACY: AN ANALYTICAL NETWORK PROCESS APPROACH WITH BENEFITS, OPPORTUNITIES, COSTS AND RISKS ANALYSIS

Dissertação para obtenção do Grau de Mestre em
Engenharia e Gestão Industrial

Orientador: Prof. António Carlos Bárbara Grilo, Professor Auxiliar,
Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa

Júri:

Presidente: Prof. Doutor Rogério Salema Araújo Puga Leal
Arguente: Prof. Doutor Virgílio António da Cruz Machado
Vogal: Prof. Doutor António Carlos Bárbara Grilo

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA

Janeiro 2013

Tiago Gil Fachada Nunes

Licenciado em Ciências da Engenharia e Gestão Industrial

A STUDY ON REDUCING DIGITAL PIRACY: AN ANALYTICAL NETWORK PROCESS APPROACH WITH BENEFITS, OPPORTUNITIES, COSTS AND RISKS ANALYSIS

Dissertação para obtenção do Grau de Mestre em

Engenharia e Gestão Industrial

Orientador: Prof. António Carlos Bárbara Grilo, Professor Auxiliar,
Faculdade de Ciências e Tecnologia da Universidade Nova de Lisboa

Júri:

Presidente: Prof. Doutor Rogério Salema Araújo Puga Leal

Arguente: Prof. Doutor Virgílio António da Cruz Machado

Vogal: Prof. Doutor António Carlos Bárbara Grilo

Janeiro 2013

A study on reducing digital piracy: an Analytical Network Process approach with Benefits, Opportunities, Costs and Risks analysis

ACKNOWLEDGEMENTS

The author of this dissertation would like to thank Professor António Grilo for his time and support as supervisor, always ready to hear new concepts and offer ideas, tips and suggestions. His assistance, text reviewing and guidance enabled the successful conclusion of this work.

The author also wishes to express sincere gratitude to Professor Maria do Rosário Cabrita from the Universidade Nova de Lisboa, Faculdade de Ciências e Tecnologia, Professor Albertina Dias and Professor Pedro Viegas from the Instituto Universitário de Almada, Instituto Piaget for their patience, kindness and availability to answer the questionnaires that proved valuable for the application and validation of the model.

In addition, the author would like to thank colleagues, friends and family for their support and for providing moments of relaxation when they were needed the most.

Finally, I would like to thank my parents for giving me the opportunity to study, for offering constant encouragement and financial support, and for providing me with a safe haven in restless times.

RESUMO

O mundo e o mercado das tecnologias informação em geral tem nos últimos tempos sofrido grandes transformações em virtude das rápidas inovações tecnológicas que são disponibilizadas universalmente a todos.

As inovações que são permanentemente introduzidas trazem consigo, cada vez mais, uma maior facilidade de acesso, de utilização, de mobilidade e outras mais-valias que por sua vez são também facilitadoras de actividades menos legais, permitindo obter produtos que são idênticos ao original sem que haja qualquer perda de qualidade no processo de cópia. Tal facto levou a que fossem criadas tecnologias com o objectivo de prevenir tais práticas de pirataria digital e permitir a quem detêm os direitos de propriedade intelectual um maior controlo; estas virão a ser conhecidas por tecnologias de gestão de direitos digitais (DRM).

A aplicação destas tecnologias trouxe consigo novos problemas, como restrições excessivas que não satisfazem os consumidores e podem prejudicar a sociedade em geral e restringem a livre utilização e troca de ideias.

Embora haja trabalho cientifico que aborde esta temática, nunca foi até hoje aplicada uma análise multi-critério que auxilie na tomada de decisão de qual poderia ser a melhor solução para diminuir o fenómeno da pirataria digital.

Recorrendo ao desenvolvimento de um modelo de processo de rede analítico (ANP) com análise de benefícios, oportunidades, custos e riscos (BOCR), procura-se nesta dissertação colmatar a lacuna existente na comunidade cientifica com a aplicação de um processo de tomada de decisão multi-critério para determinar qual a melhor alternativa para esta problemática.

Por fim, nesta dissertação encontra-se também uma aplicação prática do modelo desenvolvido na área das publicações digitais nacionais de livros.

Palavras-chave: Tomada de Decisão Multi-critérios, Processo de Rede Analítica, BOCR, Gestão de Direitos Digitais, Pirataria Digital, Propriedade Intelectual.

ABSTRACT

The world and the information technology in general has in recent years undergone a major transformation due to rapid technological innovations that became universally available to all.

These innovations that are constantly being introduced bring an increasing ease of access, use, mobility and other gains which in turn are also facilitators to illegal activities, allowing for the acquisition of products that are identical to the original without there being any loss of quality in the copy process. This led to technologies that were created in order to prevent such practices of digital piracy and give more control to those who own the intellectual property rights, known as Digital Rights Management (DRM) technologies.

The application of these technologies has brought new problems, such as excessive restrictions that do not satisfy consumers and may harm society in general by restricting the freedom of use and exchange of ideas.

Although there is scientific work on this issue, there has never been applied a multi-criteria analysis to assist in the decision making of what could be the best solution to reduce digital piracy.

By developing an analytical network process (ANP) model with analysis of benefits, opportunities, costs and risks (BOCR), this dissertation seeks to fill the gap in the scientific community with the implementation of a multi-criteria decision making process to determine the best alternative for this problem.

Finally, in this dissertation there is also a practical application of the developed model in the national digital books area.

Keywords: Multi-criteria Decision Making, Analytical Network Process, BOCR, Digital Rights Management, Digital Piracy, Intellectual Property.

TABLE OF CONTENTS

FIGURE INDEX

TABLE INDEX

LIST OF ABBREVIATIONS

AHP – Analytical Hierarchic Process

ANP – Analytical Network Process

BOCR – Benefits, Opportunities, Costs and Risks

CD – Compact Disc

CI – Consistency Index

CR – Consistency Ratio

CSS – Content Scramble System

DAT – Digital Audio Tape

DRM – Digital Rights Management

DVD – Digital Video Disc

ELECTRE – *Elimination Et Choix Traduisant la Realité* (Elimination and Choice Expressing Reality)

EPUB – Electronic Publication

IP – Intellectual Property

MCDM – Multi-Criteria Decision Making

MP3 – Moving Picture Experts Group Phase 1 Audio Layer-3

PDF – Portable Document Format

R&D – Research and Development

RI – Random Index

TOPSIS – Technique for Order of Preference by Similarity to Ideal Solution

VCR – Video Cassette Recorder

WPM – Weighted Product Model

WSM – Weighted Sum Model

LIST OF EQUATIONS

LIST OF SYMBOLS

ω – eigenvalue

λ_{max} – maximum eigenvalue

n – matrix size

1 - INTRODUCTION

Piracy has long been a cause of grievance for those that create and manage intellectual property (Johns, 2009). Whether looking at works of the written word, music or, more recently, film and, even more recently, software, content producers, publishers and retailers have taken measures to protect the fruit of their labour and source of their revenue as it evolved from solely being a physical good to a digital product in the age of the Internet, while not fully considering the consequences of such measures and how they would affect their consumers and society in general (Vernik and Purohit, 2011; von Lohmann, 2010; Hinze, 2008; Johns, 2009). Decisions need to be made on how to best proceed in a way that benefits those that create, distribute, sell, use or consume the intellectual property taking into account the potentials and limitations intrinsic of the digital realm.

Meanwhile, a multi-criteria decision making (MCDM) technique has proved its worth as a way to help organize, analyse and make complex decisions taking into consideration both quantitative and qualitative attributes: the analytical hierarchic process and its non-reliant on interdependence generalization, the analytical network process (Saaty and Vargas, 2006; Tan et al., 2007; Y. Chang, Wey and Tseng, 2009; Saaty and Begicevic, 2010; Saaty, 2008).

Applying a MCDM technique on such a complex decision as determining the best measure to take on diminishing digital piracy might provide a considerable assistance and thus eliminate an existent gap on scientific research regarding digital piracy.

1.1 - Objectives

The main objective of this dissertation is to develop an analytic network process approach with benefits, opportunities, costs and risk analysis to identify the best alternative to diminish piracy in the digital medium.

Another objective for this dissertation is to apply the developed model in the national digital books market that will allow to analyse the author's perspective of the best alternative to reach the proposed goal.

1.2 - Methodology

The first phase of this methodology consisted on proposing the subject addressed by this dissertation, bearing in mind its scientific importance, current relevance and value for society.

The second phase involved performing a literature review on the subject by mainly consulting journal articles, relevant books, conference proceedings and reports, with the use of search engines such as Biblioteca do Conhecimento Online (b-on) and Google Books. Due to the nature of the work and number of collected articles, the software Mendeley Desktop v. 1.6 was introduced in order to better organize and manage the research.

After becoming better acquainted with the current state of the thematic addressed by this dissertation, the third phase of this methodology began, with the selection and development of a multi-criteria decision making model in order to accomplish the dissertation's objectives.

The fourth phase was a practical application of the created model and the software SuperDecisions was introduced to assist on this task.

The final phase was to reach conclusions and delineate possible future works on the subject.

1.3 - Structure

This dissertation is arranged into six chapters.

The present chapter serves to introduce this dissertation and its objectives, methodology and structure.

The second chapter presents the literary review on intellectual property and piracy and is divided into its evolution and corresponding legislation, the digital rights managements that were created to protect the intellectual property and prevent piracy, the notion of a DRM-Free environment and corresponding investment on education and a summary of relevant related works on the subjects detailed in the chapter.

The third chapter presents the literary review on decision making and is divided into the analytical hierarchic process, the analytical network process, the BOCR analysis and a summary of relevant related works on the subjects detailed in the chapter.

In the fourth chapter of this dissertation the developed model is presented and its different parts exposed.

The fifth chapter has a practical application of the part of the model related to the content producer, divided into data gathering, pairwise comparisons, supermatrix formation, determining the best alternative, sensitivity analysis and its conclusions.

In the last chapter the final conclusions for this dissertation are presented along with recommendations for future works.

Finally, the bibliographic references used for the development of this dissertation can be found at the end. These references are exhibited using Harvard's citation style. The annexes associated to this dissertation can also be consulted here.

2 - INTELLECTUAL PROPERTY AND PIRACY

In this chapter a general overview of the evolution of intellectual property and its legislation is made along with the evolution of piracy, their transformation into the digital medium and efforts to prevent copyright infringement, namely through digital rights management. It is also discussed the characteristics of an environment without digital rights management and how it is connected with the education of society.

2.1 - Evolution and Legislation

The problem presented in this work can trace its roots back to the middle of the XV century, when Johannes Gutenberg set in motion for the first time his machine that would turn out to be one of the most important inventions of the second millennium, revolutionising the way people conceived and described the world in which they lived in, kick starting the beginning of the Modern Age: the printing press (Johns, 2009).

Gutenberg's press soon spread throughout Western Europe changing the way we communicate and license works as evidenced by a French law from 1547 declaring that every religious book should dictate on their first page the name of the author as well as who printed the work. This fast expansion of the printing press brought with it political and legal problems for future generations that led to the creation of the notion of "piracy" (Johns, 2009).

The origin of the term is disputed, but it is used in some texts from the early XVII century to identify plagiarists, becoming more common towards the end of the XVII century (Johns, 2009). In 1709, in the United Kingdom, the term "piracy" is legally adopted for the production and sale of unauthorized works (Panethiere, 2005).

The notion of intellectual property and the illegal use of it would evolve with society through the years (Johns, 2009; Lessig, 2004) until the advent of the Age of Information and the new technologies that allowed and facilitated the sale and purchase of intellectual property (Johns, 2009; Lessig, 2004; Vernik, 2009).

The most recent advances on digital technologies allowed the creation of electronic formats, like the MP3 compressed music file type (which enables a song with reasonably good audio quality to take up only approximately 1/10 the size of the same file in an uncompressed audio CD format), as well as file sharing networks used for both legal and illegal file transfers (Vernik, 2009). “Piracy”, traditionally used until recently to refer to illegal acts with the intent to profit, became synonym of unauthorized file sharing, even when done for personal use only (Panethiere, 2005).

The particular characteristics of a digital product make it possible to create an exact copy of the original product without degrading its value and preserving the intellectual property. There is literally no downside on a copy or second hand purchase for the consumer in the digital realm, regarding quality and while in the early years it took some degree of training to be able to copy and install and/or share a program, it is fairly easier to do so now and one simply needs to know how to use an Internet browser; the knowledge required to engage in the crime is now commonplace (Morris and Higgins, 2010). This same reasons makes it impossible to debate piracy without getting ethics and morality involved, being an hot button issue for the different stakeholders, be it content creators, producers or consumers.

There is also debate regarding the nature of intellectual property and how it should be treated when sold in a digital format as well as how to treat that digital property and persecute those guilty of copyright infringement (Waelde and Edwards, 2005). While it will take years to reach a consensus, a recent ruling from the Court of Justice of the European Union (Press Release No 94/12 Judgement in Case C-128/11 UsedSoft GmbH v Oracle International Corp.) declared that the same rules for resale should be applied to digital products as they are to physical products or, more specifically, an author of software cannot oppose the resale of his used licenses allowing the use of his programs downloaded from the internet and that the exclusive right of distribution of a copy of a computer program covered by the license is exhausted on its first sale. This decision that digital property is still property and as such deserves all the rights and protection that physical property deserves may be a sign of the general direction that the different industries and laws dealing with digital products will take, with digital products leaving the grey area that they dwell in currently, where technology has clearly outpaced legislation, to a more clear definition of property. With each new decision it will take time for the industry to adjust behaviour in response to the new legal environment, mostly due to costs to adjusting the capital stock and the organisational set-up and because it takes time to identify new cross border business opportunities and develop strategies for exploiting them.

According to Lastowka (2010), in most countries today copyright laws protect someone's works from the moment they create it until seventy years after the creator's death. In Portugal, these rights are

protected by the Code of Copyright and Related Rights (No. 63/85 of 14 March 1985, last amended by no.16/2008 of 1 Abril 2008). Under these laws, crimes can be punished with a prison sentence of up to 3 years and a fine of 150 to 250 days, doubled in case of recidivism. Negligence is also punishable with a fine of 50 to 150 days.

How suitable the current laws regarding intellectual property are regarding the digital products and its illegal reproduction remains undetermined and a matter of contention in the legal community.

Nevertheless, a relationship between piracy and declining sales has yet to be clearly established, with some studies presenting evidence linking piracy to declining sales while others do not do so (Sinha, Machado and Sellman, 2010).

2.2 - Digital Rights Management

While an universally agreed upon definition of Digital Rights Management (DRM) does not seem to exist, a number of features and aspects are normally found as the main objectives for DRM systems. These main objectives may be consider as the following: to protect, to control access to and to enforce the conditions of use of copyrighted content while preventing and tracking illicit or unauthorized use of such content. While cryptographic algorithms prevent unauthorized access, rights expression languages define the conditions of use and steganography, such as digital watermarks, enable tracking and profiling of users (Benczek, 2006).

DRM employs some of the basic notions of cryptography, where you have two parties that wish to transmit a message using a pre-determined symmetric key and applying a crypto-algorithm to encrypt and later decrypt the message, preventing those who do not know the key from reading said message. Cryptography was designed to make the recovery of plaintext from the ciphertext (and other available information, such as limited amount of plaintext) computationally infeasible. Carefully implemented cryptography effectively solves this problem (Stamp, 2003).

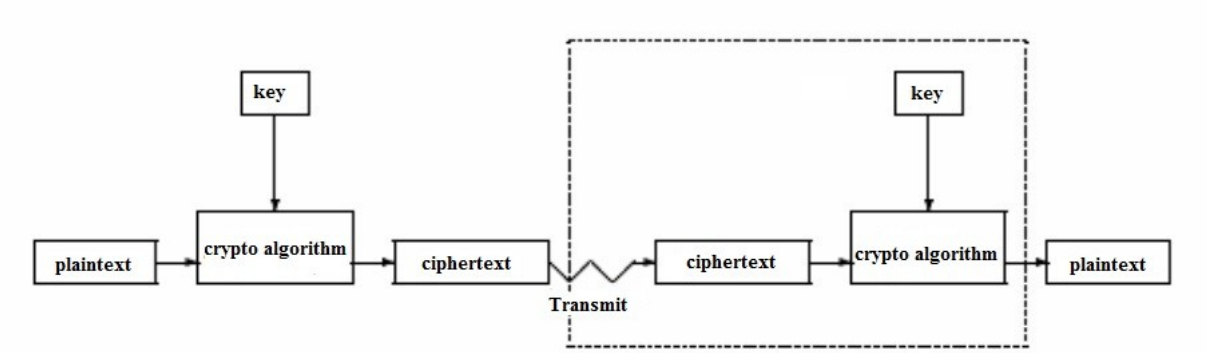


Figure 2.1: Cryptography, adapted from (Stamp, 2003)

The problem is when both the cryptographic equipment and keys are available to those that wish to read the secret message and were not allowed to do so, meaning that the dashed box on Figure 2.1 would be in the hands of those that were not supposed to have it. This is analogous to the DRM scenario, where the system attempts to restrict the actions of the intended recipient. Correctly implemented strong encryption assures us that converting ciphertext to plaintext without access to the key is computationally infeasible. Therefore, it is necessary that DRM employ strong encryption in order to eliminate the possibility that an attacker can remove protection without first recovering the key. But encryption alone is not sufficient to provide persistent protection and, at a minimum, the encryption key must be protected, which presents a considerable challenge on an open architecture such as a modern personal computer. Considering that an attacker can recover a crypto key by reverse engineering the software that contains or accesses the key, in a DRM system it is necessary that the reverse engineering problem be as difficult as possible (Stamp, 2003).

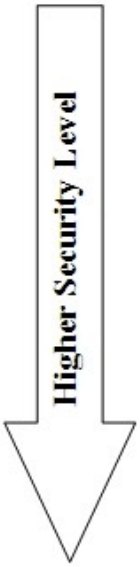
The most direct ancestors to the DRM systems used today would be the failed attempts made in the 1960's by the audio recording industry to mix an inaudible signal with the recording that would distort the signal at the magnetic reproducing head of a tape recorder, thus preventing copies (Syversen, 2004). Later in the 1980's, the Digital Audio Tape (DAT) systems, that sample audio at even higher rates than on a normal music CD and feature optical input and output, allowed digital data to be transferred from a CD without any reduction of signal, presenting this way the first opportunity to make a perfect copy of digital music. This lead to the Audio Home Recording Act in the Unites States of America, that enforced a 'Serial Copy Management System' to be built into all DAT recorders. By adding copy information when recording data on a device it should be impossible to make new duplicates of the first copy but as this was an implanted electronic signal, there were also devices that removed this data and enabled an unlimited number of copy generations (Syversen, 2004). This resembled efforts made in movie players, with Macrovision scrambling the output from VCR and

DVD and thereby producing viewable images, at the same time making the signal useless for recording on another machine. In DVD there is also the Content Scramble System (CSS) encryption that protects the digital contents by making the data on the dics unreadable without the decryption aids found in commercial DVD players. For both systems there are ways to remove them, be it through mechanical arrangements that remove Macrovision electrical pulses or using a 'DeCSS' algorithm to decrypt CSS (Syversen, 2004). Eventually the circumstances lead to an amendment of the American Digital Media Consumers' Rights Act of 2003, hoping to restore fair use and allowing user to go around protection mechanisms as long as the effort does not violate copyright of any works but having the unintended consequence of stifling legitimate activities of innovators, researchers, the press and the public at large (von Lohmann, 2004, 2010).

It is possible to find DRM systems in both digital copies transferred over the internet as well as those sold on CDs, DVDs and other physical carriers. These systems interact with the software and hardware of the user and indicate which content can be accessed by the user, serving this way to protect the interests of the owners of copyrights. Due to these DRM systems being relatively recent, technical and operational structures, payments systems and the extent to which data are collected differ significantly (Benczek, 2006). There are dozens of active DRM companies along with a growing number of formerly active companies, developing their own systems (Stamp, 2003).

The effectiveness of such systems in reducing piracy levels and how harmful it can be to the paying costumer is still up for debate, with some companies, namely in the music industry, choosing to move away from DRM while others, particularly in the e-book industry, continue to use it, despite consumer complaints (Easley, Kim and Sun, 2012). Proponents of DRM defend that imposing DRM restrictions leads to a decrease in piracy that in turn leads to higher profits for the copyright owners while opponents of DRM argue that eliminating DRM would improve the value of the product for legal users, since only legal users pay the price and suffer from the restrictions (illegal users are not affected because the pirated product does not have DRM restrictions), which would in turn increase their willingness to pay, and thus increase industry profits (Vernik & Purohit 2011).

According to Stamp (2003), DRM systems aim for one of the following four distinct security levels as seen on Figure 2.2:



Honor System	• Rely on users to "do the right thing" • No real attempt is made at technical security protection
Minimal software-based protection	• Limited technical means of protection • Only able to deter naïve users
Maximal software-based protection	• Users cannot do operations that might compromise security • Employ tamper checking techniques and various other methods
Tamper-resistant hardware	• Not a realistic option for personal computers or similar devices

Figure 2.2: Security Levels of DRM Systems, adapted from (Stamp, 2003)

The honour system rely on users (or programmers) to act according to law and is somewhat analogous to the shareware distribution software, having limited success in the marketplace. At a slightly higher level are systems that employ an extremely limited protection where, for example, such a system might attempt to protect a PDF document by simply disabling the "save as" feature and any user who is knowledgeable enough to operate a screen capture program is likely to be able to defeat such a system. In the next level, systems try to attain a measure of controlled execution, not allowing the user to perform operations that might compromise security (using the previous example, disallowing a screen capture program to run) and employing tamper checking techniques, controlled rendering and various other methods. At the highest security level stand the systems that rely on tamper-resistant hardware, a not yet realistic solution for systems intended for personal computers or similar devices (Stamp, 2003).

From the consumer point of view, DRM have the benefit of allowing different distribution models, such as pay per use, subscription, use metering, and rental, which enables economical pricing and distinctive service models while presenting the user with the inconvenience of restricting the use of the digital content, be it limiting the number of uses, applying expiration dates that require renewal or preventing the user from using the content on all their devices (Hwang, 2009). Still, many of these copy prevention systems have led to customer outrage, since products embedding them often fail to

function as expected (Syversen, 2004). Whether it is restricting the product to only allow contents to run on a very limited set of platforms or setting special limits to what data can be used on a particular platform, it is easy to understand the costumers' frustration having purchased the product expecting it to function in all players and to be able to access the data in it. New digital markets have amplified such fears since there is no longer a transfer of a physical product with DRM technologies ensuring that the consumer's library expires when the copyright holder determines it should, with no physical backup for the consumer to fall back on.

It is not hard to comprehend why the interested parts insist that implementing DRM protection is the right answer to prevent piracy in the digital realm and it outweighs the costs of DRM, both direct and through negative consumer impact. In spite of its flaws, DRM systems remain the preferred tools for authors of creative content and publishers to combat the ease with which it is possible to transport and consume unauthorized audiovisual content nowadays, at least for users with low technical knowledge, and the importance of DRM as a multidisciplinary technology is undeniable, having promoted innovative research and development in such diverse fields as authentication, biometrics, forgery detection and others (C. J. Kuo, Kalkler and Zhou, 2004).

2.3 - DRM Free Environment and Education

While the problem of unauthorized use of copyrighted material seems to be more debated than ever in this digital era, it is hardly a recent issue, as mentioned before in this thesis. The production of modern computer systems and the ability to effortlessly represent and transfer information as bit messages does not change the basis of the problem but it does bring to light more than ever the question on how to regulate the potentially limitless reproduction and how to compensate the rightful copyright owners when their work is redistributed. Since companies address it as a digital problem, it seems to beg for a digital solution, hence the adoption of DRM systems. While these systems can in fact deter piracy at a very basic level (Stamp, 2003), they have lead to consequences far outreaching the initial scope of their implementation (Pantalony, 2002; von Lohmann, 2010). But with illegal use of copyrighted material persisting even after the implementation of ever more advanced DRM technologies, measures have been taken by different stakeholders in the entertainment industry to provide to the consumer digital content without DRM systems in order to take a different approach to the problem, decisions supported by studies that consider the existence of a positive outcome from the removal of DRM,

keeping in mind the consumer and producer welfare (Sinha, Machado and Sellman, 2010; Syversen, 2004). These actions should be complemented with educational efforts taken offline as well as on-line to help technology users to understand that digital piracy is an illegal activity and the different benefits, dangers and morals of participating in the on-line world that have been suggested as an effective strategy to reduce instances of digital piracy (Morris and Higgins, 2010).

Such measures should come with the understanding that short-term along with long-term strategies need to be adopted to increase awareness and educate individuals about the negative impacts of piracy, emphasizing facts pertaining to the negative social and economical consequences, as research has shown to be viable solutions to reduce the amount of unauthorized use of copyrighted content, keeping in mind that increasing awareness would be the first step towards changing beliefs and attitude, a process that may take a fairly long period of time (Nill, Schibrowsky and Peltier, 2010).

2.4 - Related Works

A number of works related to the matters addressed in this chapter have been studied, with the most relevant ones presented in this section.

The main resource on how piracy evolved through the ages was an account of the intellectual property wars from Gutenberg to Bill Gates by Johns (Johns, 2009) that fully explored how publishing of intellectual property combated piracy throughout its different iterations on different formats, from printed books to digital compact discs and even biological and pharmaceutical products.

The impact of digital piracy in general (Sundararajan, 2003; Choi, Sang Hoo Bae and Jun, 2010) and in its different fields has been deliberated, with studies on digital music indicating producer's shrinking profits (Iltae Ahn and Yoon, 2009) and increased social welfare (Vernik, 2009; Iltae Ahn and Yoon, 2009) as causes of digital piracy, while the impact of software piracy was addressed in a study from Husted (Husted, 2000) that concluded that software piracy was correlated to a country's GNP per capita, income inequality and individualism, although said data was provided by the Business Software Alliance, which has been subject to criticism (Husted, 2000). Nill, Schibrowsky and Peltier (Nill, Schibrowsky and Peltier, 2010) provided a more localized analysis by providing factors that influence piracy in Germany. In most of these cases, the authors reported difficulties regarding the

availability of data and its handling (I. Ahn and Yoon, 2009; Vernik, 2009; Husted, 2000).

Suggestions for anti-piracy programs were provided that focused on providing incentives so that large groups, rather than individuals, are willing to comply with legal norms while demonstrating to the general public that piracy is a shameful practice, pointing out that focusing on the criminal nature of piracy would probably have less impact (Husted, 2000). Morris and Higgins (Morris and Higgins, 2010) application of criminal theory in digital piracy provided similar suggestions, mentioning initiatives geared toward educating youngsters about the benefits, dangers and morals of participating in the digital community.

On his study that analysed the persistence of the piracy issue, Panethiere (Panethiere, 2005) advises against using a single mean, be it litigation or education alone, and adopt a joint effort by the artistic communities and industries to take concerted actions, enhance public awareness and galvanize political will to eventually eradicate piracy, that resembles suggestions from other authors (Nill, Schibrowsky and Peltier, 2010).

Regarding the networks and technologies used to share digital content, works on it by Biddle, England and Peinado (Biddle, England and Peinado, 2002), Jaisingh (Jaisingh, 2007) and Waelde and Edwards (Waelde and Edwards, 2005) were studied to better understand the intricacies of digital content distribution and the risks of such activities to both content producers and intermediaries as well as the legal implications of copyright infringement, that were further addressed by Lastowka (Lastowka, 2010) and Lessig (Lessig, 2004).

In regards to the use of DRM to protect the IP and combat piracy, there was plenty of material available on the subject. From works discussing the technologies employed (C. J. Kuo, Kalkler and Zhou, 2004; Pantalony, 2002; Stamp, 2003; Subramanya and Yi, 2006), its standardization (Rump, 2004), their viability (Hwang, 2009), existing variations (Syversen, 2004; Torres-Padrosa and Delgado-Mercé, 2011), privacy concerns related to DRM (Grimm, 2005), their implications in the European Union legal framework (Benczek, 2006), the optimal level of DRM use (Illtae Ahn and Shin, 2010; S.H. Bae and Choi, 2007; Y.-L. Chang, 2007; Easley, Kim and Sun, 2012; L. Zhang, M. Zhang and X. Wang, 2008) and pricing of digital content with DRM (Park and Scotchmer, 2005; Vernik, 2009), the many facets of DRM were studied to better interpret the problem presented in this dissertation.

Articles and publications defending a DRM-free environment were also analysed, with some authors presenting reasons not to apply DRM technologies and emphasizing the negative aspects of applying

DRM technologies and restrictive measures (Doctorow, 2005; Hinze, 2008; von Lohmann, 2004, 2010), while others argued the viability of adopting a DRM-free environment (Sinha, Machado and Sellman, 2010; Vernik and Purohit, 2011).

3 - DECISION MAKING

Humans are fundamentally decision makers since everything we do consciously or unconsciously is the result of a decision. We do our best to gather useful information that will allow us to make an informed decision and not make the mistake of gathering massive amounts of information that may or may not improve our understanding and judgements.

In order to make a decision, we have to know the problem, the need and purpose of the decision, the criteria of the decision, their stakeholders and groups affected and the alternative actions to take and then try to determine the best alternative (Saaty, 2008). The criteria may be intangible and the measurement of intangible factors in decisions has for a long time defied human understanding. Number and measurement are the core of mathematics and mathematics is essential to science. Mathematics assume that all things can be assigned numbers from minus infinity to plus infinity, and all mathematical modelling of reality is described using axes and geometry. All this is predicated on the assumption that one has the essential factors and all these factors are measurable (Saaty, 2008). While socio-economical, political, cultural and psychological factors should be taken into account in many cases, these factors are generally ignored by many decision making methods since they are expressed by qualitative variables (Büyükyazici and Sucu, 2003).

One model found in technical literature that exemplifies such limitations is the Weighted Sum Model (WSM), that evaluates a number of alternatives in terms of a number of decision criteria, adding relative weights and alternative's scores to determine the best alternative (Triantaphyllou et al., 1998). While being an extremely accessible and simple method, it cannot function unless all the data is expressed in exactly the same unit (Triantaphyllou et al., 1998). A derivation of this model, the Weighted Product Model (WPM), that instead of using addition in the model it uses multiplication, bears those same disadvantages (Triantaphyllou et al., 1998).

Another method, the ELECTRE (*ELimination Et Choix Traduisant la REalité*) method, introduced in 1966 provides a clearer view of alternatives by eliminating less favourable ones through the use of pairwise comparisons of alternatives under each criterion but yields a whole system of binary outranking relations between alternatives that is not necessarily complete and as such the ELECTRE method is sometimes unable to identify the preferred alternative (Triantaphyllou et al., 1998).

An alternative to the ELECTRE method was put forward in 1981 and named the Technique for Order

Preference by Similarity to Ideal Solution (TOPSIS), that took the basic concept of selecting the alternative that has the shortest distance to the ideal solution and the farthest distance from the negative-ideal solution in a geometrical sense while assuming that each attribute has a tendency of monotonically increasing or decreasing utility, which allows to easily locate the ideal and negative-ideal solutions (Triantaphyllou et al., 1998).

All these methods (the WSM, the WPM, the TOPSIS and the ELECTRE method) have been found to present limitations when dealing with group decision-making, to have difficulties in structuring the decision-making process and to fail to incorporate both quantitative and qualitative factors (Triantaphyllou et al., 1998; Zammori, 2010).

Since the 1960's, many studies concerning multi-criteria decision making have been made to provide a systematic and comprehensive approach to decision making in which both quantitative and qualitative variables can be included in the evaluation and at the forefront of this movement is Thomas Saaty, who, in the late 1960's, developed a decision making method in which qualitative variables can be included in the evaluation, called Analytic Hierarchy Process (AHP) (Büyükyazici and Sucu, 2003), and later its generalization to dependence and feedback, the Analytic Network Process (ANP) (Saaty and Vargas, 2006). These methodologies alongside studies of the scope of human values in decision making enable researchers to analyse problems and alternatives without neglecting the aforementioned qualitative psychological and social factors (Saaty and Begicevic, 2010).

3.1 - Analytic Hierarchic Process

The AHP is a general theory of measurement used to derive relative priorities on absolute scale from both discrete and continuous paired comparisons in multilevel hierarchic structures of independent elements, keeping in mind that a hierarchy is a linear top down structure with no feedback from bottom to top levels and is characterized by a goal cluster at the top and an alternatives cluster at the bottom (Zammori, 2010). These comparisons may be taken from actual measurements or from a fundamental scale that reflects the relative strength of preferences and feelings (Saaty and Vargas, 2006).

To make a complex decision in an organized way to generate priorities, one should decompose the decision into four steps (Saaty, 2008):

1. Define the problem and determine the kind of knowledge sought;

2. Structure the decision hierarchy from the top with the goal of the decision, then the objectives from a broad perspective, through the intermediate levels to the lowest level (that usually consists of a set of alternatives);

3. Construct a set of pairwise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it;

4. Use the priorities obtained from the comparisons to weigh the priorities in the level immediately below, doing this for every element. Then for each element in the level below add its weighed values and obtain its overall or global priority. This process of weighing and adding should be repeated until the final priorities of the alternatives in the bottom most level are obtained.

It should be noted that before aggregating the relative weights of decision elements in order to obtain an overall rating for the alternatives and be able to reach a decision, one should check the consistency property of matrices to ensure that the judgements of decision makers are consistent (Lee, 2009a). Also of note is that the comparisons should be made on homogeneous elements that are close so that the judgements are not wild guesses and, if they are not homogeneous, they should be carefully selected to go into groups or clusters with a common element from one group to the next (Zammori, 2010).

In order to make the comparisons, a scale of numbers that indicates how many times more important or dominant one element is over another element with respect to the criterion or property with respect to which they are compared has to be used. This process allows to improve the quality of the judgements since it is easier to concentrate on just two factors at one time and to provide a comparative value from a scale than just adopt a random evaluation devised by the respondents on the spur of the moment (Zammori, 2010).

The fundamental scale of values to represent the intensities of judgements is shown in Table 3.1, as devised and validated by Thomas Saaty (Saaty, 2008).

Table 3.1: Fundamental scale of absolute numbers (Saaty, 2008).

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
2	Weak or slight	
3	Moderate importance	Experience and judgement slightly favour
4	Moderate plus	
5	Strong importance	Experience and judgement strongly favour one activity over another
6	Strong plus	
7	Very strong or demonstrated importance	An activity is favoured very strongly over another; its dominance demonstrated in practice
8	Very, very strong	
9	Extreme importance	The evidence favouring one activity over another; its dominance demonstrated in practice
Reciprocals of above	If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i*	A reasonable assumption
1.1 – 1.9	If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.

The reciprocal property is a particularly important aspect of paired comparisons; when one element is determined to be x times more dominant than another with respect to a given property, the lesser one is used as the unit and the larger is estimated to be some multiple of that unit and the inverse comparison is then made by assigning the lesser element the reciprocal value $1/x$ (Saaty and Vargas, 2006).

When there are several criteria to perform prioritisation and obtain synthesis the need arises to compare the importance of the criteria with respect to higher level criteria or with respect to a goal to determine their priorities and derive priorities for the alternatives with respect to each criterion (Saaty and Vargas, 2006).

One of AHP's most valued strengths is its simplicity and intuitiveness that derive from its linearity: the flow of influence in a AHP model is clear, proceeding from the outright top level to the bottom level while moving through a series of intermediate levels that represent the criteria in which the goal is decomposed (Zammori, 2010). On the other hand, a considerable flaw is the assumption made by the AHP that there is independence of higher level elements from lower level elements in a hierarchy or between elements of the same level, leading to a rigid structure that does not allow to create a general framework to deal with decisions that rely on dependencies (Zammori, 2010).

3.2 - Analytic Network Process

Many decision problems cannot be structured hierarchically when the interaction of higher level elements with lower level elements and their dependency should be taken into consideration and for these cases there's the Analytic Network Process (ANP). While the AHP models a decision making problem using a unidirectional hierarchical relationship among decision elements, the ANP allows for more complex interrelationships among decision elements (Büyükyazici and Sucu, 2003), spreading out in all directions and involving cycles between clusters and loops within the same cluster, as illustrated in Figure 3.1., which also leads to an increase in the complexity of the model (Zammori, 2010).

In the ANP, the components of the systems are depicted as nodes. If there is an interaction between two nodes, an arrow will connect them and its orientation will show the direction of the influence between them, with loops indicating inner dependencies among nodes of the same cluster (Zammori, 2010).

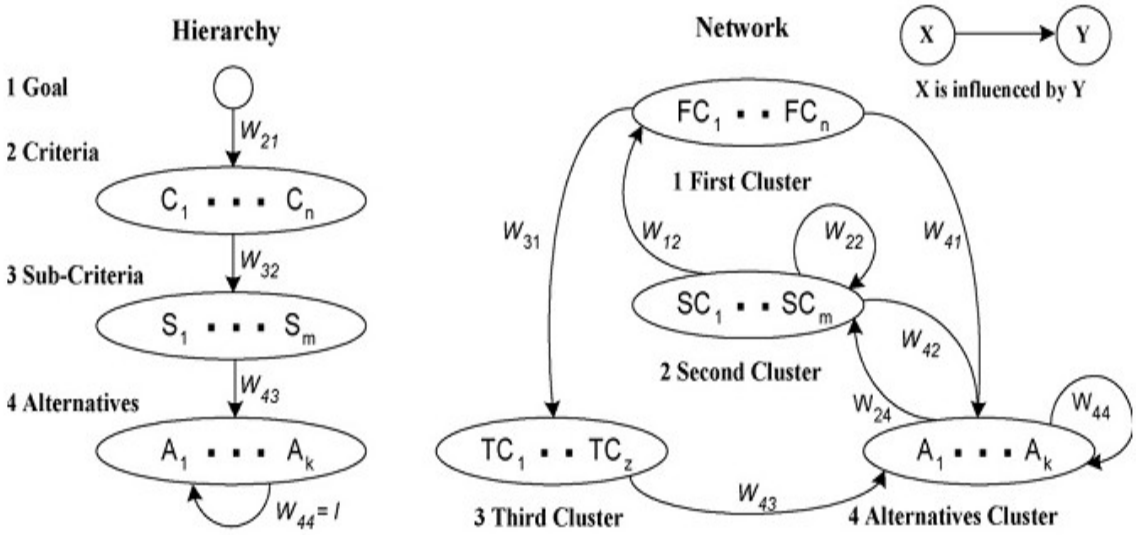


Figure 3.1: Comparison of a hierarchy with a network (Zammori, 2010).

The ANP is composed of four qualitative (1 to 4) and five quantitative (5 to 9) steps (Cheng, Li and Yu, 2005):

1. State the decision problem – The topmost level is to state the decision problem, starting with the decomposition of further levels down the structure until final level that is usually the scenarios or alternatives to be selected;

2. Verify that the decision problem is to be solved by ANP – The ANP is used to structure a decision problem into a network form and for solving a strictly hierarchical model the AHP is sufficient;

3. Structure the unstructured decision problem – The topmost decision problem level is abstract in nature. It must be decomposed into a set of manageable and measurable levels until the level of criteria for assessing the scenarios or alternatives;

4. Determine who the raters are – Those who are responsible for making the decision are raters for completing a questionnaire;

5. Design a questionnaire for eliciting data from raters – It is suggested to use the pairwise comparison, which can elicit more information to assign weights to the rated elements and to adopt the previously presented fundamental scale of absolute numbers to estimate the relative importance between paired elements;

6. Calculate the eigenvector of each of the developed matrices – Each decomposed level with respect to a higher level forms a matrix. It is necessary to calculate the eigenvector for the elements of this matrix;

7. Measure the consistency ratio (CR) of each of the matrices to find out the inconsistency of rating – One of the best reasons to use pairwise comparison and matrix is to measure the CR to ascertain that raters are consistent in rating. If the CR value cannot pass the acceptable level, it is certain that the raters rated arbitrarily or mistakenly, and re-rating is then needed;

8. Form the supermatrix by the eigenvectors of the individual matrices – The eigenvectors of each of the developed matrices should gather together to form a supermatrix;

9. Compute the final limit matrix – In order to compute the final limit matrix, the supermatrix, which has been ensured of column stochastic, has to raise to high power until weights have been converged and remain stable.

For both the AHP and ANP, the pair-wise comparison is made in the framework of a matrix, and a local priority vector can be obtained for estimating the relative importance associated with the elements being compared by solving the following expression:

$$A \cdot \omega = \lambda_{max} \cdot \omega \tag{3.1}$$

where A denotes the matrix of pair-wise comparison, ω represents the eigenvector and λ_{max} is the largest eigenvalue of A (Hsu and M. Kuo, 2011).

To verify the consistency of the comparison matrix, the consistency index (CI) and the consistency ratio (CR) can be adopted (Yüksel and Dagdeviren, 2007) and defined as:

$$CI = (\lambda_{max} - n)/(n-1) \tag{3.2}$$

$$CR = CI / RI \tag{3.3}$$

where random index (RI) denotes the average consistency index for numerous random entries of same-

order reciprocal matrices and *n* the size of the matrix (Hsu and M. Kuo, 2011). If CR ≤ 0,1, then the estimate is accepted; otherwise, a new comparison matrix is solicited until CR ≤ 0,1 (Lee et al., 2010). Inconsistency measures the logical inconsistency of judgements (Saaty and Vargas, 2006). For example, if a person was to say that X is more important than Y and that Y is more important than Z and then say that Z is more important than X, that person is not being consistent. A less inconsistent situation would be if a person was to say that X is four times more important than Y, that Y is two times more important than Z and that X is nine times more important than Z.

The supermatrix is actually a partitioned matrix where each matrix segment represents a relationship between two components in a system and to obtain global priorities in a system involving interdependent influences, the local priority vectors are entered into the appropriate columns of the supermatrix based on the flow of influence from one component to another (Saaty and Vargas, 2006).

Let the components of a decision as C_k, h = 1, ...*n*, and assuming that it has m_k elements, denoted by ek1, ek2, … ekmk, and letting W_{ij} (I = 1,2,...,n, *j* = 1,2,...,n) denotes the sub-matrix. Figure 3.2 shows a standard form of a supermatrix.

$$
W = \begin{array}{c}
 \\
 \\
C_1 \\
 \\
 \\
C_k \\
 \\
 \\
C_n \\

\end{array}
\begin{array}{c}
\begin{array}{cccccc} C_1 & & \cdots & C_k & & \cdots \end{array} \quad C_n \\
\begin{array}{cccccc} e_{11} \cdots e_{1m_1} & & \cdots & e_{k1} \cdots e_{km_k} & & \cdots \end{array} \quad e_{n1} \cdots e_{nm_n} \\
\begin{bmatrix}
W_{11} & \cdots & W_{1k} & \cdots & W_{1n} \\
\vdots & \vdots & \vdots & \vdots & \vdots \\
W_{k1} & \cdots & W_{kk} & \cdots & W_{kn} \\
\vdots & \vdots & \vdots & \vdots & \vdots \\
W_{n1} & \cdots & W_{nk} & \cdots & W_{nn}
\end{bmatrix}
\end{array}
\begin{array}{l}
e_{11} \\
e_{1m_1} \\
e_{k1} \\
e_{km_k} \\
e_{n1} \\
e_{nm_n}
\end{array}
$$

Figure 3.2: Standard form of a supermatrix, adapted from (Tan et al., 2007)

The supermatrix will be a steady state by multiplying the weighted supermatrix by itself until the row values converge to the same value for each column of the matrix (Tan et al., 2007). The alternative with the highest overall priority should be selected.

This framework is based on the following basic definitions and axioms (Köne and Büke, 2007):

- A priority or weight which is an absolute number, belongs to the closed interval [0,1] and is a measure of relative dominance;

- A reciprocal condition exists that posits that the ratio comparison between components is possible such that an evaluation of the pairwise couple (C_A,C_B) equals 1/(C_B,C_A);

- Homogeneity exists, which is the motivation for the 1-9 evaluation scale, wherein the upper limit 9 is due to the requirement of homogeneity to maintain the stability of the eigenvector to perturbation from consistency, and also due to the requirement that only a small number of elements that are of close importance should be compared;

- A dependence condition is assumed that the system can be decomposed into component parts. Both the scale and the number of elements compared can be extended indefinitely.

Since it's initial development, the ANP has become a common tool due to its elevated analytical ability (Saaty, 2007), having been used in a great variety of situations; from estimating the Colombian baby diaper market share (Neira, Castillo and Lesmes, 2009) to evaluating the best response from the United States of America to the North Korean nuclear threat (Saaty and Vargas, 2006).

3.3 - Analysis of Benefits, Opportunities, Costs and Risks

Any decision has favourable and unfavourable concerns to consider which makes it possible to deal with a decision from four different standpoints: the Benefits (B) that the decision brings, the Opportunities (O) it creates, the costs (C) that it incurs, and the risks (R) that it might carry, collectively known as BOCR merits. In the field of strategic planning, it is sometimes used similar factors known as SWOT (Strengths, Weaknesses, Opportunities and Threats) having switched the order of weaknesses and opportunities in making the connection with BOCR (Saaty, 2008). The alternatives must be ranked for each of the merits and then the four rankings are combined into a single overall ranking by rating the best alternative in each of the BOCR on strategic criteria that an individual uses to decide whether or not to implement one or the other of the decisions that they face.

Under the BOCR concept, pairwise comparison questions ask which alternative is most beneficial or provides the best opportunities in the Benefits and Opportunities sub-networks, respectively. For the Risks and Costs sub-networks, the pairwise comparison questions ask which alternative is riskiest or costliest. The weights of the alternatives under Benefits, Opportunities, Costs and Risks are combined to get a single outcome for each alternative (Lee, 2009b). Five ways have been proposed to combine the scores of each alternative (Lee, 2009a):

1. Additive

$$Relative\ priority\ for\ alternatives = bB + oO + c(1/C) + r(1/R) \tag{3.4}$$

where B, O, C and R represent the synthesised results and b, o, c and r are normalised weights of B, O, C and R subnets, respectively.

2. Probabilistic additive

$$Relative\ priority\ for\ alternatives = bB + oO + c(1-C)_{Normalised} + r(1-R)_{Normalised} \tag{3.5}$$

Costs and Risks values are treated as probabilities. If a likelihood of an occurrence is p, the the likelihood of not having an occurrence is 1-p.

3. Subtractive

$$Relative\ priority\ for\ alternatives = bB + oO - cC - rR \tag{3.6}$$

Using this formula, results can end up being negative since the most costly and risky alternatives are left with the highest priorities, as they come up from the subnets, but subtract from the benefits and opportunities.

4. Multiplicative priority powers

$$Relative\ priority\ for\ alternatives = B^b O^o [(1/C)_{Normalised}]^c [(1/R)_{Normalised}]^r \tag{3.7}$$

5. Multiplicative

$$Relative\ priority\ for\ alternatives = BO/CR \tag{3.8}$$

The BOCR concept can be applied by either the AHP or the ANP (Lee, 2009b).

3.4 - Related Works

A number of works related to the matters addressed in this chapter have been studied, with the most relevant ones presented in this section.

In order to get a better knowledge on the multi-criteria decision-making existent methods, seminal works were studied that allowed to get a better understanding of the field, such as Triantaphyllou et al. and Wallenius et al. works on MCDM methodologies (Triantaphyllou et al., 1998; Triantaphyllou, 2000; Wallenius et al., 2008), on the AHP and ANP by Thomas Saaty (Saaty, 2008, 2007; Saaty and Begicevic, 2010; Saaty and Vargas, 2006), and comparisons of the AHP and ANP methods by Zammori (Zammori, 2010) and Büyükyazici and Sucu (Büyükyazici and Sucu, 2003).

Numerous examples of diverse ANP applications where studied ranging from job performance evaluation for construction companies (Cheng and Li, 2006), evaluation of alternative fuels for electricity generation in Turkey (Köne and Büke, 2007), analysis of an Indian telecommunication service supply chain (Pramod and Banwet, 2010), selecting full-service advertising agencies (Hsu and M. Kuo, 2011), studying revitalization strategies of the Alishan Forest Railway in Taiwan (Y. Chang, Wey and Tseng, 2009), location selection for a shopping mall in Hong Kong (Cheng, Li and Yu, 2005), to being used in a SWOT analysis of a textile firm (Yüksel and Dagdeviren, 2007). These were complemented with works that added a BOCR analysis to the ANP model for supplier selection in a diesel engine manufacturing firm (Tan et al., 2007), selection of a high-tech transaction processing system (Erdogmus, Kapanoglu and Koc, 2005) and evaluation of supplier relationships in high-tech industry (Lee, H.-J. Chang and Lin, 2009).

4 – PROPOSED MULTI-CRITERIA MODEL FOR DIGITAL PIRACY REDUCTION STRATEGY SELECTION

The goal of this research is to propose a multi-criteria decision making (MCDM) model to help decision makers select the best practice in their digital marketplace in order to diminish piracy and such model is presented in this chapter.

Although there are many decision making tools available, for this research the Analytical Network Process from Thomas L. Saaty (Saaty and Vargas, 2006) was the chosen one.

The ANP was selected due to its ability to provide a general framework to deal with decisions without making assumptions about the independence of the elements between and within levels and allowing both interaction and feedback within clusters (inner dependence) and between clusters (outer dependence), something that the AHP is unable to do. To better evaluate each alternative, the criteria and their relationships are defined under benefits, opportunities, costs and risks.

4.1 - ANP model with BOCR analysis

The main goal for this model is to answer the question "What is the best alternative to diminish digital media piracy and thereby increase the number of consumers?". To do this we have to include the benefits, costs, opportunities and risks involved in the decision making process, leading to the control hierarchy in this model, illustrated in Figure 4.1.

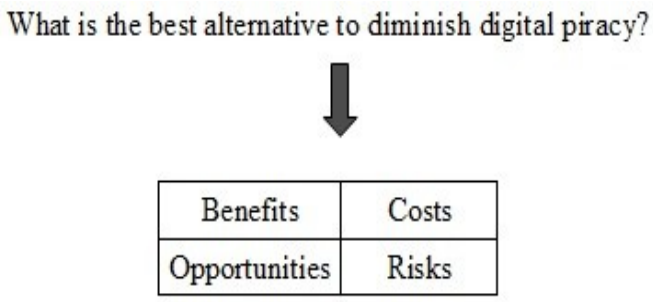


Figure 4.1: Control hierarchy

At the top of the control hierarchy exists the goal. The goal is to determine the best strategic decision which in this case is the best alternative to diminish digital piracy. The top-level network is connected to the BOCR sub-networks that have equal importance in the goal. These sub-networks consist of a network of interactions among the clusters of the alternatives and the selected criteria.

In this work a two-level network is applied that does not require strategic criteria and the BOCR merits are directly connected to the goal.

Based on literature review and research the following alternatives were considered for the model:

1. Education - Investment in education and awareness of individuals, as beings who live and organize themselves in a society, could have a greater effect in reducing piracy than the development of additional DRM technologies or draconian laws (Morris and Higgins, 2010; Husted, 2000), enabling the adoption of a "free model" (unrestricted use of the intellectual property), in order to capture and retain a greater number of consumers (Sinha, Machado and Sellman, 2010).

2. Law enforcement – Request government and competent officials to enforce existing laws and/or devise newer and harsher laws to further protect copyrights, punish copyright-infringement and possibly discourage users with criminal intents (Panethiere, 2005; Nill, Schibrowsky and Peltier, 2010).

3. Security - Develop more stringent measures that give more control to the owner of intellectual property over the freedom of use while potentially making it more difficult to create illegal copies and increasing the hassle for technologically capable users (Stamp, 2003; Panethiere, 2005).

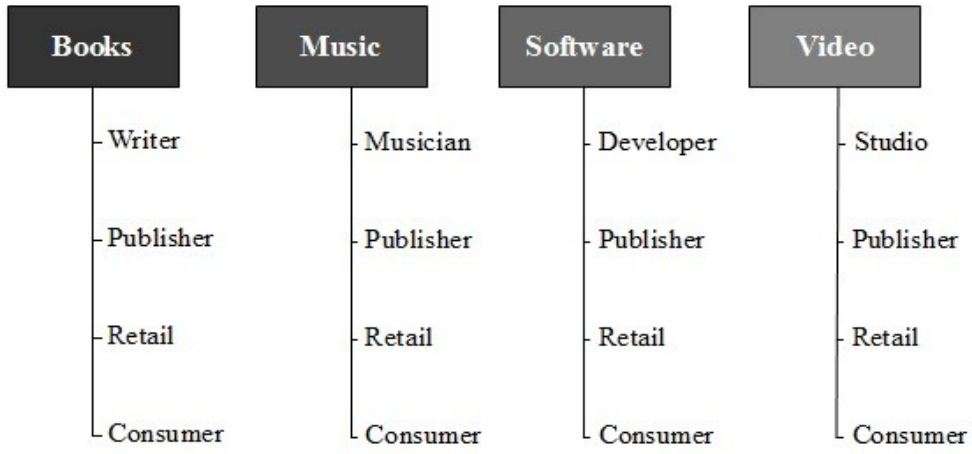


Figure 4.2: The four areas of the digital media

Four main cores can be identified within the digital media realm with the following stakeholders, applying the model to each of these stakeholders in each of the cores presented in Figure 4.2.

For each of the four groups of stakeholders, a BOCR analysis was developed to illustrate the different criteria relevant to the domain they work on.

The decision elements at each component of the BOCR are compared pairwise with respect to their merit. Experts are asked to respond to a series of pairwise comparisons in which two elements are compared in terms of how they contribute to their particular upper level criterion (Saaty and Vargas, 2006). For example: when comparing Benefits criteria in regard to the alternatives, the question will ask how preferable one criteria is over the other in regard to the selected alternative or, in other words, it will focus on how much more benefits one criteria will bring over the other for that alternative. In case of multiple respondents, the geometric mean is applied to combine the experts responses and the consistency test is applied to verify the consistency of each comparison matrix (Tan et al., 2007).

Two types of connections between nodes contained in clusters in each sub-network are represented as one-way and two-way dependences. If there is one-way dependence between the two clusters, it is presented with directed arrows. The two-way dependences are represented with bi-directed arrows.

The sub-networks and pairwise comparisons are represented in the following sub-chapters for each the stakeholders in the digital books market. Due to the similarities between the digital books, music, video, and software markets, with the same criteria applied for the author (writer, musician, studio and software developer), publisher, retailer and consumer, only the area that is later studied in a practical application of the model is presented in this chapter.

The sheer scope of the target-markets of this research lead to the simplification and generalization of the criteria, so that questionnaires wouldn't get too voluminous and thus later create foreseeable complications when gathering data through interviews with experts.

4.1.1 - Digital Books

Digital books, also known as *e-books*, are the digital embodiment of the ancient art of written work, presenting as much variety as its physical version and introducing new ways of selling, transferring

and enjoying the work as well as new adversities that tend to be refashions of age-old problems (Johns, 2009). The most common format for digital books is Adobe Systems' protected Portable Document File (PDF) but open alternatives exists such as EPUB (short for electronic publication) by the International Digital Publishing Forum (McSherry and Cohn, 2010).

The stakeholders and criteria that were considered for this market are presented next.

4.1.1.1 – Author

The author is the creator of the written work. The following criteria was considered for the author:

Table 4.1: BOCR analysis for the Author

Benefits	Costs	Opportunities	Risks
- Dissemination of IP - Image	- Higher vulnerability to illegal copying - Lack of publishers	- Reach a larger number of consumers - New sources of revenue - Encourage the exchange of ideas	- Loss of control over IP

Benefits:

- Dissemination of IP: to encourage the spread of intellectual property, bringing the authors' work to a greater number of interested people and giving the opportunity for the authors to share their thoughts with a larger audience, in turn providing satisfaction in seeing their own work discussed and more prospective consumers of their works .

- Image: to create an identity with consumers that leads to a relationship of trust and proximity to them, providing an incentive for future acquisitions of the authors' work.

In Figure 4.3, the Benefits sub-network for the author is illustrated, displaying the two-way dependences between the two existing clusters of Alternatives and Criteria.

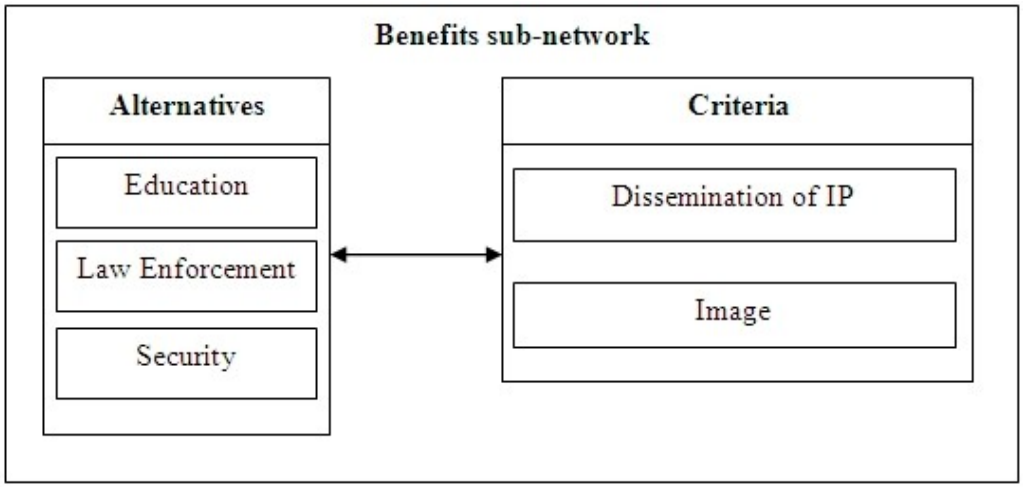


Figure 4.3: Author - Benefits sub-network

Opportunities:

- Reach a larger number of consumers: digital distribution provides the authors a broader range of audiences to communicate with, allowing a greater number of people to access their works in digital format with little or even no publicity, which could lead to a greater number of paying consumers for their future work.

- New sources of revenue: using digital means to spread the IP enables the author to monetize it through the sale of merchandise or events such as lectures.

- Encourage the exchange of ideas: exchange of ideas is an asset for both the author and society, providing, in the specific case of the author, a source of new material / inspiration for their future work and improvement of the existing one.

In Figure 4.4, the Opportunities sub-network for the author is displayed, showing the two-way dependences between the two existing clusters of Alternatives and Criteria.

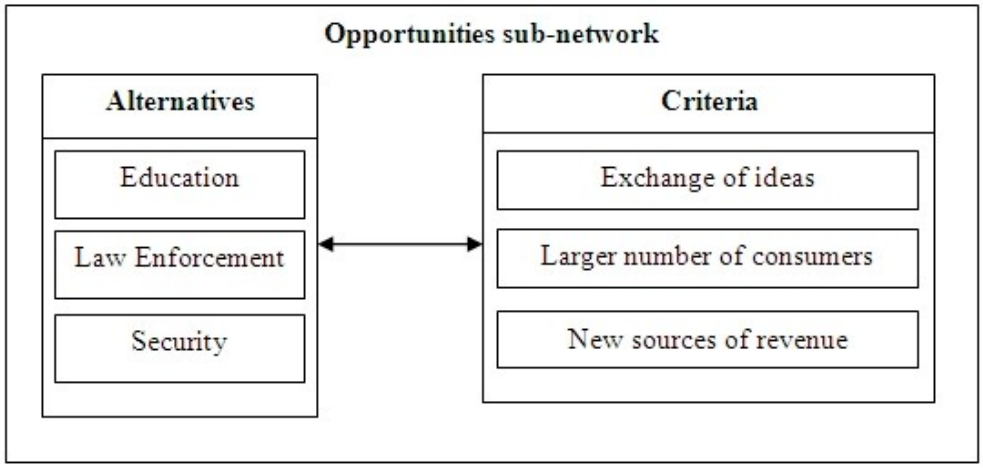


Figure 4.4: Author - Opportunities sub-network

Costs:

- Higher vulnerability to illegal copying: there is to the author an omnipresent possibility of being the victim of copyright infringement that is made even more technically feasible in digital products, although this can be mitigated by the willingness or lack of interest from potential infringers from copying an "unprotected" product.

- Lack of publishers: publishers may not agree with the stance the author takes on their IP protection (or lack thereof), making it difficult to obtain contracts.

Figure 4.5 displays the Costs sub-network for the author, showing the two-way dependences between the two existing clusters of Alternatives and Criteria.

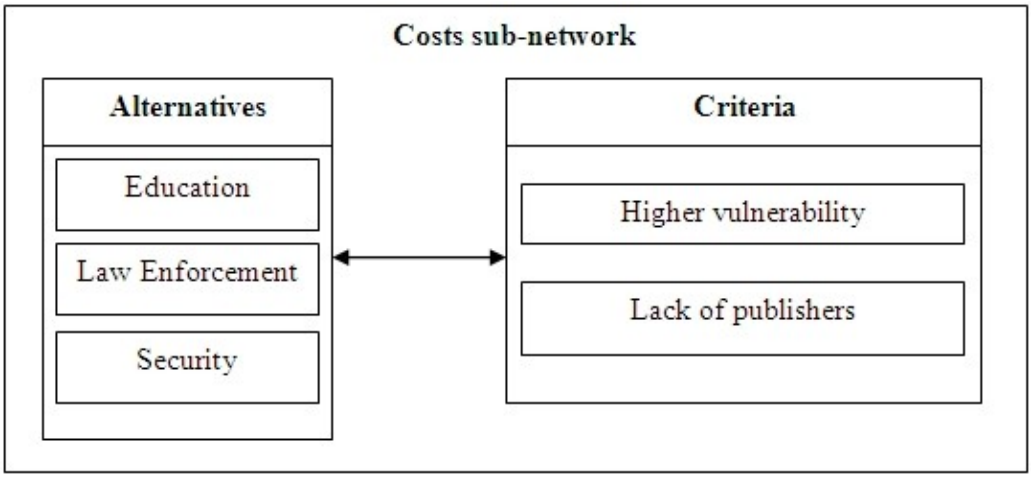


Figure 4.5: Author - Costs sub-network

Risks:

- Loss of control over IP: technical vulnerability can lead to cases of intellectual property theft, with other individuals taking ownership of the work of the author.

Figure 4.6 illustrates the Risks sub-network for the author, displaying the two-way dependences between the two existing clusters of Alternatives and Criteria.

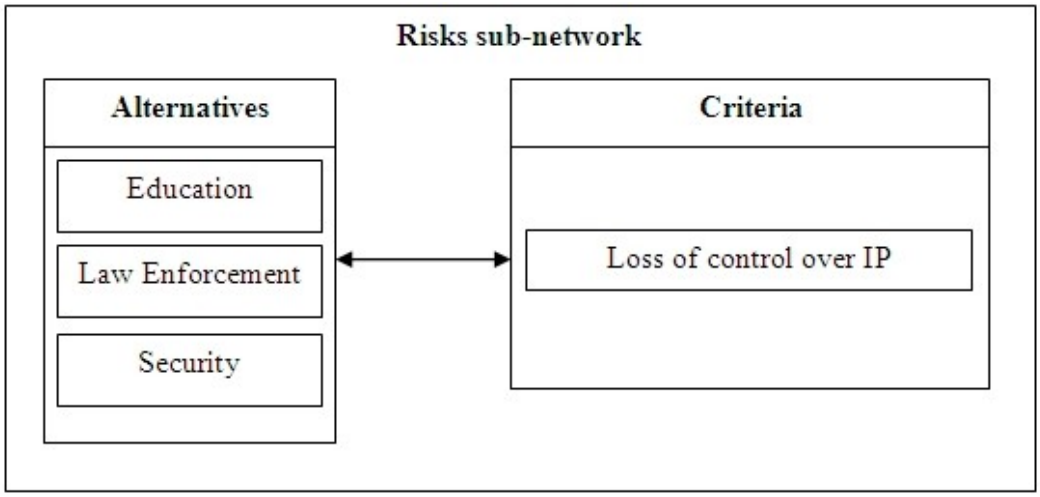


Figure 4.6: Author - Risks sub-network

4.1.1.2 – Publisher

The publisher is the entity responsible for the production and dissemination of the author's work. The following criteria was considered for the publisher:

Table 4.2: BOCR analysis for the Publisher

Benefits	Costs	Opportunities	Risks
- Image - Value	- Loss of writers - Giving up control over the product	- Exploring new markets - Costs reduction	- Loss of market share - Decreasing sales volume

Benefits:

- Image: to create a relationship of trust with consumers, generating positive word of mouth, respecting them and avoiding a climate of suspicion or feeling "guilty until proven innocent", which may foment consumer loyalty and sales.

- Value: to increase the IP's worth at the eyes of the consumer, making it more desirable and increasing the amount the consumer is willing to pay in order to have access to it.

In Figure 4.7, the Benefits sub-network for the publisher is illustrated, displaying the two-way dependences between the two existing clusters of Alternatives and Criteria.

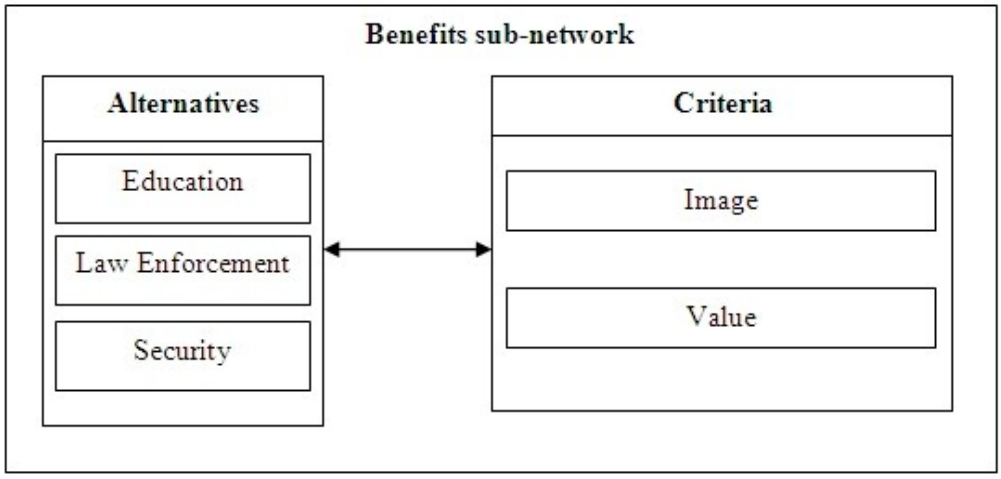


Figure 4.7: Publisher - Benefits sub-network

Opportunities:

- Explore new markets: digital distribution allows a publisher to reach new areas and provides the means for the emergence of new markets to explore (especially in emerging economies) as well as a larger base of customers that provide alternative revenue sources (limited editions, physical packages exclusives, etc.).

- Costs reduction: publishers have the possibility of eliminating costs derived from non-value-added activities such as R&D and implementation of new protection technologies.

Figure 4.8 illustrates the Opportunities sub-network for the publisher, showing the two-way

dependences between the two existing clusters of Alternatives and Criteria.

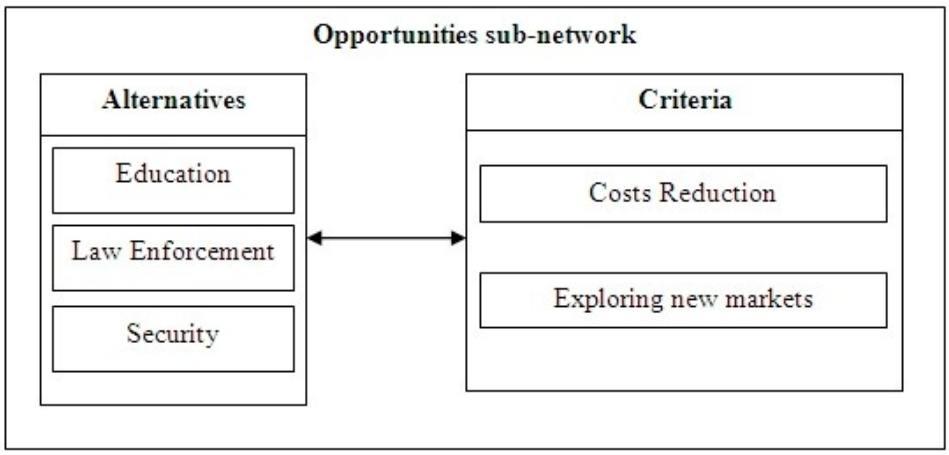


Figure 4.8: Publisher - Opportunities sub-network

Costs:

- Loss of writers: authors may not agree with the stance the publisher takes with IP protection (or lack thereof) and publishers might lose authors this way.

- Giving up control over the product: using digital means of distribution allows the publisher to provide different ways for the consumers to access the desired IP has he/she prefers which in turn can limit the publisher's manoeuvring, namely regarding the control over distribution, (re)sale and use of the product.

Figure 4.9 illustrates the Costs sub-network for the publisher, exhibiting the two-way dependences between the two existing clusters of Alternatives and Criteria.

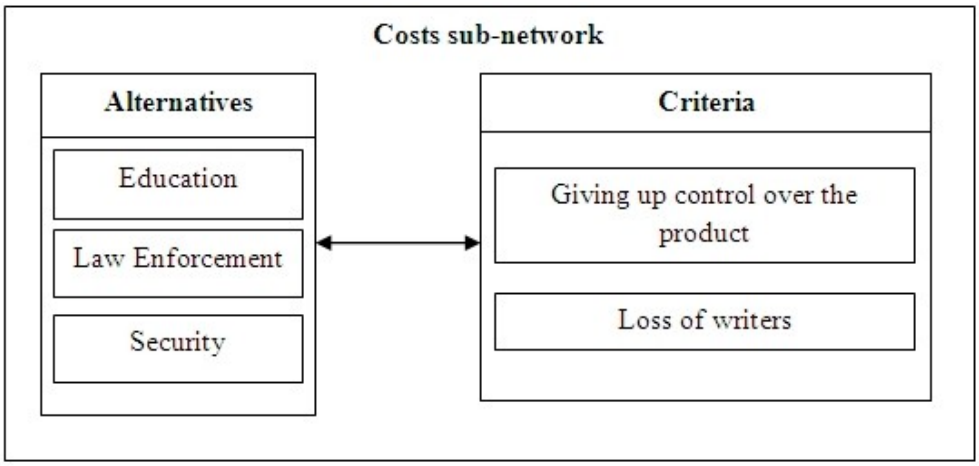


Figure 4.9: Publisher - Costs sub-network

Risks:

- Loss of market share: the publisher may lose a share of the market to the competition if no barriers and limitations are introduced to prevent entry to said competition.

- Decreasing sales volume: being vulnerable to digital piracy, the publisher can see the IP copied on a large scale, lowering the volume of sales for both the digital version and its physical counterpart.

In Figure 4.10, the Risks sub-network for the publisher is displayed, showing the two-way dependences between the two existing clusters of Alternatives and Criteria.

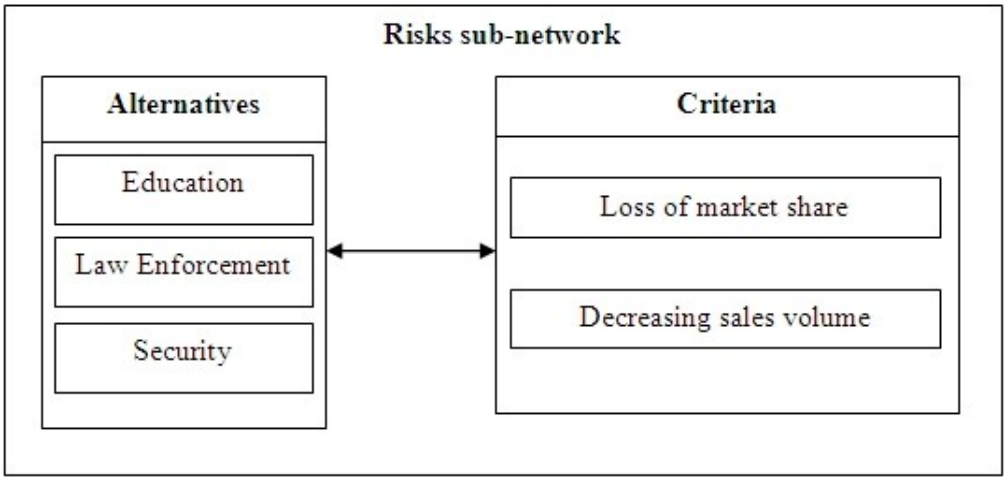


Figure 4.10: Publisher - Risks sub-network

4.1.1.3 – Retailer

The retailer is the entity responsible for selling the work to the consumer. The following criteria was considered for the retailer:

Table 4.3: BOCR analysis for the Retailer

Benefits	Costs	Opportunities	Risks
- Image - Value	- Loss of publishers - Giving up control over the product	- Exploring new markets - Cost Reduction	- Loss of market share - Decreasing sales volume

Benefits:

- Image: to create a relationship of trust with consumers, yielding positive word of mouth, consumer loyalty and future purchases.

- Value: to increase the IP's worth at the eyes of the consumer, making it more desirable and increasing the amount the consumer is willing to pay in order to have access to it.

In Figure 4.11 the Benefits sub-network for the retailer is illustrated, displaying the two-way dependences between the two existing clusters of Alternatives and Criteria.

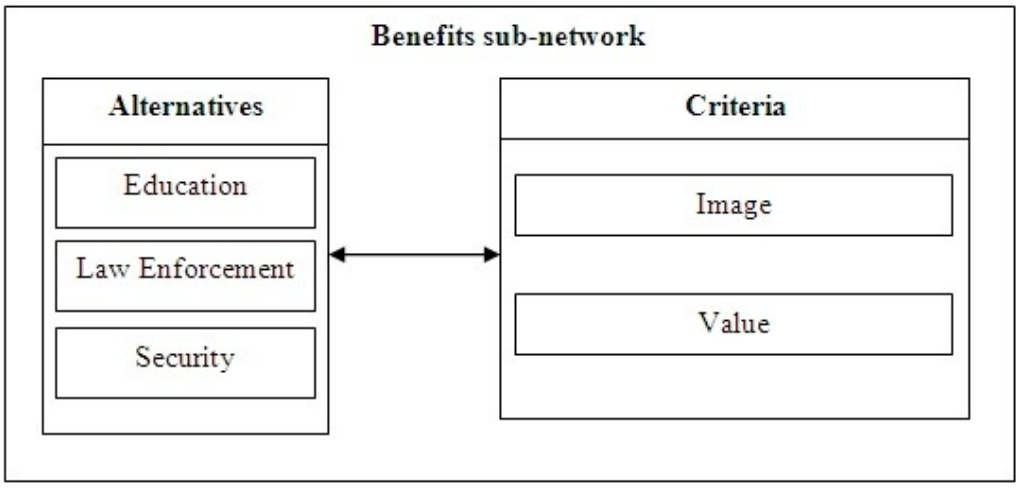


Figure 4.11: Retailer - Benefits sub-network

Opportunities:

- Explore new markets: digital distribution provides means for a retailer to reach new areas and allows for the emergence of new markets to explore (especially in emerging economies) as well as a larger base of customers that provide alternative revenue sources.

- Costs reduction: publishers have the possibility of eliminating costs derived from non-value-added activities such as R&D and implementation of new protection technologies.

Figure 4.12 illustrates the Opportunities sub-network for the retailer, exhibiting the two-way dependences between the two existing clusters of Alternatives and Criteria.

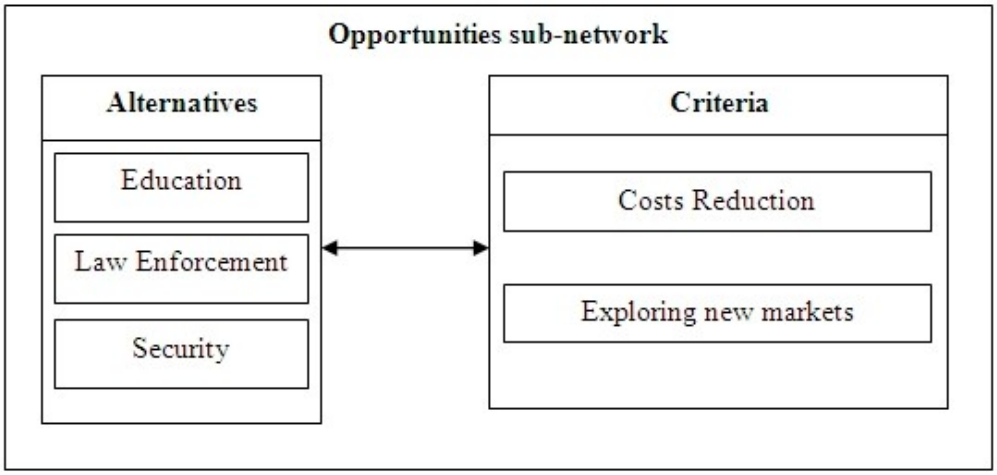


Figure 4.12: Retailer - Opportunities sub-network

Costs:

- Lack of publishers: publishers may not agree with the stance the retailer takes on their IP protection (or lack thereof), making it difficult to obtain contracts.

- Giving up control over the product: using digital means of distribution allows the retailer to provide different ways for the consumers to access the desired IP has he/she prefers which in turn can limit the retailer's manoeuvring, namely regarding the control over distribution, (re)sale and use of the product.

Figure 4.13 displays the Costs sub-network for the retailer, showing the two-way dependences between the two existing clusters of Alternatives and Criteria.

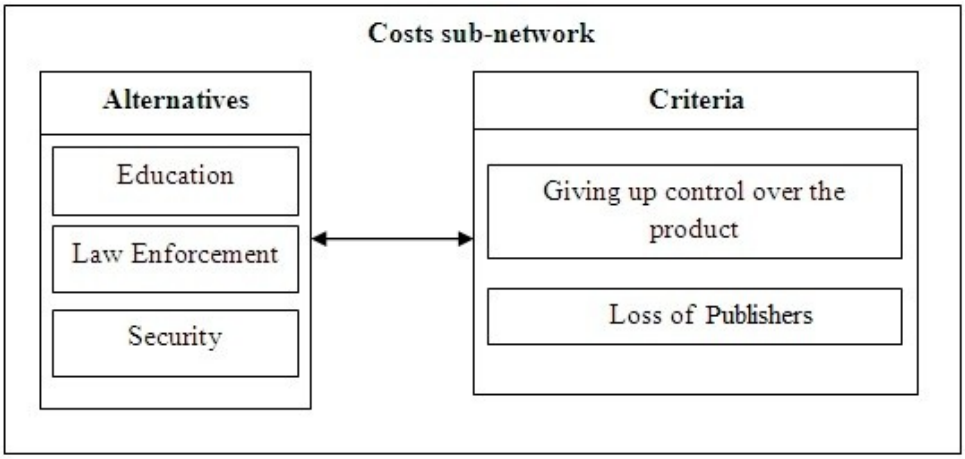


Figure 4.13: Retailer - Costs sub-network

Risks:

- Loss of market share: the retailer may lose a share of the market to the competition if no barriers and limitations are introduced to prevent entry to said competition.

- Decreasing sales volume: being vulnerable to digital piracy, the retailer can see the IP copied on a large scale, lowering the volume of sales for both the digital version and its physical counterpart.

In Figure 4.14 the Risks sub-network for the retailer is displayed, exhibiting the two-way dependences between the two existing clusters of Alternatives and Criteria.

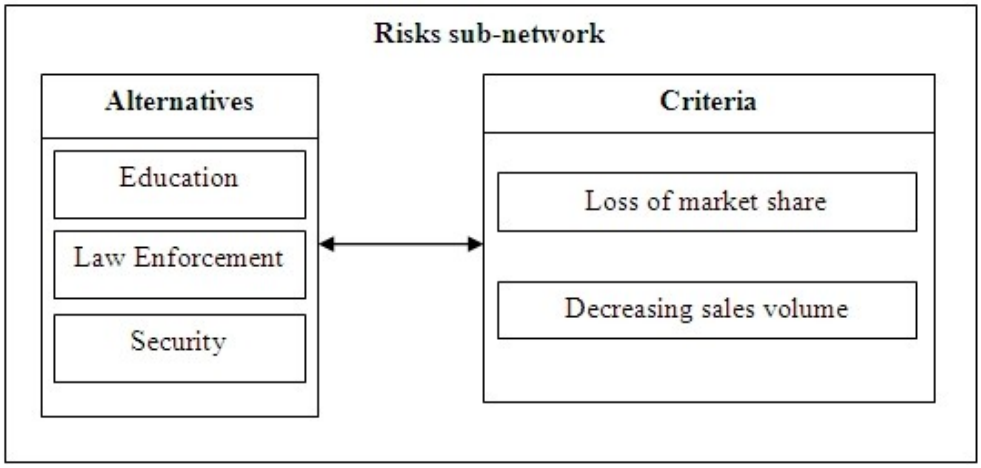


Figure 4.14: Retailer - Risks sub-network

4.1.1.4 – Consumer

The consumer is the final user of the author's work. The following criteria was considered for the consumer:

Table 4.4: BOCR analysis for the Consumer

Benefits	Costs	Opportunities	Risks
- Freedom of use - Easy to obtain new material	- Refund/credit	- New IPs	- Harmful versions

Benefits:

- Freedom of use: a digital version of the product provides the consumer the ability to acquire and use the eBook that he/she bought as it best suits the consumer.

- Easy to obtain new material: through digital means it becomes easier for the consumer to get know new authors and new IP, and develop an opinion on them.

Figure 4.15 displays the Benefits sub-network for the consumer, exhibiting the two-way dependences between the two existing clusters of Alternatives and Criteria.

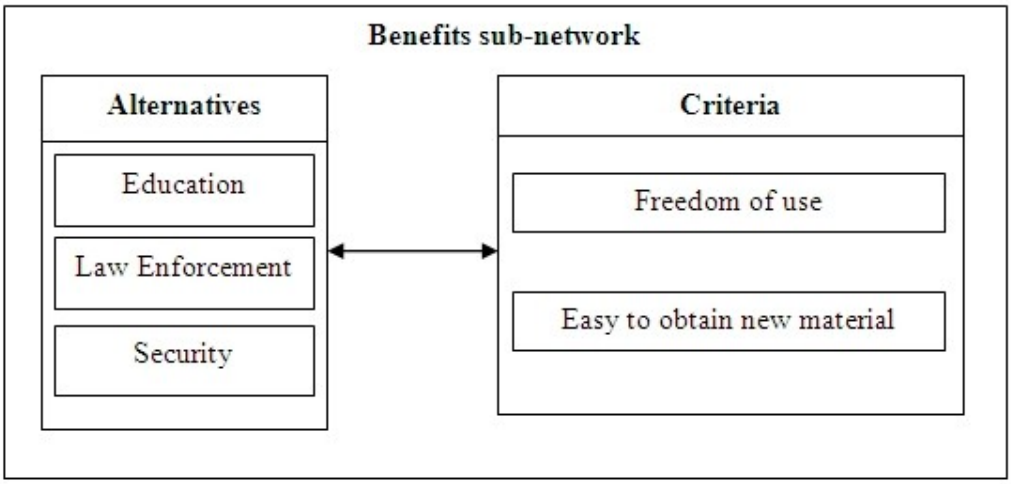


Figure 4.15: Consumer - Benefits sub-network

Opportunities:

- New intellectual properties: since it is simpler and more accessible to get to know new IPs, it will be possible for the consumer to potentially discover and create new ones based on their research.

Figure 4.16 illustrates the Opportunities sub-network for the consumer, showing the two-way dependences between the two existing clusters of Alternatives and Criteria.

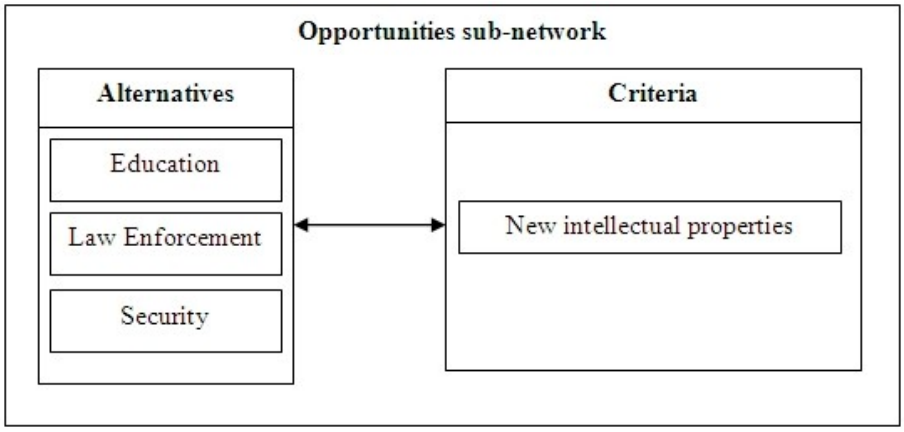


Figure 4.16: Consumer - Opportunities sub-network

Costs:

- Refund/credit: situations in which the consumer can return the eBook to its origin in order to obtain store credit or similar schemes are uncommon and difficult to maintain without proper technologies and restrictions.

In Figure 4.17 the Opportunities sub-network for the consumer is illustrated, showing the two-way dependences between the two existing clusters of Alternatives and Criteria.

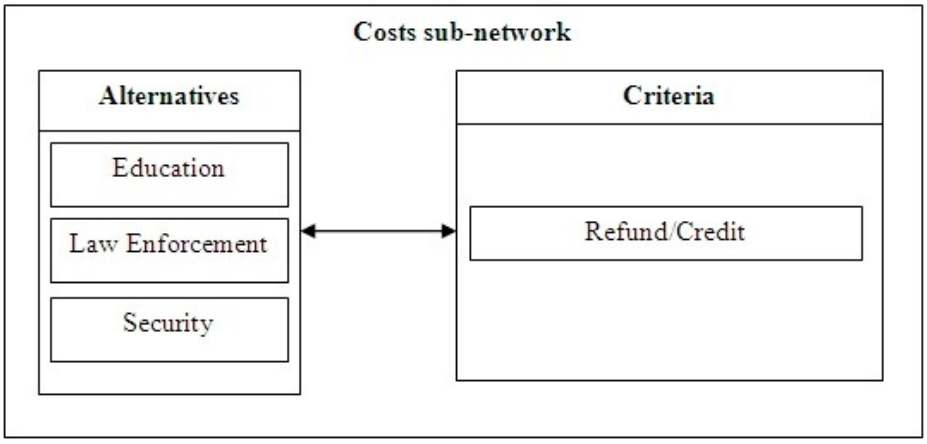


Figure 4.17: Consumer - Costs sub-network

Risks:

- Harmful versions: creation of harmful versions (with viruses, trojans, etc.) of the digital product are a possibility and it can affect the consumer who acquires the product from sources other a trusted provider, a situation that is not possible to prevent without technologies that can provide signatures indicating the origin of the product.

In Figure 4.18 the Risks sub-network for the consumer is displayed, showing the two-way dependences between the two existing clusters of Alternatives and Criteria.

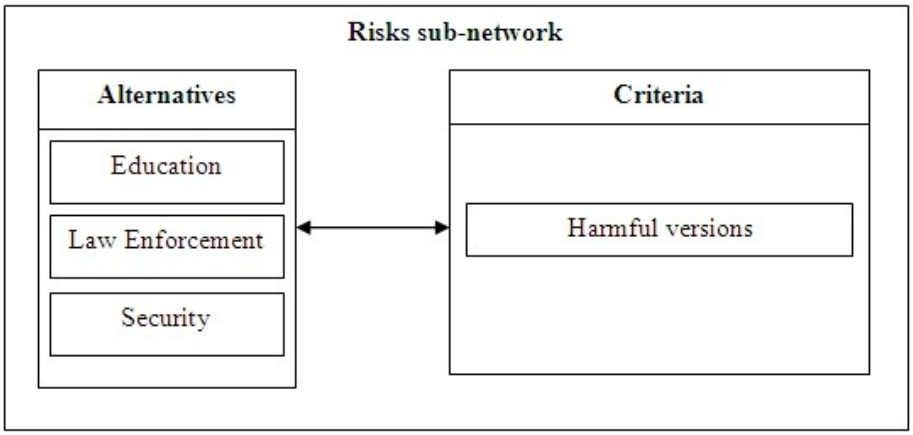


Figure 4.18: Consumer - Risks sub-network

5 – MODEL APPLICATION

In this chapter, an attempt is made to apply the proposed model on the digital book market.

The main goal of this application was to validate the previously presented ANP BOCR model.

Due to time and resource constraints, the initial decision was made to focus on the Portuguese market for digital books, namely writers and publishers, the two most nationally represented (and possibly approachable) stakeholders in the model.

The calculations and graphical representations were made with the assistance of the software SuperDecisions v.2.0.8, developed by William J. Adams of Embry Riddle Aeronautical University, Daytona Beach, Florida working with Rozann W. Saaty of Creative Decisions Foundation, Pittsburgh, Pennsylvania. SuperDecisions is a simple easy-to-use software package for constructing decision models with dependence and feedback, and developed in collaboration with the creator of the Analytical Hierarchic Process and Analytical Network Process, Thomas Saaty.

5.1 - Data Gathering

A questionnaire was created to obtain data for the 39 pairwise comparisons from the writers. Another questionnaire was made to obtain data for the 36 pairwise comparisons from the publishers. In order to gather the required data, various writers and publishers were contacted to possibly schedule interviews to be able to discuss any doubts that might appear regarding the research that was being conducted and the questions being made, as well as obtain further feedback on the criteria and problematic addressed by this research. To further simplify the data gathering process, the questionnaires were put available online so that remote access was a possibility, in lieu of a scheduled interview due to whatever unforeseen circumstances that might disallow such contact.

However, due to a mixture of lack of interest, collaboration and unavailability from the contacted publishers, it was impossible to gather data and an analysis of the publisher's model had to be abandoned.

Published writers Prof. Maria do Rosário Cabrita from the Universidade Nova de Lisboa, Faculdade de Ciências e Tecnologia, Prof. Albertina Dias and Prof. Pedro Viegas from the Instituto Universitário de Almada, Instituto Piaget were interviewed due to their knowledge and insight on the digital books market from a writer's point of view. The questionnaires used on these one-on-one interviews with the authors are available in Annex I. With their answers it was possible to obtain the required information to conduct the pairwise comparisons between clusters and elements.

5.2 - Pairwise comparisons

After aggregating the data from the answers given by the writers with the geometric mean, with the assistance of OpenOffice's spreadsheet module, Calc, and inserted the data on the software SuperDecisions, the priorities were calculated and the inconsistency index was checked to verify if it had a value of less than 0,10 (10%).

As an example, Table 5.1 to Table 5.4 display the pairwise comparisons for the elements in the Benefit sub-network and Figure 5.1 to Figure 5.4 present the resulting priorities and corresponding inconsistency index, as illustrated by the SuperDecisions software.

Table 5.1: Pairwise comparisons with respect to "Education"

	Dissemination of IP	Image
Dissemination of IP	1	0,190
Image	5,277	1

From Table 5.1 it can be understood that the criterion “Image” is strongly more important than “Dissemination of IP” in regard to the alternative “Education”, from an author's perspective. In other words, the authors were inquired on how much more important to them the criterion “Image” was than the criterion “Dissemination of IP” and the aggregated reply indicates that the criterion “Image” is approximately 5,277 times more important than the criterion “Dissemination of IP”. In turn, the value of 0,190, that indicates how many times the criterion “Dissemination of IP” is more important than the criterion “Image”, was obtained through the reciprocal value of 1/5,277.

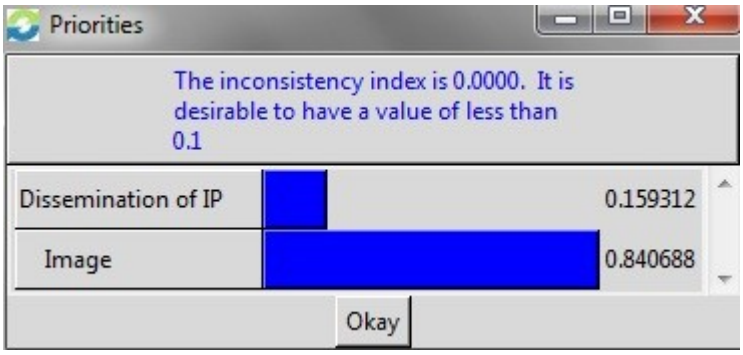


Figure 5.1: Priorities and inconsistency index for "Education"

The resulting priorities displayed in Figure 5.1 indicate the local priorities computed from the pairwise comparison in Table 5.1.

There is also a denotation on Figure 5.1 that the inconsistency index has a value of 0. This happens because only one judgement between two criteria is being made and, therefore, there is no room for inconsistency.

Table 5.2: Pairwise comparisons with respect to "Law Enforcement"

	Dissemination of IP	Image
Dissemination of IP	1	2,140
Image	0,467	1

Table 5.3: Pairwise comparisons with respect to "Security"

	Dissemination of IP	Image
Dissemination of IP	1	1,613
Image	0,620	1

Table 5.2 and Table 5.3 display a similar format to Table 5.1 only this time the question asked to the interviewed authors was in regard to the alternative “Law Enforcement” and the alternative “Security”, respectively. The answers were that the criterion “Dissemination of IP” is 2,140 times more important than “Image” with respect to the alternative “Law Enforcement” and 1.613 times more important than

“Image” for the alternative “Security”.

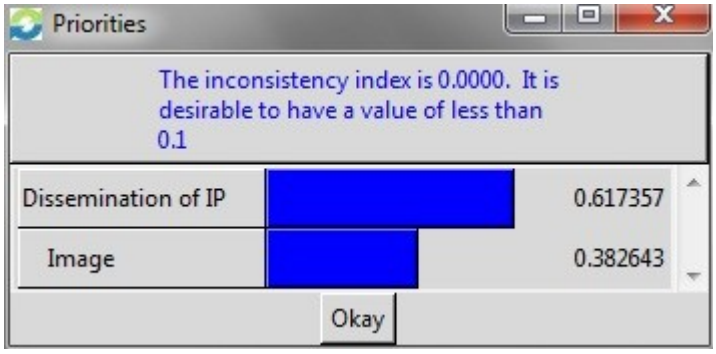


Figure 5.2: Priorities and inconsistency index for "Security"

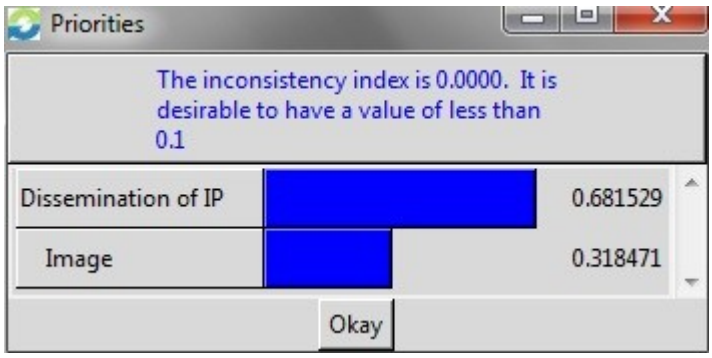


Figure 5.3: Priorities and inconsistency index for "Law enforcement"

Figure 5.2 displays the computed local priorities as well as the inconsistency index for the alternative “Law Enforcement” and Figure 5.3 for the alternative “Security”.

Similar to Figure 5.1, the inconsistency index for Figure 5.2 and Figure 5.3 has a value of 0. Like before, this happens because only one judgement between two criteria is being made and, therefore, there is no room for inconsistency.

Table 5.4: Pairwise comparisons with respect to “Dissemination of IP"

	Education	Law Enforcement	Security
Education	1	2,480	3,979
Law Enforcement	0,403	1	0,629
Security	0,251	1,590	1

Table 5.5: Pairwise comparisons with respect to "Image"

	Education	Law Enforcement	Security
Education	1	8,277	4,327
Law Enforcement	0,121	1	0,481
Security	0,231	2,080	1

Table 5.4 and Table 5.5 display the pairwise comparisons obtained from the authors for the criteria "Dissemination of IP" and "Image" where the questions asked were how much more preferable one alternative was to the other with respect to a criterion.

For example, using Table 5.4, on the first row one sees that the alternative "Education" was deemed by the authors 2.480 times more preferable than the alternative "Law enforcement" with respect to the criterion "Dissemination of IP" and 3.979 times more preferable than the alternative "Security" with respect to the same criterion. The corresponding reciprocal values of 0,403 and 0,251 on the first column are obtained from 1/2,480 and 1/3,979 respectively.

These pairwise comparisons were then inserted in SuperDecisions and the local priorities were computed, as can be seen on Figure 5.4 and Figure 5.5.

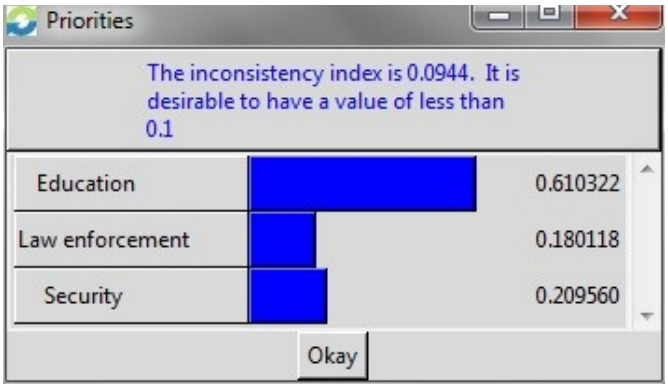


Figure 5.4: Priorities and inconsistency index for "Dissemination of IP"

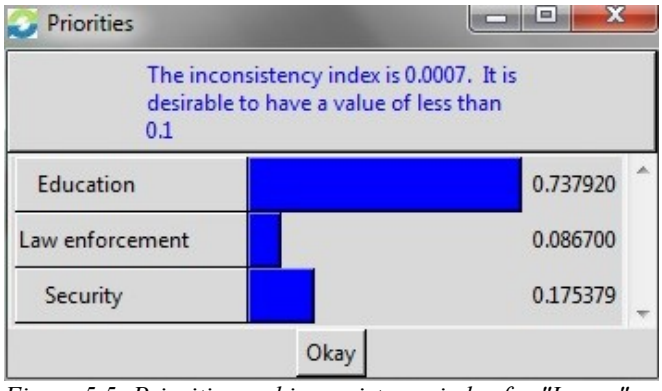


Figure 5.5: Priorities and inconsistency index for "Image"

In Figure 5.4 it is possible to see that the inconsistency index is of 0,09 which is a value lower than 0,10 and, as such, it is not necessary to correct any judgement. Such is also the case in Figure 5.5, with an inconsistency index value of lower than 0,10.

If it had been necessary, a correction would have required a new meeting with the interviewed experts in order to revise the questions and reach more consistent answers. It should be noted that the SuperDecisions software would have aided in this situation since it is possible through it to highlight the most inconsistent judgement and this way detect the judgement that more direly requires reviewing.

Since the inconsistency indexes had values of less than 0,1, the local priorities obtained can then be safely inserted in the unweighted supermatrix. This was the case for all the alternative's and criterion's pairwise comparison matrices inserted in SuperDecisions for the Benefits, Opportunities, Costs and Risks sub-networks.

5.3 - Supermatrix formation

With the help of SuperDecisions, the supermatrix was easily obtained.

Table 5.6 shows the unweighted supermatrix for the Benefits sub-network. The unweighted supermatrix contains the local priorities derived from the paiwise comparisons throughout the network. For example, the priorities of the elements "Dissemination of IP" and "Image" with respect to the alternative "Education" are shown in the two bottom cells of the first column, 0,159 and 0,841 respectively. All the local priority information can be read this way directly from the unweighted supermatrix.

Table 5.6: Unweighted supermatrix for the Benefits sub-network

	Education	Law Enforcement	Security	Dissemination of IP	Image
Education	0,000	0,000	0,000	0,610	0,738
Law Enforcement	0,000	0,000	0,000	0,180	0,087
Security	0,000	0,000	0,000	0,210	0,175
Dissemination of IP	0,159	0,682	0,617	0,000	0,000
Image	0,841	0,318	0,383	0,000	0,000
Sum	**1,000**	**1,000**	**1,000**	**1,000**	**1,000**

The columns already summed to one in the unweighted supermatrix and as such there was no need to weight the components to make the columns sum to one in the weighted supermatrix. The weighted supermatrix would have been obtained by multiplying all the elements in a component of the unweighted supermatrix by the corresponding cluster weight (Saaty and Vargas, 2006). There was no such thing in this case because there were only two clusters and cluster comparisons cannot be made when there are only two.

Table 5.7 shows the limiting supermatrix for the Benefits sub-network. The limiting matrix was obtained by raising the weighted supermatrix, which in this case is also the unweighted supermatrix, to powers by multiplying it times itself. When the column of numbers was the same for every column, the limit matrix had been reached and the matrix multiplication process was halted.

Table 5.7: Limiting supermatrix for the Benefits sub-network

	Education	Law Enforcement	Security	Dissemination of IP	Image
Education	0,350	0,350	0,350	0,350	0,350
Law Enforcement	0,058	0,058	0,058	0,058	0,058
Security	0,093	0,093	0,093	0,093	0,093
Dissemination of IP	0,152	0,152	0,152	0,152	0,152
Image	0,348	0,348	0,348	0,348	0,348

The remaining supermatrices for the Opportunities, Costs and Risks sub-networks are available for consultation in Annex II, Annex III and Annex IV respectively.

5.4 - Determining the best alternative

The total weights, ideal weights and normal weights for the alternatives were calculated for the BOCR merits and are presented in Figure 5.6 for the Benefits sub-network, Figure 5.7 for the Opportunities sub-network, Figure 5.8 for the Costs sub-network and Figure 5.9 for the Risks sub-network.

Name	Graphic	Ideals	Normals	Raw
Education		1.000000	0.699061	0.349531
Law enforcement		0.164722	0.115150	0.057575
Security		0.265769	0.185789	0.092894

Figure 5.6: Weights of the alternatives for the Benefits sub-network

Name	Graphic	Ideals	Normals	Raw
Education		1.000000	0.771557	0.385779
Law enforcement		0.103558	0.079901	0.039950
Security		0.192523	0.148542	0.074271

Figure 5.7: Weights of the alternatives for the Opportunities sub-network

Name	Graphic	Ideals	Normals	Raw
Education		1.000000	0.595660	0.297830
Law enforcement		0.368035	0.219224	0.109612
Security		0.310774	0.185116	0.092558

Figure 5.8: Weights of the alternatives for the Costs sub-network

Name	Graphic	Ideals	Normals	Raw
Education		1.000000	0.607261	0.303630
Law enforcement		0.217975	0.132367	0.066184
Security		0.428764	0.260372	0.130186

Figure 5.9: Weights of the alternatives for the Risks sub-network

The Raw column shows the priorities from the limiting matrix, the Normals column gives the results

normalised for each component and the Ideals column shows the results that were obtained from dividing the values in either the normalised or limiting columns by the largest value in the column. From the Ideals column it is easier to read how the alternatives fare in relation to the best possible one. So, for example, it is possible from the Ideals column in Figure 5.6 to say that the "Security" alternative is 26,58% as good, from the point of view of the benefits it provides, as the best solution.

According to Figure 5.6 and Figure 5.7, the alternative "Education" is the best one in benefits and opportunities. It is also the most costly and risky alternative, as it can be seen in Figure 5.8 and Figure 5.9. The alternative "Law Enforcement" is considered the alternative that provides least benefits and opportunities while also being the one that provides less risks, according to Figure 5.6, Figure 5.7 and Figure 5.9 respectively. From Figure 5.8 it is also possible to understand that the alternative "Security" is the least costly one.

It remains to analyse the overall weights of the alternatives. In order to calculate them, three of the five suggested formulas (Lee, H.-J. Chang and Lin, 2009) were inserted in the software SuperDecisions. It is irrelevant which formula it is used if the purpose is to simply discover the best alternative; the difference lies in how one wishes to present and use the results (Saaty and Vargas, 2006). The results for the additive formula, subtractive formula and multiplicative formula are collected in Table 5.8. It was assumed for this work that the Benefits, Opportunities, Costs and Risks merits had equal importance.

Table 5.8: Summary of results using the additive, subtractive and multiplicative formula

	Additive formula		Subtractive formula		Multiplicative formula	
	Ideals	Normals	Ideals	Normals	Ideals	Normals
Education	1,000	0,370	0,000	0,000	1,000	0,626
Law Enf.	0,841	0,311	-1,000	-0,530	0,213	0,133
Security	0,859	0,318	-0,885	-0,470	0,384	0,241

While using the additive and multiplicative formula, the alternative with the highest results should be selected. With the subtractive formula, alternatives with negative results are the ones that should be avoided.

Whichever formula was selected, the alternative "Education" was deemed the best alternative, as it can be seen in Table 5.8, and, at the opposite end of the spectrum, the alternative "Law Enforcement" was the least favourable alternative.

5.5 - Sensitivity analysis

In this sub-chapter, it will be shown how the results would change if the importance of the Benefits, Opportunities, Costs and Risks nodes were changed from the original perception that all merits had equal importance which leads to a value of 0,25 for each merit.

It is not possible to perform sensitivity for merits of BOCR with the multiplicative formula, because the effects of changing their weights cancel out due to the formula. With this is mind, the additive formula was adopted for the sensitivity analysis.

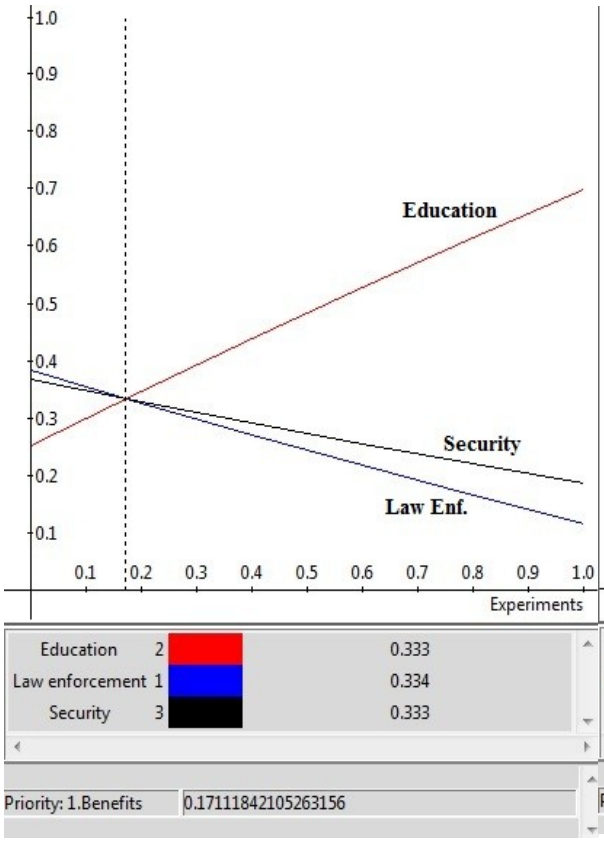


Figure 5.10: Sensitivity graphic with Benefits selected as independent variable

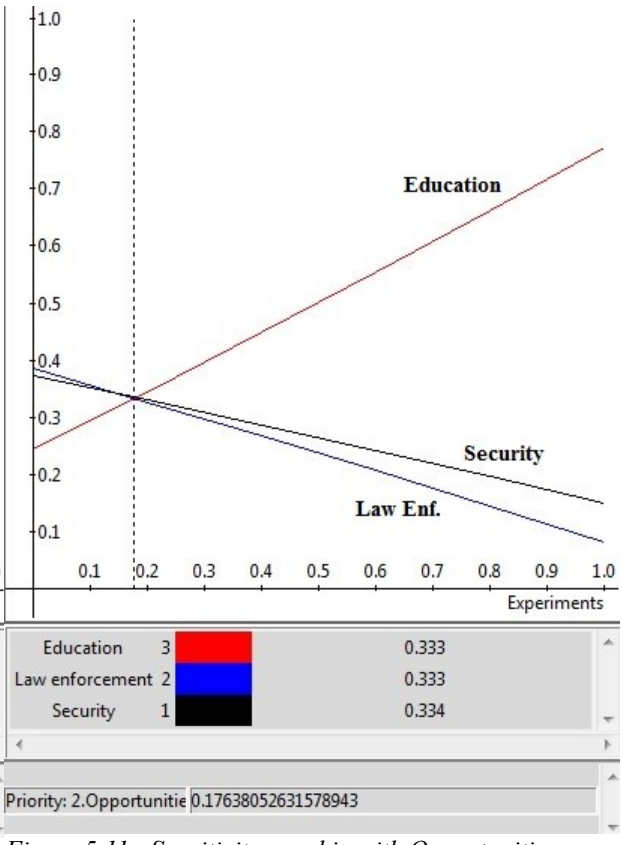


Figure 5.11: Sensitivity graphic with Opportunities selected as independent variable

As it is possible to perceive from Figure 5.10, the alternative "Education" remains the best option for as long as Benefits have a value higher than 0,171. For equal and lower values, the alternative "Law enforcement" becomes the preferable alternative.

A similar situation occurs in the sensitivity analysis for Opportunities, as Figure 5.11 illustrates. For

values higher than 0,176, the alternative "Education" is the best alternative while for lower values than 0,176, "Law enforcement" becomes the best one. At the point value of 0,176, the alternative "Security" is presented as the best alternative.

For both Benefits and Opportunities, the higher the values given to these merits, the better the alternative "Education" performs while the other two alternatives become worse.

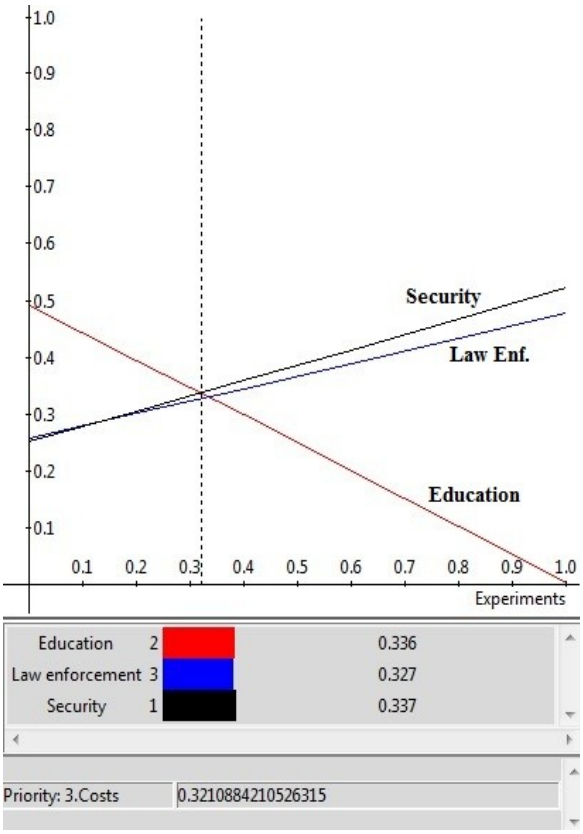


Figure 5.12: Sensitivity graphic with Costs selected as independent variable

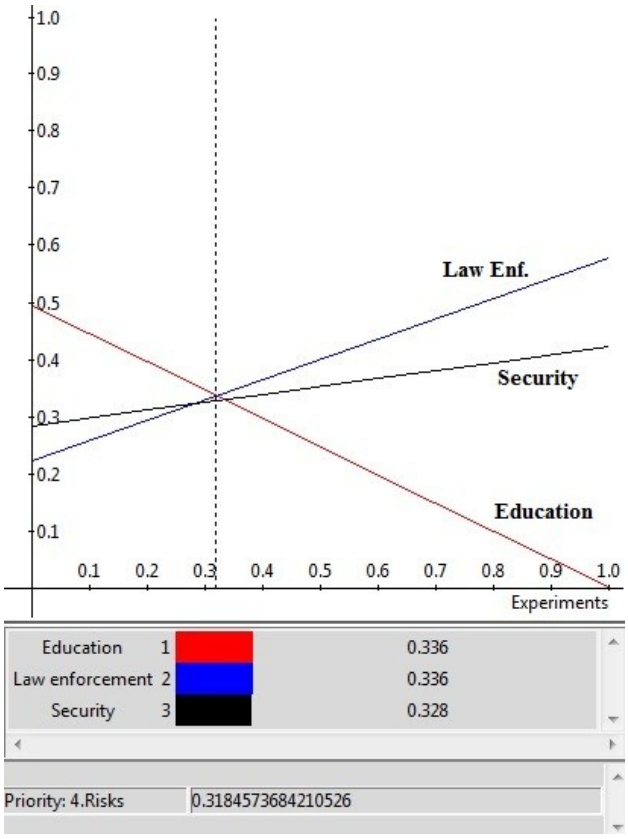


Figure 5.13: Sensitivity graphic with Risks selected as independent variable

From Figure 5.12 it is possible to ascertain that for values equal or higher than 0,321 for Costs, the best alternative is "Security" while for values lower than 0,321 the best alternative would be "Education".

Regarding the sensitivity analysis for Risks, for values higher than 0,318 "Law enforcement" becomes the best alternative while for values lower than 0,318 the alternative "Education" turns into the preferable alternative, as it can be seen on Figure 5.13.

For both Costs and Risks, choosing the best alternative means choosing the less costly or risky one,

respectively. The alternative “Education” suffers more the higher the value given to both these merits while the alternative “Security” becomes the preferable one in a more cost-conscious environment and the alternative “Law Enforcement” thrives in a more risk-minded scenario.

5.6 - Conclusion

Even though precautions had been taken, data gathering proved to be the most difficult part of this work. Not only is it time consuming to contact, schedule interviews, send questionnaires, gather responses and wait for replies, it is difficult to assure cooperation from the proposed respondents. Even during interviews, an extra effort is required from the interviewee to remain concentrated in order to obtain consistent answers in what can be considered long questionnaires that inherently originate from the numerous pairwise comparisons of an ANP model.

The use of a software tool, in this case SuperDecisions, tremendously assisted on acquiring pair-wise comparison matrices and consistency tests as well as calculating supermatrices, weights and determining the best alternative.

The final results indicate that, from an author's perspective, the best alternative to the problematic studied in this work is to invest in education and awareness of society, in detriment of researching security tools and enforcing copyright laws.

The sensitivity analysis further allows to verify that the higher the values of Benefits and Opportunities, the better the alternative to invest in education looks while the alternative to invest in the development of security tools benefits more from higher values to Costs. The alternative of enforcing copyright laws is the one that gains the most from high values to Risks. Again, this analysis was possible to be easily made thanks to the assistance provided by SuperDecisions.

6 – CONCLUSIONS, RECOMMENDATIONS AND FUTURE WORK

The piracy debate on how to best combat it is an extremely important issue for the industries involved as well as society in general and while amply discussed in the media and, to a lesser extent, in the scientific community, it had yet to be addressed as a MCDM problem. This work attempted to cover such gap by developing an ANP approach to the aforementioned problematic. Through the incorporation of human preferences into the decision making process, the ANP approach enables decision makers to overcome strategic decisions and has proved to be the right tool for such undertakings (Erdogmus, Kapanoglu and Koc, 2005). The ANP allowed to create a complex decision making model reliant on qualitative input that would otherwise be difficult to work with while avoiding AHP's limitations of ignoring feedback and dependencies. While a lack of scientific works on the addressed digital markets and respective piracy levels hinder works on the matter, scientific discussion on the tools and techniques used to prevent digital piracy and on its legal intricacies allowed to develop a model that resonated with interviewed authors and allowed to conduct a practical example.

However, a well-known flaw of the ANP approach might have influenced negatively this research due to the high number of pairwise comparisons required that led to large and time-consuming questionnaires. This might have contributed to the lack of cooperation from contacted publishers which ultimately impoverished considerably this research.

The application of the model allowed to conclude that, from the author's point of view, of the three proposed alternatives an investment in education and awareness of individuals, as beings who live and organize themselves in a society, is the preferable alternative which will have a greater effect in reducing piracy than the development of more stringent measures that give more control to the owner of intellectual property or to enforce existing laws and/or devise newer and harsher laws to further protect copyrights. This alternative presented high results on benefits and opportunities that outweighed the fact that it was also the most costly and risky alternative. Such results would corroborate the notion that an author would be interested in having his/her body of work reach a larger audience in detriment of immediate financial gain. If such proposition could be applied to publishers and retailers remains to be seen. This might be related with, in most cases, the majority of profits from sales belonging to those that most heavily invested in the commercialization of the IP, publishers and retailers, rather than the authors.

As mentioned before in this dissertation, as long as the consumer has access to the complete code to reproduce the digital product (be it an ebook, music file, video file or software) there will always be a way to circumvent the protection and make an illegal copy (Stamp, 2003). Alternatives that might work to fully prevent this type of illegal reproduction require solutions that just are not feasible or are too expensive (Stamp, 2003), and harsher DRM restrictions that might make it harder to make an illegal copy, while feasible, seem to have undesirable consequences to both the publisher applying it as well as the consumers in terms of brand image and technical support difficulties (Vernik and Purohit, 2011). These points further add strength to the argument to adopt a less restrictive environment and commit to educating consumers and society in general. Such reasoning seems to be backed by the results of the application of the model presented in this dissertation.

Regarding future work on this subject, many paths are open for further exploration.

The first step would be to acquire the missing data from the remaining stakeholders (publishers, retailers and consumers) not addressed in this dissertation's model application referring to the digital books market for it would allow a complete analysis on this market and provide a better indication on how different (or akin) the authors' understanding of the situation is to that of the publishers, retailers and consumers. In turn, such broader view would allow to re-evaluate the alternatives adopted and discern any readjustments necessary to be made on the components of the model to adapt it to the ever-changing technical reality that it delves in.

Another logical step would be to apply this model in the remaining suggested areas and collect information and possibly expand or concentrate on more specific segments within them. Another possible action would be to further inquire the interviewers on how much they would rate the BOCR merits in order to apply ratings on the ANP model. It would also be interesting to explore other more specific viable measures such as to make legitimate purchasing the easiest and best supported method as possible in order to reduce digital piracy. Research on those measures has yet to be executed and/or published, as far as it was possible to discern.

It should be noted that future work on this field should be addressed by a multidisciplinary team capable of further exploring the legal concepts related to intellectual property and consumer rights, and possibly present solutions in terms of future legislation on a area in our society that seems to sorely need it, as well as the complexities associated with digital rights managements technologies and broadband networks.

REFERENCES

Ahn, Illtae and Shin, I., 2010. On the optimal level of protection in DRM. *Information Economics and Policy*, 22(4), pp.341–353. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0167624510000491> [Accessed 26 September 2011].

Ahn, Iltae and Yoon, K., 2009. On the Impact of Digital Music Distribution. *CESifo Economic Studies*, 55(2), pp.306–325. Available from: <http://cesifo.oxfordjournals.org/content/55/2/306.short> [Accessed 6 March 2012].

Bae, S.H. and Choi, P., 2007. Firms' Optimal Digital Rights Management (DRM) Strategies: The Effects of Public Copy Protection and DRM Compatibility. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Firms+'+Optimal+Digital+Rights+Management+(+DRM+)+Strategies+:+The+Effects+of+Public+Copy+Protection+and+DRM+Compatibility#0> [Accessed 13 August 2012].

Benczek, P., 2006. Implementation of DRM Systems under the EU Legal Framework. *ISSE 2006: securing electronic business processes:*,(2003), pp.72–94. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Implementation+of+DRM+Systems+under+the+EU+Legal+Framework#0> [Accessed 6 March 2012].

Biddle, P., England, P. and Peinado, M., 2002. The darknet and the future of content distribution. *ACM Workshop on Digital*, Available from: <http://the-evan.com/files/rt/darknet_msft.pdf> [Accessed 6 March 2012].

Büyükyazici, M. and Sucu, M., 2003. The analytic hierarchy and analytic network processes. *Hacettepe Journal of Mathematics and Statistics*, 32pp.65–73. Available from: <http://www.mat.hacettepe.edu.tr/hjms/english/issues/vol32/full-text/65-73.pdf> [Accessed 6 March 2012].

Chang, Y., Wey, W.-M. and Tseng, H.-Y., 2009. Using ANP priorities with goal programming for revitalization strategies in historic transport: A case study of the Alishan Forest Railway. *Expert Systems with Applications*, 36(4), pp.8682–8690. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0957417408007112> [Accessed 6 March 2012].

Chang, Y.-L., 2007. Who should own access rights? A game-theoretical approach to striking the optimal balance in the debate over Digital Rights Management. *Artificial Intelligence and Law*, 15(4), pp.323–356. Available from: <http://www.springerlink.com/index/10.1007/s10506-006-9026-9> [Accessed 6 March 2012].

Cheng, E. and Li, H., 2006. Job performance evaluation for construction companies: An analytic network process approach. *Journal of construction engineering and management*, 132(8), pp.827–836. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Job+Performance+Evaluation+for+Construction+Companies+:+An+Analytic+Network+Process+Approach#0> [Accessed 29 May 2012].

Cheng, E., Li, H. and Yu, L., 2005. The analytic network process (ANP) approach to location selection: a shopping mall illustration. *Construction Innovation: Information, Process, Management*, 5(2), pp.83–97. Available from: <http://www.emeraldinsight.com/journals.htm?articleid=1577624&show=abstract> [Accessed 6 March 2012].

Choi, P., Bae, Sang Hoo and Jun, J., 2010. Digital piracy and firms' strategic interactions: The effects of public copy protection and DRM similarity. *Information Economics and Policy*, 22(4), pp.354–364. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S016762451000051X> [Accessed 6 March 2012].

Code of Copyright and Related Rights No. 63/85 of 14 March 1985, last amended by no.16/2008 of 1 Abril 2008

Court of Justice of the European Union, 2012. Press Release No 94/12 Judgement in Case C-128/11 UsedSoft GmbH v Oracle International Corp.

Doctorow, C., 2005. Digital Rights Management: A failure in the developed world, a danger to the developing world. *International Telecommunications Union*,pp.1–28. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Digital+Rights+Management+:+A+failure+in+the+developed+world+,+a+danger+to+the+developing+world#0> [Accessed 6 March 2012].

Easley, R., Kim, B.C. and Sun, D., 2012. Optimal Digital Rights Management with Uncertain Piracy. *2012 45th Hawaii International Conference on System Sciences*,pp.4525–4534. Available from:

<http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=6149442> [Accessed 6 March 2012].

Erdogmus, S., Kapanoglu, M. and Koc, E., 2005. Evaluating high-tech alternatives by using analytic network process with BOCR and multiactors. *Evaluation and Program Planning*, 28(4), pp.391–399. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0149718905000601> [Accessed 23 September 2011].

Grimm, R., 2005. Privacy for Digital Rights Management Products and their Business Cases. *University Koblenz and Fraunhofer Institute for Digital Media Technology*, Available from: <http://www.uni-koblenz.de/~grimm/texte/Privacy4DRM_Tech-Axmedis-Grimm-final.pdf> [Accessed 6 March 2012].

Hinze, G., 2008. Making Knowledge Accessible across Borders: The Case for Mandatory Minimum International Copyright Exceptions and Limitations for Education, Capacity Building. *Electronic Frontier Foundation*,(October), p.6. Available from: <http://eric.ed.gov/ERICWebPortal/recordDetail?accno=ED509860> [Accessed 13 August 2012].

Hsu, P. and Kuo, M., 2011. Applying the ANP Model for Selecting the Optimal Full-service Advertising Agency. *International Journal of Operations Research*, 8(4), pp.48–58. Available from: <http://www.orstw.org.tw/IJOR/vol8no4/6-Vol_8, No. 4, pp.48-58.pdf> [Accessed 29 August 2012].

Husted, B.W., 2000. The Impact of National Culture on Software Piracy. *Journal of Business Ethics*, 1352(26), pp.197–211.

Hwang, S., 2009. How Viable Is Digital Rights Management? *Computer*,pp.28–34. Available from: <http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5054869> [Accessed 6 March 2012].

Jaisingh, J., 2007. Piracy on File-sharing networks: Strategies for Recording Companies. *Journal of Organizational Computing and Electronic Commerce*, 17(4), pp.329–348. Available from: <http://www.tandfonline.com/doi/abs/10.1080/10919390701636239> [Accessed 6 March 2012].

Johns, A., 2009. *Piracy: The intellectual property wars from Gutenberg to Gates*. University of Chicago Press. Available from: <http://books.google.com/books?hl=en&lr=&id=jFMEPUO7LS0C&oi=fnd&pg=PP8&dq=Piracy+the+intellectual+property+wars+from+gutenberg+to+gates&ots=8G-AQSaYft&sig=OiVRFrccijvbddnakCXoB-ixSx8> [Accessed 8 March 2012].

Kuo, C.J., Kalkler, T. and Zhou, W., 2004. Digital Rights Management. *IEEE Signal Processing Magazine*, (March), pp.11–13.

Köne, A. and Büke, T., 2007. An Analytical Network Process (ANP) evaluation of alternative fuels for electricity generation in Turkey. *Energy Policy*, 35(10), pp.5220–5228. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0301421507002133> [Accessed 14 September 2011].

Lastowka, G., 2010. *Virtual Justice*. Yale University Press: New Haven. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Virtual+Justice#0> [Accessed 6 March 2012].

Lee, A.H.I., 2009a. A fuzzy AHP evaluation model for buyer–supplier relationships with the consideration of benefits, opportunities, costs and risks. *International Journal of Production Research*, 47(15), pp.4255–4280. Available from: <http://www.tandfonline.com/doi/abs/10.1080/00207540801908084> [Accessed 7 September 2011].

Lee, A.H.I., 2009b. A fuzzy supplier selection model with the consideration of benefits, opportunities, costs and risks. *Expert Systems with Applications*, 36(2), pp.2879–2893. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0957417408000559> [Accessed 25 August 2011].

Lee, A.H.I. et al., 2010. *The construction of a comprehensive model for production strategy evaluation*. Available from: <http://www.springerlink.com/index/10.1007/s10700-010-9077-y> [Accessed 6 March 2012].

Lee, A.H.I., Chang, H.-J. and Lin, C.-Y., 2009. An evaluation model of buyer–supplier relationships in high-tech industry — The case of an electronic components manufacturer in Taiwan. *Computers & Industrial Engineering*, 57(4), pp.1417–1430. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0360835209002113> [Accessed 6 March 2012].

Lessig, L., 2004. *Free Culture: How Big Media Uses Technology and the Law to Lock Down Culture and Control Creativity*. Available from: <http://www.questia.com/googleScholar.qst?docId=5008913304> [Accessed

6 March 2012].

von Lohmann, F., 2004. *Measuring the Digital Millennium against the Darknet: Implications for the regulation of technological protection measures*. Electronic Frontier Foundation. Available from: <http://heinonlinebackup.com/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/laent24&section=30> [Accessed 6 March 2012].

von Lohmann, F., 2010. *Unintended Consequences: Twelve Years under the DMCA*. Electronic Frontier Foundation. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Unintended+Consequences+:+Twelve+Years+under+the+DMCA#0> [Accessed 6 March 2012].

McSherry, C. and Cohn, C., 2010. *Digital Books and Your Rights: A Checklist for Readers*. Electronic Frontier Foundation. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Digital+Books+and+Your+Rights+:+A+Checklist+for+Readers#0> [Accessed 29 August 2012].

Morris, R.G. and Higgins, G.E., 2010. Criminological theory in the digital age: The case of social learning theory and digital piracy. *Journal of Criminal Justice*, 38(4), pp.470–480. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0047235210000711> [Accessed 3 May 2012].

Neira, E., Castillo, M. and Lesmes, D., 2009. Analytic Network Process (ANP): an approach to estimate the colombian baby diaper market share. In: Proceedings of the International Symposium on the Analytic Hierarchy Process, 2009. Available from: <http://www.isahp.org/2009Proceedings/Final_Papers/15_Castillo_Neira_ANPinColombianDiaperMarketShare_REV_FIN.pdf> [Accessed 19 August 2012].

Nill, A., Schibrowsky, J. and Peltier, J.W., 2010. Factors that influence software piracy: a view from Germany. *Communications of the ACM*, 53(6), pp.131–134. Available from: <http://dl.acm.org/citation.cfm?id=1743581> [Accessed 3 May 2012].

Panethiere, D., 2005. The Persistence of Piracy: the Consequences for Creativity, for Culture, and for Sustainable Development. *Doctrine and Opinions, July 2005*, 23(September), p.19. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:The+Persistence+of+Piracy:+The+Consequences+for+Creativity,+for+Culture,+and+for+Sustainable+Development#0> [Accessed 5 July 2012].

Pantalony, R., 2002. Museums and Digital Rights Management Technologies. *Museum International*, 54(216), pp.13–20. Available from: <http://onlinelibrary.wiley.com/doi/10.1111/1468-0033.00395/abstract> [Accessed 6 March 2012].

Park, Y. and Scotchmer, S., 2005. Digital rights management and the pricing of digital products.(October), Available from: <http://www.nber.org/papers/w11532> [Accessed 9 September 2012].

Pramod, V. and Banwet, D., 2010. Analytic Network Process Analysis of an Indian Telecommunication Service Supply Chain: A Case Study. *Service Science*, 2(4), p.281. Available from: <http://www.sersci.com/magazine/V2N4.pdf#page=69> [Accessed 6 March 2012].

Rump, N., 2004. Can digital rights management be standardized? *Signal Processing Magazine, IEEE*,(March), Available from: <http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1276114> [Accessed 13 August 2012].

Saaty, T., 2008. Decision making with the analytic hierarchy process. *International Journal of Services Sciences*, 1(1), pp.83–98. Available from: <http://inderscience.metapress.com/index/02t637305v6g65n8.pdf> [Accessed 6 March 2012].

Saaty, T., 2007. Time dependent decision-making; dynamic priorities in the AHP/ANP: Generalizing from points to functions and from real to complex variables. *Mathematical and Computer Modelling*, 46(7-8), pp.860–891. Available from: <http://www.sciencedirect.com/science/article/pii/S0895717707000982> [Accessed 6 March 2012].

Saaty, T. and Begicevic, N., 2010. The scope of human values and human activities in decision making. *Applied Soft Computing*, 10(4), pp.963–974. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S1568494610000785> [Accessed 13 October 2011].

Saaty, T. and Vargas, L.G., 2006. *Decision making with the analytic network process: Economic, political, social*

and technological applications with benefits, opportunities, costs and risks. Springer Verlag. Available from: <http://books.google.com/books?hl=en&lr=&id=TegYgX6JRo8C&oi=fnd&pg=PA1&dq=DECISION+MAKING+WITH+THE+Economic+,+Political+,+Social+and+Technological+Applications+with+Benefits+,+Opportunities+,+Costs+and+Risks&ots=yDJvDum8bJ&sig=e2C9SRUBRQQqqSJD4Slf0he5YgU> [Accessed 6 March 2012].

Sinha, R., Machado, F. and Sellman, C., 2010. Don't think twice, it's all right: music piracy and pricing in a DRM-free environment. *Journal of Marketing*, 74(March), pp.40–54. Available from: <http://www.journals.marketingpower.com/doi/abs/10.1509/jmkg.74.2.40> [Accessed 6 March 2012].

Stamp, M., 2003. Digital rights management: the technology behind the hype. *Journal of Electronic Commerce Research*, 4(3), pp.102–112. Available from: <http://www.csulb.edu/journals/jecr/issues/20033/paper3.pdf> [Accessed 6 March 2012].

Subramanya, S. and Yi, B.K., 2006. Digital rights management. *Potentials, IEEE*, 25(2), pp.31–34. Available from: <http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1649008> [Accessed 6 March 2012].

Sundararajan, A., 2003. Managing digital piracy: Pricing, protection and welfare. *NYU Working Paper No. 2451/14154*, 17(4), pp.329–348. Available from: <http://www.tandfonline.com/doi/abs/10.1080/10919390701636239> [Accessed 6 March 2012].

Syversen, K., 2004. *Digital Rights Management Promises, Problems and Alternative Solutions*. Citeseer. Available from: <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.105.1176> [Accessed 8 March 2012].

Tan, X. et al., 2007. An application of ANP with benefits, opportunities, costs and risks in supplier selection: a case study in a diesel engine manufacturing firm. In: Automation and Logistics, IEEE International Conference, Aug 2007. Ieee. Available from: <http://ieeexplore.ieee.org/lpdocs/epic03/wrapper.htm?arnumber=4338798> [Accessed 29 May 2012].

Torres-Padrosa, V. and Delgado-Mercé, J., 2011. Alternativas Para la Autogestión de Los Derechos de Autor en el Mundo Digital. *El Profesional de la Informacion*, 20(1), pp.61–70. Available from: <http://elprofesionaldelainformacion.metapress.com/openurl.asp?genre=article&id=doi:10.3145/epi.2011.ene.08> [Accessed 3 January 2012].

Triantaphyllou, E., 2000. *Multi-Criteria Decision Making Methodologies: A Comparative Study*. 1st Ed. Dordrecht: Kluwer Academic Publishers.

Triantaphyllou, E. et al., 1998. Multi-criteria decision making: an operations research approach. *Encyclopedia of electrical …*, 15pp.175–186. Available from: <http://univ.nazemi.ir/mcdm/Multi-Criteria Decision Making.pdf> [Accessed 8 September 2012].

Vernik, D., 2009. *Essays on Digital Distribution of Information Goods*. Duke University. Available from: <http://dukespace.lib.duke.edu/dspace/handle/10161/1209> [Accessed 6 March 2012].

Vernik, D. and Purohit, D., 2011. Music Downloads and the Flip Side of Digital Rights Management. *Marketing Science*,pp.1–17. Available from: <http://static.917wy.com/2011/10/11/mksc.1110.0668-1.pdf> [Accessed 6 March 2012].

Waelde, C. and Edwards, L., 2005. Online intermediaries and liability for copyright infringement. In: A report to the WIPO Seminar on Copyright and Internet Intermediaries, 2005. Available from: <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Online+Intermediaries+and+Liability+for+Copyright+Infringement#0> [Accessed 6 March 2012].

Wallenius, J. et al., 2008. Multiple criteria decision making, multiattribute utility theory: Recent accomplishments and what lies ahead. *Management Science*, 54(7), pp.1336–1349. Available from: <http://www.terry.uga.edu/~rsteuer/PDF_Links/TenYear.pdf> [Accessed 6 March 2012].

Yüksel, İ. and Dagdeviren, M., 2007. Using the analytic network process (ANP) in a SWOT analysis – A case study for a textile firm. *Information Sciences*, 177(16), pp.3364–3382. Available from: <http://linkinghub.elsevier.com/retrieve/pii/S0020025507000230> [Accessed 3 September 2011].

Zammori, F., 2010. The analytic hierarchy and network processes: Applications to the US presidential election and to the market share of ski equipment in Italy. *Applied Soft Computing*, 10(4), pp.1001–1012. Available from:

<http://linkinghub.elsevier.com/retrieve/pii/S1568494609001380> [Accessed 27 March 2012].

Zhang, L., Zhang, M. and Wang, X., 2008. The Optimal Level of Intellectual Property Protection in Presence of Network Effects. In: Wireless Communications, Networking and Mobile Computing, 2008. WiCOM'08. 4th International Conference on, 2008. IEEE. Available from: <http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4680237> [Accessed 6 March 2012].

ANNEX

Annex I – Questionnaire

Benefícios

Relativamente à alternativa de apostar na Educação: quão mais importante é o factor "Imagem" do que é o factor "Divulgação da IP", do ponto de vista dos benefícios que proporciona

- Extremamente menos importante
- Intermédio - - - -
- Muito menos importante
- Intermédio - - -
- Menos importante
- Intermédio - -
- Algo menos importante
- Intermédio -
- Igualmente importante
- Intermédio +
- Algo mais importante
- Intermédio ++
- Mais importante
- Intermédio +++
- Muito mais importante
- Intermédio ++++
- Extremamente mais importante

Relativamente à alternativa "Reforço de Leis": quão mais importante é o factor "Imagem" do que é o factor "Divulgação da IP", do ponto de vista dos benefícios que proporciona

- Extremamente menos importante
- Intermédio - - - -
- Muito menos importante
- Intermédio - - -
- Menos importante
- Intermédio - -
- Algo menos importante
- Intermédio -
- (•) Igualmente importante
- Intermédio +
- Algo mais importante
- Intermédio ++
- Mais importante
- Intermédio +++
- Muito mais importante
- Intermédio ++++
- Extremamente mais importante

Relativamente à alternativa "Segurança": quão mais importante é o factor "Imagem" do que é o factor "Divulgação da IP", do ponto de vista dos benefícios que proporciona

- Extremamente menos importante
- Intermédio - - - -
- Muito menos importante
- Intermédio - - -
- Menos importante
- Intermédio - -
- Algo menos importante
- Intermédio -
- (•) Igualmente importante
- Intermédio +
- Algo mais importante
- Intermédio ++
- Mais importante
- Intermédio +++
- Muito mais importante
- Intermédio ++++
- Extremamente mais importante

Benefícios: Imagem

Relativamente ao benefício "Imagem": quão preferível é a alternativa "Educação" à alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao benefício "Imagem": quão preferível é a alternativa "Educação" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao benefício "Imagem": quão preferível é a alternativa "Segurança" à alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Benefícios: Divulgação da IP

Relativamente ao benefício "Divulgação da IP": quão preferível é a alternativa "Educação" à alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao benefício "Divulgação da IP": quão preferível é a alternativa "Educação" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao benefício "Divulgação da IP": quão preferível é a alternativa "Segurança" à alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Oportunidades

Relativamente à alternativa "Educação": quão mais importante é o factor "Alcançar um maior n.º de consumidores" do que o factor "Novas fontes de receita", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Educação": quão mais importante é o factor "Alcançar um maior n.º de consumidores" do que o factor "Fomentar a troca de ideias", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Educação": quão mais importante é o factor "Novas fontes de receita" do que o factor "Fomentar a troca de ideias", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Reforço de Leis": quão mais importante é o factor "alcançar um maior n.º de consumidores" do que o factor "novas fontes de receita", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Reforço de Leis": quão mais importante é o factor "alcançar um maior n.º de consumidores" do que o factor "fomentar novas ideias", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Reforço de Leis": quão mais importante é o factor "novas fontes de receita" do que o factor "fomentar novas ideias", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Segurança": quão mais importante é o factor "alcançar um maior n.º de consumidores" do que o factor "novas fontes de receita", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Segurança": quão mais importante é o factor "alcançar um maior n.º de consumidores" do que o factor "fomentar novas ideias", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Segurança": quão mais importante é o factor "novas fontes de receita" do que o factor "fomentar novas ideias", do ponto de vista das oportunidades que proporciona

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Oportunidades: Alcançar um maior n.º de consumidores

Relativamente à oportunidade "Alcançar um maior n.º de consumidores": quão preferível é a alternativa "Educação" à alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à oportunidade "Alcançar um maior n.º de consumidores": quão preferível é a alternativa "Educação" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à oportunidade "Alcançar um maior n.º de consumidores": quão preferível é a alternativa "Reforço de Leis" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Oportunidades: Novas fontes de receita

Relativamente à oportunidade "Novas fontes de receita": quão preferível é a alternativa "Educação" à alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à oportunidade "Novas fontes de receita": quão preferível é a alternativa "Educação" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à oportunidade "Novas fontes de receita": quão preferível é a alternativa "Reforço de Leis" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Oportunidades: Fomentar novas ideias

Relativamente à oportunidade "Fomentar novas ideias": quão preferível é a alternativa "Educação" à alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à oportunidade "Fomentar novas ideias": quão preferível é a alternativa "Educação" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à oportunidade "Fomentar novas ideias": quão preferível é a alternativa "Reforço de Leis" à alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Custos

Relativamente à alternativa "Educação": quão mais importante é o factor "Maior vulnerabilidade à cópia ilegal" do que o factor "Falta de editoras", do ponto de vista dos custos que acarreta

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Reforço de Leis": quão mais importante é o factor "Maior vulnerabilidade à cópia ilegal" do que o factor "Falta de editoras", do ponto de vista dos custos que acarreta

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente à alternativa "Segurança": qução mais importante é o factor "Maior vulnerabilidade à cópia ilegal" do que o factor "Falta de editoras", do ponto de vista dos custos que acarreta

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Custos: Maior vulnerabilidade à cópia ilegal

Relativamente ao factor "Maior vulnerabilidade à cópia ilegal": qução mais dispendiosa é a alternativa "Educação" do que o é a alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao factor "Maior vulnerabilidade à cópia ilegal": quão mais dispendiosa é a alternativa "Educação" do que o é a alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao factor "Maior vulnerabilidade à cópia ilegal": quão mais dispendiosa é a alternativa "Reforço de Leis" do que o é a alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Custos: Perda de editoras

Relativamente ao factor "Perda de editoras": quão mais dispendiosa é a alternativa "Educação" do que o é a alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao factor "Perda de editoras": quão mais dispendiosa é a alternativa "Educação" do que o é a alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao factor "Perda de editoras": quão mais dispendiosa é a alternativa "Reforço de Leis" do que o é a alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Riscos

Relativamente ao risco "Perda de controlo de IP": quão mais arriscada é a alternativa "Educação" do que o é a alternativa "Reforço de Leis"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao risco "Perda de controlo de IP": quão mais arriscada é a alternativa "Educação" do que o é a alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Relativamente ao risco "Perda de controlo de IP": quão mais arriscada é a alternativa "Reforço de Leis" do que o é a alternativa "Segurança"

- (●) Extremamente menos
- ( ) Intermédio - - - -
- ( ) Muito menos
- ( ) Intermédio - - -
- ( ) Menos
- ( ) Intermédio - -
- ( ) Algo menos
- ( ) Intermédio -
- ( ) Igualmente
- ( ) Intermédio +
- ( ) Algo mais
- ( ) Intermédio ++
- ( ) Mais
- ( ) Intermédio +++
- ( ) Muito mais
- ( ) Intermédio ++++
- ( ) Extremamente mais

Annex II – Supermatrices for the Opportunities sub-network

Table 8.1: Unweighted supermatrix for the Opportunities sub-network

	Education	Law Enforcement	Security	Exchange of ideas	More consumers	New sources of revenue
Education	0,000	0,000	0,000	0,750	0,793	0,738
Law Enforcement	0,000	0,000	0,000	0,070	0,077	0,110
Security	0,000	0,000	0,000	0,180	0,129	0,163
Exchange of ideas	0,285	0,265	0,266	0,000	0,000	0,000
More consumers	0,593	0,432	0,548	0,000	0,000	0,000
New sources of revenue	0,122	0,303	0,186	0,000	0,000	0,000

Table 8.2: Limit matrix for the Opportunities sub-network

	Education	Law Enforcement	Security	Exchange of ideas	More consumers	New sources of revenue
Education	0,386	0,386	0,386	0,386	0,386	0,386
Law Enforcement	0,040	0,040	0,040	0,040	0,040	0,040
Security	0,074	0,074	0,074	0,074	0,074	0,074
Exchange of ideas	0,140	0,140	0,140	0,140	0,140	0,140
More consumers	0,287	0,287	0,287	0,287	0,287	0,287
New sources of revenue	0,073	0,073	0,073	0,073	0,073	0,073

Annex III – Supermatrices for the Costs sub-network

Table 8.3: Unweighted supermatrix for the Costs sub-network

	Education	Law Enforcement	Security	Higher vulnerability	Lack of publishers
Education	0,000	0,000	0,000	0,512	0,646
Law Enforcement	0,000	0,000	0,000	0,305	0,167
Security	0,000	0,000	0,000	0,182	0,187
Higher vulnerability	0,325	0,325	0,611	0,000	0,000
Lack of publishers	0,675	0,675	0,389	0,000	0,000

Table 8.4: Limit matrix for the Costs sub-network

	Education	Law Enforcement	Security	Higher vulnerability	Lack of publishers
Education	0,298	0,298	0,298	0,298	0,298
Law Enforcement	0,110	0,110	0,110	0,110	0,110
Security	0,093	0,093	0,093	0,093	0,093
Higher vulnerability	0,189	0,189	0,189	0,189	0,189
Lack of publishers	0,311	0,311	0,311	0,311	0,311

Annex IV – Supermatrices for the Risks sub-network

Table 8.5: Unweighted supermatrix for the Risks sub-network

	Education	Law Enforcement	Security	Loss of IP control
Education	0,000	0,000	0,000	0,607
Law Enforcement	0,000	0,000	0,000	0,132
Security	0,000	0,000	0,000	0,260
Loss of IP control	1,000	1,000	1,000	0,000

Table 8.6: Limit matrix for the Risks sub-network

	Education	Law Enforcement	Security	Loss of IP control
Education	0,304	0,304	0,304	0,304
Law Enforcement	0,066	0,066	0,066	0,066
Security	0,130	0,130	0,130	0,130
Loss of IP control	0,500	0,500	0,500	0,500