The Application of Blockchain to the Management of Online Gambling Data

A dissertation submitted in partial fulfilment of the requirements for the degree of Bachelor of Science (Honours) in Business Information Systems.

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DECLARATION

I hereby declare that this dissertation entitled The Application of Blockchain to the Management of Online Gambling Data is entirely my own work, and it has never been submitted nor is it currently being submitted for any other degree.

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ABSTRACT

“The appearance of Blockchain may imply the dawn of a new technological revolution”

The blockchain allows the disintermediation and decentralisation of all transactions of any type between all parties on a global basis by providing a robust platform. Being a decentralised transaction ledger that is part of a larger computing infrastructure makes possible not only the decentralisation of economic transactions (E.g. Bitcoin crypto-currency) but also the inclusion of many other functions related to storage, communication, file serving, and archiving. This implementation applies the advantages of managing transactions with blockchain to the storage, access, dispatch, or receipt of files. This study investigates the feasibility and the benefits of adopting the blockchain technology into the online gambling management.

In order to fulfil the aim and objectives of the study, a review of the pertinent literature was conducted, being completed with primary data collection through semi-structured interviews. The analysis of this data provided enough knowledge to establish relationships between the online gambling regulator organisation procedures and blockchain features. Within the data analysis, the benefits and limitations of this implementation were identified and two recommendations for the implementation were provided.
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CHAPTER 1. INTRODUCTION

1.1 Background to the Research.

It is surprising how modern technologies are being developed year by year. It seems that technological changes perform a significant role in human evolution from basic parameters like the size of the world population or life expectancy to more complex ones like the way that businesses behave to obtain the most of their procedures (Bostrom, 2006). This constant evolution has caused substantial changes in the world of business, allowing public and private organisations to expand more rapidly, and to adopt new methodologies that make their processes more effective or efficient. Because of this, being up to date with emergent technologies is becoming essential to make the most of the available resources.

From Swan’s (2015) point of view, the appearance of Blockchain may imply the dawn of a new technological revolution. The blockchain technology has the potential of becoming a new seamless integrated layer the Web has never had for payments, decentralised exchange, digital asset transfer, and smart contract execution on the internet. As with any innovative technology, new application areas are constantly being discovered, opening the gates for research projects about this subject. The researcher, after investigating the subject of online gambling regulation, saw a possible opportunity for application and started communicating with the organisation staff to ensure that the project could be carried out. In a previous investigation, the researcher found that online gambling regulation involved several transactions between the regulator organisation and gambling providers, but an insight was needed to get deep knowledge of the organisation transactions and procedures so the primary data gathering was considered a good practice.

1.2 Research Aim.

This research project aims to investigate the application of the blockchain technology to the control of online gambling. Rather than financial applications, the researcher aims to find a transaction management solution that fits into the online gambling regulation structure.
1.3 Research Objectives.

In order to fulfil the before mentioned research aim, the following objectives must be achieved:

1. To critically review the existing peer-reviewed literature on centralised and decentralised systems, and explain the appearance of an emerging technology known as ‘Blockchain’.
2. To present a descriptive analysis of Blockchain in relation to security, reliability and efficiency.
3. To evaluate the possible benefits that blockchain would provide to online gambling regulation considering the information gathered via semi-structured interviews.
4. To investigate the possible application of Blockchain technology to the control of online gambling, and provide recommendations for its implementation.
CHAPTER 2. LITERATURE REVIEW

2.1 Introduction.

The aim of this chapter is to explore the features of centralised and distributed computing systems when implemented in business organisations and explain the appearance and features of an innovative technology called blockchain.

To achieve the aim of this chapter, the following structure will serve as a guideline. First, a definition of centralised computing is discussed. Centralisation features are described, showing the benefits that this structure offers in view of its limitations. The current distributed computing systems are explored and considered as an alternative to getting rid of some centralised issues, bearing in mind several security limitations. Finally, the Blockchain technology appearance is explained, giving a detailed explanation of the benefits that this technology can provide and a description of some application platforms.

2.2 Centralised Structures.

Centralised computing systems are the ones that use centralization in their structure. As defined by Surbhi (2015), “The retention of powers and authority with respect to planning and decisions is known as Centralization”.

In a common computing structure, the client PCs are connected physically or over the network to a central server that processes their requests. This server has high-end computing features, massive storage and has installed the primary applications so that the client PCs are dependent on this server for any application access, storage, internet request, etc. Therefore, a centralised computing system is the one in where a central server has the authority and is responsible for delivering application logic, processing and providing computing resources to the attached clients (Techopedia, 2016). A representation of a centralised computing structure is shown in Figure 1.
Making your computing system centralised offers several advantages: Security is a key point to consider, not only because of having all the information stored in the same place but because of the control gained having the internet access points centralised. It is also easier to manage potential risks while having a single processing unit.

Korzeniowski (2013) argues that IT costs are significantly reduced due to centralising functions such as help desk, disaster recovery, and centralised email. Software licensing costs are also reduced due to the reduced number of purchases needed. In addition, it offers additional benefits like less travelling, having fewer shipping locations and eliminating redundant positions, processes, and systems.

Moreover, one of the most important advantages of centralised computing is the information integrity. In big companies, the amount of information stored is massive and the employees often work with multiple databases. With all this constantly moving information, it is crucial to have it under control, being aware of having redundant information in the system. This can be easily managed in a centralised structure.

Click (2006) explains that the expensiveness of centralized structures, the strong infrastructure needed, workers’ commitment to meet the standards, and constant integration of new processes and
acquisitions can make centralization a painful process, but once it is completed, everything can be managed from one location; there isn’t a necessity of having experts in every location, communication is easier, and problems can be resolved quickly.

2.3 Limitations of Centralised Structures.

Having a centralised structure offers several advantages, but it also has multiple limitations that should be considered.

Service availability is one of the limitations of a centralised computing structure. It represents the percentage of time that the system is available to the clients. The obligation of a connection between the PCs and a central unit to perform the main processes makes the connections between them one of the weakest points in the system. If this connection breaks down, the client would not be able to connect and share information with the central unit until the problem is fixed. The same happens if the issue resides in any of the computing features of the central unit. Although the issues are relatively easy to discover while having just one processing unit, the central unit can't offer any services to the clients until the problems are being solved. This leads to less availability of the system, causing significant economic losses in most of the businesses. But having issues with the connections or in central unit features are not the only things to consider reaching high availability in a centralised system. Service availability is also threatened by usage peaks. If a system is only prepared to handle standard use of its services, it is vulnerable to break down when users have work overload and are continuously making service petitions. These situations are normally hard to prevent, so a centralised system must have not only high-end features to be efficient with all user petitions but also a plan to prevent degradation or even a service collapse. (Sparrow, n.d; Corridori, 2012)

Corridori (2012) states that this was more of a problem in the early days of computing when they might have only one computer that provides services to all users, but nowadays, centralised systems take advantage of some techniques that can raise the availability of the service up to 99.9%. However, having this high percentage of availability requires such a big and complex infrastructure that is not cost effective to many companies.

Having a central unit also carries trust problems. When all the information is stored and managed
by a single entity, the customers must trust them regarding data and processes reliability. It is important to consider this threat to ensure the company information security and integrity.

Centralised processing consists of a single CPU, or a couple of them in the same location, that access the stored information and perform the business processes with it. Although these processing units have high-end features, they are vulnerable to work overload.

### 2.4 Distributed Systems.

A distributed system consists of a network of autonomous computers that communicate with each other in order to achieve a goal. Although the computers are independent and do not physically share memory or processors, they communicate with each other using messages, pieces of information transferred from one computer to another over a network. Messages can communicate things such as: executing procedures with particular arguments, sending and receiving data packages, or sending signals that tell other computers how to behave (DeNero, 2011).

![Decentralised Structure](image)

**Figure 2.** Decentralised Structure. (Kolodynski, 1969)

Computers in a distributed system can have separate roles. A computer's role depends on the system objectives and the computer's own hardware and software properties. There are two predominant
ways of organising computers in a distributed system. The first is the client-server architecture, and the second is the peer-to-peer architecture (DeNero, 2011).

The client-server architecture is a way to distribute a service from a central source. Its performance is similar to a centralised structure. There is a single server that provides a service, and multiple clients that communicate with the server in order to operate with its products. In this architecture, the server's job is to respond to service requests, while a client's job is to use the data provided in response to performing some task. This architecture shares the centralised architecture some of the drawbacks like the single point of failure and a possible denegation of service with too many petitions (DeNero, 2011).

The alternative architecture is Peer-to-Peer. The term *peer-to-peer* is used to describe distributed systems where the work is divided among all the units of the system. All the computers send and receive data, and they all contribute some processing power and memory. As a distributed system increases in size, its computational resources also increase. Reliability is an important feature that this kind of systems must have, as the information exchange process must be accurate (DeNero, 2011).

In the rest of this report, the peer-to-peer architecture will be referred when referring to distributed systems, as the client-server architecture shares most of the characteristics of centralised structures.

One of the key aspects of distributed systems is service availability. Lai et al. (2002) state on their distributed systems availability analysis that one of its applications is to help the system distributing the work effort. Using the Jelinski-Moranda Model, the following figure shows the system availability curve during the first hours of the implementation of a distributed system. The variables on the graph consider the hardware and software failure and repair rates, and $N_0$ is the number of remaining errors.
Figure 3 shows that the lowest availability period is within the first 150 hours of the system implementation. This is because a lot of errors and bugs are identified when the software testing phase begins. The system starts the recovery after reaching the lowest point, increasing the availability and maintaining stable this value during a prolonged period when the maximum point is reached. This happens because the errors found are gradually fixed until the software becomes ‘bug-free’. It is recommended that due to the initial low availability of the distributed systems, the system should not be released until the initial testing phase is finished. In fact, if the required level of availability is specified, the amount of testing needed can be estimated to know how much time would be needed to release a system that meets the availability requirements (Lai et al; 2002).

After the software is implemented and tested, a highly available system remains. Corridori (2012) evaluates the following advantages of adopting a distributed structure: Since there are multiple working computers in a distributed system, a single failure usually affects only some of the end users. None of the servers manages resources that are critical to all the end users; therefore, multiple failures in all servers are needed to stop all system services. But apart from high availability, distributed systems offer several advantages. Having multiple and small working sectors implies that each local management has deep knowledge of their server performance. This makes easier the process of making local changes, as fewer reviews and approvals will be needed to implement new
configurations. Moreover, if some problems occur when implementing changes, only the local environment would be affected, reducing the risk of stopping the service. The same happens if the system is affected by a natural disaster; it will only stop giving services if all servers are damaged (Corridori, 2012, Samiksha, n.d)

When including additional capacity. The system can grow easily by adding distributed servers to the current network, instead of having to upgrade the whole central computing unit like in a centralised architecture (Corridori, 2012).

2.5 Limitations of Distributed Systems.

Spread computing units can offer several advantages, but have cost and security limitations. Multiple servers need numerous qualified specialists to manage each server's behaviour, and although many management operations can be done remotely, some of them need skilled personnel to be available locally. This traduces into high management costs to ensure the system service quality (Corridori, 2012).

In a distributed system, servers need to be constantly sharing information to provide their services. This amount of access points makes control and security in distributed systems a key concern. In a research about security threats in distributed systems, Gómez and Martínez (2009) collect some of the most common security issues of this type of architecture. Many of the threats are related to malicious peers. Malicious peers are the ones that provide bad service when selected as service providers. These can be individual or belong to a malicious collective. Malicious collectives, often with camouflage by offering good services, can harm the reputation of a peer and raise the trust in a malicious one.
This malicious transformation may occur due to issues in the peer performance or due to an adversary attack. As mentioned before, controlling the access points can be a challenging task, especially in big distributed networks. Therefore, it is quite easy for a hacker with hateful intentions to get into a low-secured distributed system. After accessing the network, he can initiate a disproportionate number of malicious peers in the network. Each time one of the peers is selected as a service provider, it provides a bad service, after which it is disconnected and replaced with a new peer identity. This attack is known as ‘Sybil Attack’. Another common attack to a distributed system is ‘Man in the Middle’. In this attack, a malicious peer is initiated in the network so he can intercept messages from a peer to another and rewrite them for personal intentions (Gómez and Martínez, 2009).
In their research, Gómez and Martínez (2009) offer solutions to these common threats. To prevent individual malicious peers, the system should decrease the level of trust of those peers that always provide bad services. Malicious collectives are harder to detect if they are camouflaged, but it is possible if the system distinguishes the trust level deposited on a peer as a recommender and the trust deposited on the same peer as a service provider. A peer creation cost can be also implemented to make expensive the replacement of malicious peers in the ‘Sybil Attack’. Last of all, to prevent ‘Man in the Middle’ attacks, the messages between peers should be encrypted. However, they state that unfortunately, this practice is not feasible in some environments like wireless sensor networks.

2.6 Blockchain.

Swan (2015) describes the appearance of Blockchain as “The dawn of a new revolution”. A revolution that started with the crypto-currency Bitcoin. This currency offered an automated consensus among the network users to backup and issue the information on it, instead of being backed up by a central authority. Therefore, users no longer must trust the other party to perform a transaction. In its place, a self-policing algorithm rejects any malicious attempt against the system. Swan (2015) technically explains Bitcoin as “digital cash that is transacted via the Internet in a decentralised trustless system using a public ledger called the blockchain”. Bitcoin offers a new form of money that combines a peer-to-peer file sharing and public key cryptography.

The blockchain is the public ledger of all Bitcoin transactions that have ever been executed. It is in
constant growth, as the network nodes also known as “miners” are constantly adding new blocks with the purpose of updating the ledger with the latest transactions. This process occurs every 10 minutes (Swan, 2016).

The miners are high-end computers that perform the role of administrators of the blockchain. Although they join the network voluntarily, their participation is encouraged with monetary remuneration. Miners compete with each other solving computational puzzles, where the fastest, effective, and most efficient solution wins the prize (Rosic, 2016).

Swan (2016) explains that the blocks contained in the blockchain are added chronologically and every user has a copy of the full blockchain, which is downloaded automatically when a user joins the network. This blockchain contains all the information from the first transactions ever executed to the most recently added block. The access to the information in the blockchain is easily accessible for the network users. They can search for information of any transaction using a block explorer (E.g. https://blockchain.info/).

![Blockchain procedure in monetary transactions](image)

**Figure 7.** Blockchain procedure in monetary transactions. (Fernández, 2016)
The blockchain technology is known to solve the trust problems that appear in the current centralised transaction models, as users can trust the system of the public ledger as opposed to having to trust in the transaction counterparty (e.g. another person) or third party intermediary (e.g. a bank). Regarding the internal security problems in distributed systems, most of them are solved due to the multiple node validations of the blockchain technology. If a malicious node enters the system, his changes into the ledger need to be approved by the rest of nodes according to blockchain rules and restrictions. The modification can only be replicated if it gets validated by the clear majority of nodes. Every non-valid change is discarded denying malicious intents (Swan, 2016)

Figure 8. Blockchain Disintermediation. (Lewis, A. 2016)

The blockchain allows the disintermediation and decentralisation of all transactions of any type between all parties on a global basis by providing a robust platform. Furthermore, blockchain applications not only remain in economic transactions, but also in any form of asset registry, inventory, and exchange. These assets can be hard assets, which include physical property, and intangible assets that comprise votes, ideas, health data, etc. (Swan, 2016)

Being a decentralised transaction ledger that is part of a larger computing infrastructure makes possible the inclusion of many other functions related to storage, communication, file serving, and archiving. File management through Blockchain is possible by including a pointer with access methods and privileges for the stored file. This implementation applies the advantages of managing transactions with blockchain to the storage, access, dispatch, or receipt of files. (Swan, 2016)
2.7 Blockchain as a Database.

One of the important aspects that differentiate databases from spreadsheets is that they contain rules that help ensure the information reliability. Regarding today’s most popular databases, the common rules are the following (Greenspan, 2015a):

- The Database Schema describes what kind of information is allowed in each column. For example, the phone number must contain 4 digits and cannot be left blank (“null”).
- The Unique keys state that a column must have a different value in every row.
- Check constraints enforce relationships between the column values in each row. For example, if the department is “Procurement” then the room number must start with a 3 or 4.
- Foreign keys enforce relationships between tables. For example, if the database contains another table used for payroll, there might be a rule that every employee ID in the payroll table must also exist in the staff directory.

Every time that a modification is done in the database, the software ensures that the database rules are followed. If a modification is done violating any of these rules, it gets rejected.

When a database belongs to a single organisation is relatively simple to manage transactions, but things get harder when a single database is shared between two or more organisations. A central entity is needed to control the information integrity, manage simultaneous transactions that may include changes in the same information, and grant permissions to only access the allowed information. However, some trust problems may remain with the central entity that manages the database (Greenspan, 2015a). Greenspan (ibid) explains that to remove intermediaries between data and organisations, a database with the following characteristics would be needed:

- A robust peer-to-peer network that allows a quick propagation of the database transactions to all connected nodes.
- A way to automatically identify and solve conflicts between transactions.
- A synchronisation technology that ensures all peers has an identical copy of the database.
- A method for tagging different pieces of information as belonging to different participants, and enforcing this form of data ownership without a central authority.
- A paradigm for expressing restrictions on which operations are permitted.

By applying the blockchain technology to a database system, not only those characteristics would be provided, but also a new way of validating the changes. As mentioned above, standard databases include some rules that evaluate if a modification is valid, but some problems may appear when those databases are shared, as database-level restrictions like “Unique keys” and “Check Constraints” cannot protect the database against malicious modifications. Blockchain includes a transaction validation where every single node in the network evaluates if the transaction is valid (Greenspan, 2015a).

![Diagram showing traditional and blockchain database approaches.](Swisscom Digital Technology, 2016)

**Figure 9.** Blockchain database approach. (Swisscom Digital Technology, 2016)

### 2.8 How to implement Blockchain
Several developer platform companies emerged from the increased popularity of blockchain, offering tools to facilitate application development that fits this technology into each particular organisation requirements.

“Multichain is an off-the-shelf platform for the creation and deployment of private blockchains (permissioned Blockchains), either within or between organisations” (Greenspan, 2015b). It aims to solve problems that appear when deploying standard blockchain technology into companies, which is done by providing a privacy and control layer in an easy-to-use package. Similar to the Bitcoin core software from which it is derived, Multichain supports Windows, Mac, and Linux operating systems. It provides a simple API that shares information with other information systems, and both command line and graphical interfaces. The range of Multichain features includes extensive reconfigurability, rapid deployment, permissions management, native assets and data streams. (Greenspan, 2015b)

Ethereum is a platform and a programming language for building and publishing distributed applications. More fundamentally, Swan (2016) explains that Ethereum is a “fundamental underlying infrastructure platform that can run all blockchains and protocols, rather like a unified universal development platform”. Going further than other blockchain platform providers, Ethereum allows the development and implementation of smart contracts in any organisation. A contract in the traditional sense is an agreement between two or more parties to do or not do something in exchange for something else, with the need of trusting the other party to fulfil its side of the obligations. Smart contracts feature the same kind of agreement to act or not act, but they take away the necessity of trust between parties. This is because a smart contract is both defined by the code and executed by the code so if the requirements are not fulfilled, the contract cannot be executed (Swan, 2016). To start its implementation, an Ethereum client must be downloaded in each node. There are three different clients available, each of them related to a programming language to develop Blockchain applications: GO, C++, and Python. The command line tools in the clients will allow the user to connect to a Blockchain server, to run a customised application in the Ethereum Blockchain, or to create a private Blockchain network. (Ethereum, 2016)

2.9 Online Gambling Regulation.

Although online gambling has a global audience, there is not a global legislation that covers the
legality of online gambling. Instead, regulating the issues that may appear with this practice is in the hands of each country. This means that what is legal and what is not depends on the country you live in (Walker, 2017).

For this report, the information collected about online gambling regulation will be based on Spanish laws and restrictions.

In the year 2011, an organisation is created as a part of the Ministry of Finance and Public Administrations. This institution regulates, authorises, supervises, controls and if necessary penalises gambling activities in the Spanish State. In particular, the regulations are applied to gaming operations through the internet, television, mobile phones, or any other interactive communication system. (Errasti, 2015)

2.10 Conclusion.

To sum up, a blockchain is a distributed database that was invented to eliminate some of the problems of centralised and distributed structures. When implemented into a standard database system, it creates and maintains a growing list of ordered records, called blocks. These blocks comprise the information of all transactions that occur in the system, adding a timestamp and a link to the previous block. The blockchain writing permissions reside on the “miner” nodes, which make use of complex algorithms to build the blocks and attach them to the rest of the chain. These blocks cannot be modified but corrections can be uploaded referring to previous transactions, appearing as an insertion of a new block to the block chain. This technology provides a reliable ledger of transactions whose access can be public or restricted.
CHAPTER 3. METHODOLOGY

3.1 Introduction.

Considering the large number of projects whose findings are rejected due to an inappropriate methodology, it is essential to identify and evaluate the most appropriate practice in order to create useful understanding in the subject area (Hagyard, 2015). The main objectives of this chapter are the following:

- To explore the main philosophical paradigms and research methodologies commonly used in research projects.
- To evaluate the different research approaches and select the most convenient one for this project.

The application of the appropriate procedures in this section will provide the guidelines for the analysis of the primary data collection findings.

In this chapter, the procedures used for the primary data collection will be described, giving the appropriate theoretical descriptions in each section before the application to this study. The first section comprises an explanation of the philosophical paradigms that are implied in a research project, as the results of the data collection will vary depending on which method is followed. The second section explores two opposite research methodologies and describes some reasons why one is considered more appropriate to obtain the most suitable results related to this project primary data gathering. After the method guidelines are explained, the interview structure is defined, describing the motives of choosing semi-structured interviews. Several arguments of the participant selection are then explained, and a final sample of the participants’ composition is provided. To end with, the final parts cover ethical considerations of the data collection, emphasising the anonymity of the people participating in semi-structured interviews.

3.2 Research Philosophy.

Conducting a research project implies consciously or unconsciously, to investigate the research
questions from a particular viewpoint. There are two main research paradigms: positivism and interpretivism. Depending on which one is chosen to conduct the research project, the results will be guided in one way or another (Hagyard, 2015). Therefore, before applying a specific research methodology, the researcher’s philosophical position should be identified.

The positivist paradigm is related to an observable social reality, and the product of that research is often represented by law-like generalisations. It is also a paradigm where hypotheses are usually tested, and conclusions are drawn with the extension of the findings to the rest of the population (Myers, 1997). Since the positivist paradigm is linked to a quantitative research methodology, and it is based on a strict, inflexible evidence collection, it is considered inappropriate for this data collection. Alternatively, the interpretive research methodology is oriented to study the social world, seeking an emphatic understanding of human behaviour. The interpretive belief that reality is personally constructed makes complementary the use of qualitative methods and enables to gain insight into each individual’s experience (Hagyard, 2015). Applied to the project objectives, an interpretive practice in the primary data collection would provide a strong knowledge base relative to the current technological situation of the studied organisation, in order to evaluate the feasibility of implementing the blockchain technology into their systems.

3.3 Quantitative and Qualitative Research Methodologies.

In addition to applying an interpretive research methodology, the primary data collection will be guided by a qualitative research process. This process aims to discover how participants feel about their lived experiences in the studied subject. Because the data gathered this way is subjective, the results are not necessary extendable to the whole population, but can provide an insight into the viewpoint of the participants about the subject in question. Qualitative research methods range from interviews to participant observation and can include a collection of written data including email and diaries. (Hagyard, 2015)

As opposite, and as defined by Saunders et al. (2003), “Quantitative research involves the analysis and interpretation of some numerical data or data that could usefully be quantified”. In other words, Saunders et al. (2007) define quantitative research as data expressed in numbers instead of words. Data in this method range from simple counts like frequency of occurrences, to more complex analysis like test scores. Quantitative methods focus on the analysis of data in a numerical format, usu-
ally investigating a sample and then extending the findings to the entire population (Hagyard, 2015).

Qualitative practices are considered more suitable than quantitative ones for the primary data collection in this project. A quantitative methodology would not delve enough into the level of detail required for the implementation of an innovative technology in an organisations’ environment, so the project would not meet some of the projected goals. On the other side, qualitative methodologies are thought to help the researcher understand the IS situation of the organisation, and identify the key aspects that would determine the Blockchain implementation. The participants will conduct a series of semi-structured interviews where they can openly explain the procedures of Spanish online gambling regulations.

3.4 Semi-structured Interviews.

Interviews are probably the most widely used method for data gathering. Conducting open-ended interviews provides an in-depth insight into the participant’s experiences. However, interviews are also challenging for the researcher in terms of giving the appropriate meaning to the participant answers. It is important for the researcher to analyse the participant’s speech to develop an appropriate understanding of the expressed ideas, paying special attention to the non-verbal communication. (Hagyard, 2015)

For this research, several semi-structured interviews will be conducted about Spanish online gambling regulation procedures. Open-ended questions and freedom of response will allow the researcher to gain opinions and thoughts of the participant’s answers. Since one of the main objectives of this research is to evaluate the possible improvements that the blockchain technology would bring if applied to the online gambling control, special emphasis will be put in getting knowledge about the diverse kinds of transactions that they manage. The researcher will send an email to the participants with the interview questions after meeting face-to-face and explaining the main objectives of the project. The participants will respond via email with the appropriate answers to the questions given. Since the interviewed members are Spanish, the semi-structured interviews will be conducted in Spanish and then translated by the researcher to English. A copy of the original interviews will be provided in Appendix A.

The subjects covered in the semi-structured interviews are:
- Background questions that include information about the DGOJ objectives and basic information about the participants.

- Discussion about gambling control objectives.

- Discussion about the transactions that take place within the communications between the DGOJ and the gambling providers.

- Discussion about the possibility of having transaction information replicated to improve integrity and security.

- Discussion about possible benefits of applying the blockchain technology to their information systems.

- Discussion about the current application programming interfaces in their databases.

- Discussion of future features they would like in their information systems.

3.5 Research Approach.

The research approach defines in which way the data collection relates to the theory stated. It is divided into two research approaches: inductive and deductive. (Saunders et al., 2007)

As Gabriel (2013) states, “an inductive research is concerned with the generation of new theory emerging from data”. Inductive reasoning starts with observations and the theories are proposed towards the end of the research process being guided by the observations (Goddard & Melville, 2004). On the other hand, the deductive approach can be explained by deriving a hypothesis from the premises of the theory. The deduction begins with an expected pattern “that is tested against observations, whereas induction begins with observations and seeks to find a pattern within them” as Babbie (2010) states.

In the research process employed in this project, the researcher does not know if the blockchain technology can be applied to the organisations’ procedures, thus has to make a qualitative research in order to get a clear vision of their systems. Towards the end of the project, and once the information is gathered, the researcher makes up a theory about the feasibility of adopting the mentioned technology and which benefits would it provide. Therefore, the research process in this project follows an inductive reasoning.
3.6 Sampling.

Within the DGOJ, a sample of participants will be selected using Purposive sampling, as they have the characteristics required for the study. Those characteristics include having knowledge about the different transactions that occur in the online gambling regulation processes. The researcher requested participation to at least five people responsible for the management in different areas of the organisation. Participants were selected who were in the best position to give an accurate answer to the questions given. As the questions subjects might belong to different organisation areas, they will be assigned to the employee with better knowledge in the mentioned area.

The final sample consists of five members of the management in DGOJ, ranging from middle management to deputy director. This sample involves participants with knowledge about all procedures included in online gambling regulation.

3.7 Ethical Considerations.

Ethical considerations are present in every part of the primary data collection and treatment. Although it is thought that the project subject does not have important ethical implications, some guidelines are applied to provide an adequate ethical guarantee. The measures have been clearly explained to the participants in every visit the researcher made to their offices. Additionally, participants were given a participant information sheet with important ethical information. Most of the ethical considerations were built around the understanding that the results of the semi-structured interviews are used expressly for the benefit of this research, and participants’ information remain anonymous and securely stored. Further ethical considerations are the following:

- Consent from participants is required from the interviewees by the completion of the consent form before they can take part in the study.

- Participant’s right to anonymity will be reiterated throughout the research and they may withdraw their participation at any point.

- The researcher will only record participant’s name, anonymising it if the participant wants.
- All data will remain confidential and will be stored securely in a password protected computer system.

- The interviewee will remain the right to withdraw any information gathered. The researcher will remind the interviewee that the information collected will only be accessible by the researcher.

- Any data provided will not be traceable back to specific people.

These guidelines were made to ensure that the points covered in this research do not cause any harm to participants and that their participation in the research is consented, understanding that their involvement will contribute to the fulfilment of the project objectives.

3.8 Summary.

In this section, the researcher has been guided through the different approaches by different theories commonly used for primary data collection. Regarding this chapter objectives, the researcher has successfully evaluated the different methodologies and approaches, understanding the appropriate uses of every research practice. This study’s theoretical approach has followed the procedures of interpretivism, conducting several semi-structured interviews with members of the online gambling regulator organisation in order to perform a qualitative data evaluation. The data collection is related to the theory approaches by making an inductive reasoning, starting with observations on the organisation’s practices and then developing a theory on the application of blockchain. The application of these guidelines helps to make the best use of the data gathered in next chapter.
CHAPTER 4. INTERVIEW RESULTS

4.1 Background Information.

In the first visit to the organisation’s offices, the researcher described the project aim and objectives and asked for consent to gather information through interviews. Some questions were brought, and he explained the nature of several key questions involved in the semi-structured interviews. The participants were given the appropriate questions and every further communication was made via e-mail. Most of the questions were asked to numerous participants in order to collect diverse viewpoints depending on the department where they belong. Since the researcher translated the answers from Spanish to English, a draft version was sent back to the participants to get their approval before writing the definitive version in the project. The following section shows the mentioned questions followed by a brief explanation of the question purpose and the answers given by the participants. Participants are classified as P1, P2, P3, P4, and P5.

4.2 Interview Results.

Q.1 What are the overall objectives of the organisation?

Participants were asked to explain the main objectives of the organisation for the researcher to have an overall understanding of their working environment.

Responses:

P2:
It is the official body responsible for regulating, authorising, supervising, controlling and, where appropriate, penalising state-level online gambling activities.

P3:
It is the official organisation within the National State Administration in charge of the regulation and control of the gambling market in Spain, particularly online gambling.

P5:
The organisation’s main objectives are to ensure the proper development of the Spanish gambling
market and to prosecute illegal gambling in accordance with current legislation and regulations.

**Q.2 Does the organisation have centralised or decentralised information systems?**
This question is proposed to provide the researcher with information to decide if the shift towards a decentralised structure should be considered in the implementation of Blockchain.

**Responses:**

**P2:**
The organisation has centralised systems but occasionally is supported by external services.

**P3:**
The organisation has centralised information systems.

**P4:**
Most of the systems within the organisation have a centralised structure. However, some databases used by the organisation belong to autonomous regions.

**Q.3 Which kinds of communications does the organisation handle with online gambling providers?**
The answers to this question would give an understanding of the different communications that the organisation establishes with online gambling providers in order to identify in which areas could blockchain be implemented.

**Responses:**

**P1:**
From the supervision department perspective, the communications between the regulator organisation and online gambling providers (also called operators) are:

- Sending and receiving data files with information about players or transactions.
- Sending information about issues detected in the quality of the data received from the providers.
- Sending and receiving information related to doubts and queries.
**P2:**
Online gambling providers, in accordance with the relevant legislation, must periodically send certain information to the organisation (this information may vary on each procedure). According to Law number 39 for public administration, communications are made through the organisation electronic headquarters. The mentioned communications may be made via email for certain procedures.

**P3:**
On the one hand, several procedures are performed in the organisation’s electronic headquarters. These procedures include electronic registers, gambling licenses requests, information reception, doubts resolution, and complaint management. On the other hand, daily connections are established with each operator server in order to collect game and players’ information. These connections are performed through the SFTP protocol.

**P4:**
From my perspective, the organisation establishes communications with the operators once they fill and submit the appropriate form through the electronic headquarters, explaining the issues encountered and requesting its amendment.

**P5:**
Although the communications that involve legal guarantees are performed through the organisation’s electronic headquarters, further communications are made via email or phone calls. These communications may also involve face-to-face meetings.

**Q.4 Which communications require sending and receiving transactions?**
This is one of the key questions of the interview. Participants’ responses would provide an insight into the communications channels and processes in order to identify which ones could potentially be improved with the use of blockchain, addressing a key objective of the project.

**Responses:**

**P1:**
Regarding the supervision communications, there are several ways in which the organisation conduct transactions with the operators:
The first type of transaction is conducted when the providers send information related to their players and games. The information is divided into different files, that are sent daily to the organisation for their inspection. This transaction comprises sending and receiving files via SFTP connection, using a warehouse as a trusted third party to store these files before including them into the organisation’s storage. The members of the organisation then download these files locally for inspection purposes.

The file inspection process also involves carrying out transactions. Once the issues are identified, the providers are informed, an email is sent detailing the problems to be solved. Usually, some documentation is attached to explain the ways to solve open issues. The last transaction in the inspection department takes place in doubts and queries communications. Both providers and the organisation send emails including documentation or samples of issues encountered.

P3:
Transactions made through the electronic headquarters include fixed communications between the organisation and the operators. These transactions are made on a daily, monthly, and annual basis, and consist in sending and receiving information about their business structure and economical operations. Other transactions made through the organisation’s electronic headquarters are the type-approval of new games of chance and new licenses applications. In addition, other transactions related to sending and receiving files are carried out through the SFTP protocol.

P5:
Periodical communications between the operators and the organisation are conducted including, among others, changes in technical systems and economic information. In addition, within the instruction of administrative processes, transactions are made in the information exchange of license applications, service extensions, changes in technical systems, and sanction procedures.

Q.5 How long does it take to send and receive those transactions?
This question complements Q4. It would help to include further information about the transactions and to evaluate changes in the transaction’s duration with the implementation of Blockchain.

Responses:

P1:
Sending and receiving information via email and SFTP is an instant process. However, depending
on the number and size of the documents attached, the building process of emails might be delayed.

**P3:**
Transactions via electronic headquarters do not take longer than the time spent on signing in and filling the appropriate form. When using the SFTP protocol, transfer times depend on the size of the files being downloaded from the operators’ servers.

**P5:**
Since the transactions are performed by a telematic process, sending and receiving them is automatised.

**Q.6 Do the transactions include a digital signature or other identification methods?**
Since blockchain has applications related to digital signatures, this question is asked to evaluate if those applications would be useful for the organisation.

**Responses:**

**P1:**
Yes, every data file is digitally signed to ensure provider’s identity and attest that it is the provider who sends the information.

**Q.7 Is there any transaction that needs to be attested by a trusted third party?**
The purpose of this question is to know if the organisation needs trusted third parties for any transaction that could be eliminated using blockchain, improving the transactions efficiency.

**Responses:**

**P3:**
Yes, transactions made through the electronic headquarters require every user to provide a valid electronic certificate issued by a trusted certification authority, most common certificates come from the National Currency and Stamp Manufacturer (FNMT).

**P5:**
The electronic headquarters provides integrity, non-repudiation, and timestamp guarantees
according to the national security and interoperability schemes. These guarantees are possible through the use of electronic certificates.

**Q.8 Does the organisation transfer information with other governmental institutions?**
This question is asked to evaluate the inclusion of governmental nodes that could have access to certain gambling information for legal purposes.

**Responses:**

**P2:**
Yes, the organisation maintains communications with other governmental institutions like the Police, that offers an ID validation software to verify the identity of the players. Gambling information related to taxes is also reported to the tax authorities.

**P3:**
Yes, sometimes information is transferred to the Police, Judges, Tax Authorities and the Parliament as a response to legal requests.

**P5:**
Yes, the organisation establishes communications with autonomous communities in terms of the type-approval of gambling systems.

**Q.9 Does the organisation give public access to any kind of information?**
One of blockchain’s key benefits is the possibility of providing transparency into the transactions information. This feature could add an additional transparency layer to the organisation.

**Responses:**

**P2:**
Yes, the organisation has online website services where they publish relevant information for online gambling providers and bettors. This site is called “transparency portal”.

**P3:**
The organisation publishes information related to, among others, current gambling laws and regulations, legal gambling providers, licenses, access to the electronic headquarters, and secure and responsible gambling practices.

**P5:**
The department where I work does not give public access to any information. However, the organisation publishes studies and reports about online gamblers’ profiles and the gambling market. This information can be accessible through the organisations’ website.

**Q.10 Are there events that should automatically start a procedure?**
The possibility of implementing smart contracts is another blockchain key feature. This type of contract is both defined by the code and executed by the code, implementing an automated and reliable action when a condition is met (Swan, 2015). Some of the organisation’s automated procedures could benefit from this technology.

**Responses:**

**P3:**
File transactions from the operators’ servers to the organisation and processes inside the electronic headquarters are automated. Regarding infringements, fraud, illegal gambling, and other risk aspects, each situation is individually evaluated.

**Q.11 Does any transaction need acknowledgement of receipt?**
In blockchain, the ledger itself acts like the acknowledgement of receipt by timestamping the exact time when the transaction is sent and received. If this acknowledgement is needed in the organisation’s transactions, this feature would be a straightforward way to implement it.

**Responses:**

**P1:**
Currently, standard email communications do not have an acknowledgement of receipt. However, there are some important transactions that do need it, and an acknowledgement in every transaction would be useful to verify if the data has been correctly received by the addressee.

**P3:**
All transactions within the electronic headquarters include an acknowledgement of receipt for the operators.

**P4:**
With regard to the notifications managed in the organisation, if the transactions involve face-to-face meetings, an acknowledgement of receipt is required. Otherwise, an identification through an electronic registry certifies that the information has been visualised.

**P5:**
Every transaction involves an acknowledgement of receipt. In transactions regulated by an administrative process, the acknowledgement is channelled through the electronic headquarters. For other means of communication like email, the email itself serves as evidence.

**Q.12 Would a replication of transaction data be useful to prevent data loss, damage or corruption?**
As mentioned above in blockchain features (2.6 in the literature review), the transactions made through blockchain are replicated to all nodes in the network after being approved. This question is asked to know if this information redundancy would be useful.

**Responses:**
**P1:**
Yes, a replication of the transaction data would be useful.

**P3:**
Yes, it would be useful.

**Q.13 Does the database system have any Application Programming Interface (API)?**
Questions 13 and 14 were planned to evaluate if the organisation has had any problem to consider when implementing a previous application programming interface into their database. If they had, an extra layer of difficulty would be added to the blockchain implementation since an API would be needed.
Responses:
P1, P2, P3, P4, P5: I don’t know.

Q.14 In case an API has already been implemented, were the results of that implementation positive?

Responses:
P1, P2, P3, P4, P5: I don’t know.

Q.15 Would it be possible to implement a virtual machine in the organisation servers?

One of the studied blockchain platform providers requires downloading a virtual machine for executing the code written in its applications, so a previous implementation of a similar one would give an early overview of its feasibility.

Responses:
P3: 
I think that some virtual machines have already been implemented in our servers. I, therefore, believe that a virtual machine implementation for blockchain would be possible.

Q.16 Do you think that the application of blockchain technology could improve any other feature in the organisation?

Participants are asked this question to cover any possible missing aspect of the blockchain implementation.

Responses:
P1, P2, P3, P4, P5: I don’t know.

Q.17 What do you expect from your information systems within the next 5 years?

Participants were asked this question in order to evaluate the similarities between their expectations and the improvements that blockchain would provide to their systems.
Responses:

P5:

Within the next five years, we expect to improve the usability of our tools, optimise the processes flow, and refine the data models and its management.

4.3 Summary.

With the help of the methodology guidelines described in chapter three, several semi-structured interviews were conducted. These interviews provided incredibly useful information for the possible adoption of the blockchain technology in the organisation. Within the responses, participants gave detailed information about the different transactions conducted between the organisation and third parties, providing a solid foundation for the evaluation of blockchain benefits. Unfortunately, participants’ work is not related to the database management and could not answer questions 13 and 14 about the implementation of an application interface, so this report will draw from the fact that blockchain would be the first API implementation in the organisation’s database.
CHAPTER 5. RESULTS ANALYSIS

5.1 Introduction.

With the primary and secondary data collection being finished, the researcher has enough knowledge to evaluate the possible improvements that blockchain technology could provide if applied into the organisation. This chapter will explore the results of the data analysis in relation to the aims and objectives of the research. The researcher will connect the procedures mentioned in the interviews with the pertinent blockchain features, identifying the key aspects for a successful implementation. More specifically, this section has two objectives:

- Evaluate if the blockchain technology can provide improvements in the transaction management of the organisation.

- Investigate the possible application of Blockchain technology to the organisation, and provide recommendations for its implementation.

5.2 Analysis of Blockchain Benefits in the Organisation.

The results of the semi-structured interviews led to the conclusion that the benefits of adopting blockchain are divided into three application areas:

The first and larger area of application could be in the transactions that the organisation conducts with online gambling providers. The second application area could be in the communications that the organisation maintains with other governmental institutions. The third area of application could be related to the information that the organisation gives public access.

5.2.1 First Application Area: Communication with Operators.

According to the results of the interviews, the organisation maintains communications that involve performing transactions with online gambling providers. However, participants emphasised that the communication platform varies depending on the organisation department. Therefore, this section will divide this application area into the two main communication channels mentioned in the
interviews (P2, P3, and P5 in questions 3 and 4). Throughout both sections, the researcher will try to unify the two current channels into a single blockchain communication platform.

5.2.1.1 SFTP and Email Transactions.

Within the communications between the organisation and the operators, several procedures are made via SFTP or email. These communications involve sending and receiving transactions so an evaluation will be made to contrast the current organisation methods with blockchain transaction management features. The differences between the methodologies will provide the required knowledge to decide if the transaction management would be improved with this application.

Regarding the detailed description of the SFTP process provided by P1 in question 4, this protocol is used when the organisation requires data files from the operators. Each operator uploads a version of their files into their SFTP client, an automated process transfers the files to the organisation’s SFTP client, and then are locally downloaded by the organisation’s supervisors. This process could be alternatively made in a private blockchain, where the operators and the organisation become nodes of the blockchain network. When the operators have the information ready, they would use the blockchain application to send the requested files. The application would assign those transactions to the miners, who build the blocks in the chain with the latest information (Rosic, 2016). Since blockchain is a distributed database, the information would be replicated in every node of the network, eliminating the necessity of making periodical backups. A fact that must be considered is that file sharing through SFTP often contains big files that may delay the sharing process as mentioned in question five by P3. The delay would be higher in blockchain since the files are replicated multiple times. This feature would benefit both the operators and the regulator organisation, so operators could also remove their periodical backup procedures. Although the information resides in every network node, the access to this information is restricted by the network itself, granting access via private keys only to the author and the regulator organisation. The files submitted would be timestamped, providing the organisation with an unalterable time log stating when the operators first submitted the requested files, and if those files have been modified. Blockchain statements in this section are based on the book “Blockchain, blueprint for a new economy” by Swan (2016).

P1 stated in question 5 that every file is digitally signed to proof the author’s identity. With
blockchain is the network itself who establishes a digital signature between the transaction parties (Swan, 2016). When a node sends a document, the blockchain platform attaches a digital signature to the document, and when the document is received by the miners, the signature is verified before adding the document to the chain. This automatizes the process of digitally sign every file that is sent via SFTP. The process of electronically signing the documents is described in the following scheme:

![Figure 10. Electronic Signature (Catapult, 2016).](image)

Transactions made through email could also be linked to the blockchain network to get advantage of some of its benefits. According to the interview results, game and players’ information, the description of problems to be solved, and the resolution of doubts and queries are sent via email, attaching the pertinent documents when needed. Although blockchain application in this area would leave in place email communications, establishing an API between the email service and the blockchain would record all the communications in a time log, stating the exact time when the communications were sent and received. Furthermore, data models that state what information and how the information should be sent to the regulator organisation could be publicly shared through
the blockchain. This method could be applicable to all the information that need to be distributed to all operators.

5.2.1.2 Electronic Headquarters Transactions.

As interviewees stated in questions 3 and 4, the electronic headquarters is used for transactions that involve legal guarantees, including gambling licenses requests, information reception, doubts resolution, and complaint management. Since electronic headquarters transaction procedures were not specified in the interviews, and understanding that is a powerful and reliable platform, a further investigation is needed to know the required effort and resources that would allow replacing the current online headquarters portal with a blockchain application. Nevertheless, blockchain features could complement its performance, adding an unalterable trace of the transactions that would be replicated in every network node. Although this implementation would not improve the system’s efficiency, it would provide a secure and reliable database to store transaction information. This information would also be accessible from the same block explorer as SFTP and email communications, improving the data integration.

5.2.2 Second Application Area: Transactions with other governmental institutions.

In the interview, P2, P3, and P5 were asked if the organisation maintains communications with other governmental institutions. P2 explained that the organisation establishes communications with Spanish National Police Corps in order to work together for the validation of players’ identification. This is considered a good scenario for the implementation of smart contracts. Considering the definition of smart contract given by Swan (2015), it performs the same role as a standard contract between two parties, but a smart contract is both defined by the code and executed by the code. This means that the smart contract would find some parameters inside the transactions and trigger a specific procedure. Regarding players’ identification with software provided by the police, the procedure using blockchain features could be the following: After the operators send players’ information through the blockchain network, the information is received by the network miners, responsible for the chain construction. The smart contract would be implemented inside these miners. Some specific parameters like the identification expiration date or the players’ date of birth would trigger a blockchain transaction that indicates to the police a validation request of the
selected identification documents. This procedure would take place even before the information reaches the regulator organisation node, making the outsourcing process of ID validation more efficient.

Further responses to question 8 indicated that other governmental institutions like Judges, Tax Authorities and the Parliament sometimes access certain information in response to legal requests. The inclusion of these institutions in the blockchain network should be considered. During standard conditions, these nodes would not have privileges to access the information held in the ledger but when a legal request is provided, a smart contract could grant access to the appropriate transactions. Blockchain would represent a high-security option to transfer information that is considered particularly sensible and would assure access only to the necessary information, respecting gamblers’ privacy.

5.2.3 Third Application Area: Transparency Portal.

P2 defined the organisation’s website as a “Transparency portal” where informative data is posted for the benefit of operators and players. As P3 and P5 explained in the interview, the website includes current gambling laws and regulations, legal gambling providers, licenses, access to the electronic headquarters, secure and responsible gambling practices, and diverse reports about online gamblers’ profile and the gambling market. The inclusion of blockchain would provide a new transparency layer in the organisation, offering the possibility of publishing the transactions’ information that they consider appropriate. This could be done simply by modifying the transactions privileges and integrating a transactions section into the website. This section would contain a block explorer that access only to the proper blockchain database information as defined by Swan (2016).

5.3 Implementation of Blockchain in the Organisation.

Among the considerable number of blockchain platform providers that are constantly appearing in the market, the implementation of these services into the organisation will be explained using Ethereum services. The researcher has considered this platform the most appropriate due to its high-level programming languages, and because of the smart contract development that it includes.
Considering P2, P3, and P4 responses to question 2, the current system has a centralised structure, where the organisation acts like the central authority in most of the cases. Applying blockchain might seem the decentralisation of some of the organisation’s procedures, but with the implementation of a private blockchain network, the developers can build an application suited to the organisation’s requirements (Buterin, 2015).

Regarding the fact that participants could not answer the questions addressing the subject of application programming interfaces, there is no background experience in this area. This fact involves more testing phases to assure a correct relationship between the blockchain application and the database. Nevertheless, the API implementation is not considered a threat since it is a widespread practice in the industry. The participant identified as P3 also stated that the organisation has already implemented certain virtual machines for different purposes in their servers, which is considered a useful finding since Ethereum core is a virtual machine that executes the code written in the applications and must be installed in every node of the network (Ethereum, 2016).

The following sections will explain two possible blockchain implementations for online gambling regulation purposes. Considering that several transactions involve sending and receiving documents, the file sharing area will be a key implementation. The recommended procedures included in the following sections (5.3.1 and 5.3.2) are based on Swan’s (2015), Ethereum (2016), Buterin’s (2015), and Lyтовченко’s (2016) documentation.

5.3.1 Full Blockchain Implementation.

This implementation derives from the point of view that all file sharing will be made by the blockchain technology. The implementation starts by downloading Ethereum developer application, which is a framework that allows the developers to adapt the blockchain technology to each scenario. These developer tools include 3 different clients: GO, C++, and Python (Ethereum, 2015). The developers would choose the most appropriate one with regard to the organisation requirements and their programming experience. Regarding the information gathered in the interviews, the key features of the development would be the implementation of a file management service through the blockchain network, the inclusion of a block explorer into the organisation’s website, and the development of a ledger that records information of all transactions, including those made through the electronic headquarters. The file management development will cover several points mentioned
in section 5.2.1.1, where some implementation guidelines were needed to evaluate the possible blockchain benefits.

First, a visual interface should be developed in the client nodes. The WPF application is considered the most appropriate due to its compatibility with the standard Ethereum interface. WPF would allow developing a user-friendly interface as a replacement of Ethereum’s standard command-line client interface. The file transferring application would then be developed considering the following recommended process: the operators would first upload the new transactions to the network transaction queue using the client interface. Periodically (for instance every 10 minutes), the miners (high-end computers located in the organisation), would collect all the files sent by the operators and would encrypt all the information inside the block to assure information security. The system would then proceed to its validation according to the conditions established by the organisation. Once the transaction is approved, the new block containing the files would be part of the chain and therefore would be replicated to every network node. At this point, the block would include all files sent during the period, classified with the appropriate identification, and secured with specific private key encryption methods. The miners’ block collection time could be adjusted to improve the system efficiency.

The block explorer implementation should be accessible by adding a new section in the website containing the transaction search engine provided by Ethereum. Privileges should be established to give public access only to the appropriate information. Network users could also use this platform for accessing the information of their transactions. The search engine would be prepared for a shared use by requesting a transaction identification only given to the transaction stakeholders for accessing classified data.

By implementing another application programming interface that communicates the electronic headquarters with the blockchain ledger, the timestamp information of its transactions would be captured in the ledger, integrating all transactions information into a single platform.

5.3.2 Blockchain Implementation with Externalised File Storage.

This implementation will be guided by Lytovchenko’s (2016) case study of developing a system for secure document transfer built on top of blockchain technologies. Deriving from the fact that
transactions often include big files as P3 stated in question 5, some amendments should be done to last chapter’s recommendation since these files might be too large to be stored in the blockchain database. The solution would include two key units: document storage and blockchain transaction management. The following scheme gives a guiding representation of a similar blockchain network:

![Blockchain Network Scheme](image)

**Figure 11.** Blockchain Network Scheme (Lytovchenko, 2016).

In Figure 11 is shown that, as in the previous implementation, the network would contain client and miner nodes. The organisation and the operators would be examples of client nodes, and the mining nodes would still perform algorithms to attach the new blocks to the chain. However, unlike in last section recommendations, the blockchain database will only contain transaction references, leaving the file storage in the hands of an off-chain storage provider. In Lytovchenko’s (2016) case study, the storage services are managed by GitHub (a highly-secure cloud storage provider), but it could be replaced with other shared databases. The last section’s recommended file transfer process would remain the same but in addition, a link is established between the blockchain and the storage system. This results in the files being stored in the selected storage system and the transaction references being stored in the blockchain ledger, solving the big file storage issue.
5.4 Summary.

In the first part of the chapter, the current communication procedures defined by the interview participants have been studied, evaluating the feasibility of replacing the current platforms with the blockchain technology. Among this migration process, several benefits have been discovered:

- With a full blockchain implementation, transferred files and transactions’ log would be replicated in every node of the network, eliminating the necessity of making periodical backups. With an externalised file storage, only the transactions’ log would be replicated.
- In both implementations, the submitted files would be timestamped, providing the organisation with an unalterable time log stating when the operators first submitted the requested files, and if those files have been modified.
- Digital signatures in files transferred through blockchain would be automated.
- Establishing an API between the email service and the blockchain would record all the communications in a time log, stating the exact time when the communications were sent and received.
- Data models that state what information and how the information should be sent to the regulator organisation could be publicly shared through the blockchain, taking advantage of the above-mentioned benefits. This benefit would also address P5 expectations for the organisation’s information systems by improving the data models’ management.
- Blockchain would provide a more secure platform for document sharing than email attaching.
- Blockchain adoption would enable a single access point for all transactions information, using a single explorer to access the block chain.
- The personal identity validation procedure would take place even before the information reaches the organisation node, making the foreign validation process more efficient.
- Blockchain would represent a high-security option for transferring sensible information to governmental institutions and would assure access only to the necessary information respecting gamblers’ privacy.
- The adoption of blockchain would provide a new transparency layer in the organisation, offering the possibility of publishing the transactions’ information that they consider
appropriate. By giving public access to certain kind of transactions.

However, the research has also shown some blockchain limitations considering the current process behaviour. The duration of the transactions would be higher since every blockchain update must be approved and replicated into every node of the network. Moreover, further investigation is needed to know the necessary effort and resources to develop a blockchain application that provides the same security and efficiency levels as the Electronic headquarters do. This is subject of a separate study that should be conducted once blockchain is seriously considered as an alternative to the current procedures. Managing the cultural and technological changes is a must. Users are used to a settled-down technology, so the change to a barely known technology may cause threats, issues and mistrust among end users. A lack of change management or an inefficient methodology could lead to failure in the project setup. Budget availability is also a factor to consider beforehand since even with a good feasibility analysis and identified benefits, a lack of economic resources could block the start or development of the project.

In the second part of the chapter, two implementation guidelines have been recommended, both based on the blockchain platform “Ethereum”. The first one is related to a blockchain network where the file storage and management are performed with blockchain technology, and the second one considers a fact mentioned by a participant that could cause issues with the first reasoning. The appropriate adjustments are explained, describing how the issue would be addressed. The blockchain application described in this section is considered feasible since no significant issues have been discovered in the migration process.
CHAPTER 6. CONCLUSION AND OBJECTIVES EVALUATION

6.1 Dissertation Summary.

With the initial idea of investigating the possible application of the blockchain technology to the online gambling management, the researcher first started gathering information about the features of this technology, providing a background history of the reasons why this technology emerged. Blockchain key features were then explained, adjusting the large amount of blockchain characteristics to the magnitude of this project. A detailed evaluation of the methodologies used for the primary data gathering was described, supported with the appropriate theoretical explanations, and deciding which practices are the most suitable to obtain the best results associated with the project aim and objectives. Once the methodology was clearly established, the primary data collection took place. The collection was directed by the guidelines established in the methodology, conducting several semi-structured interviews with the aim of gaining an insight into the organisation transactions and procedures. With the procedures being identified, the researcher developed a rationale on how blockchain processes would replace the existing ones, providing a list of benefits and limitations on this subject. Two examples of application guidelines were then described, considering two different points of view in the development of the blockchain structure.

6.2 Aim and Objectives Evaluation.

Regarding the aim of the project, this research project aims to investigate the application of the blockchain technology to the control of online gambling. Rather than financial applications, the researcher aims to find a transaction management solution that fits into the online gambling regulation structure. To achieve this, four objectives were established. This section will discuss the procedures followed to fulfil these objectives.

Objective 1. - To critically review the existing peer-reviewed literature on centralised and decentralised systems, and explain the appearance of an emerging technology known as ‘Blockchain’.

This objective has been addressed through the investigation of centralised and decentralised
computing structures in the literature review chapter. Surbhi’s (2015) statement “The retention of powers and authority with respect to planning and decisions is known as Centralization” helped the researcher with the understanding of centralisation, and Corridori’s (2012) article enabled a variety of information to be collected about centralisation advantages and disadvantages. Furthermore, DeNero (2011) and Gómez, F. and Martínez, G. (2009) supported the explanations given of decentralised computing systems and security issues that affect this type of network structures. Finally, blockchain appearance factors were explained considering Swan’s (2015) detailed description of the blockchain technology, some of them related to the limitations mentioned in centralised and decentralised structures.

Objective 2. - To present a descriptive analysis of Blockchain in relation to security, reliability and efficiency.

The researcher has addressed this objective by giving a comprehensive explanation of blockchain key features, adjusting the large number of blockchain characteristics to the magnitude of this project. The thorough work made by Swan (2015) in her book “Blockchain: Blueprint for a new Economy” has served as the perfect comprehensive guide for this objective fulfilment, being completed with Barsky’s and Wilmer’s (2015) book “Bitcoin for the Befuddled”.

Objective 3. - To evaluate the possible benefits that blockchain would provide to online gambling regulation considering the information gathered via semi-structured interviews.

For the fulfilment of this objective, the researcher selected the proper information from the broad responses given by the participants. Special emphasis was given to the recurring aspects of the described procedures where the key steps were identified and represented in a supposed blockchain scenario. The first section of the interview results analysis not only evaluated the possible benefits of a blockchain application in specific organisation processes but also established connections between the current procedures and the same procedures done through a blockchain network, offering a rationale on which blockchain features could be applied in each stage. The analysis done in the mentioned section, therefore, solved this research objective, identifying benefits in several aspects of the transaction process.
Objective 4. - To investigate the possible application of Blockchain technology to the control of online gambling, and provide recommendations for its implementation.

In the second part of chapter 5, two implementation guidelines have been recommended, both based on the blockchain platform “Ethereum”. Both implementations provide recommendations of an application process considering different scenarios and are underpinned by a comprehensive a similar case study performed by Lytovchenko (2016). Regarding the migration processes described in the whole chapter, the implementation of blockchain for the control of online gambling has been considered a feasible process. This objective is therefore considered fulfilled.

6.3 Further Research

Being an emergent technology and due to the lack of documentation and spread experience of this science implies making a further research with more detailed business data before taking the decision of applying this technology. In further investigations, data models, a functional analysis, and use cases should be made for a deeper feasibility evaluation adapted to the specific organisation requirements. Further investigation is also needed to know the required effort and resources that would allow replacing the current online headquarters portal with a blockchain application, considering that this application must provide the same security and efficiency levels as the previous platform does. The development of this study should be conducted once blockchain is seriously considered as an alternative to the current procedures.
REFERENCES


BIBLIOGRAPHY


GLOSSARY

**API:** Application Programming Interface. Program that allows to request or exchange information between heterogeneous applications.

**Bitcoin:** The most popular crypto currency. Independent of financial authorities and banks and based on the blockchain technology.

**Blockchain:** Refers to the transaction management technology.

**Block chain:** Refers to the chain of blocks implemented by the blockchain technology.

**Client Node:** Blockchain network node that performs transactions through a client interface.

**CPU:** Central Processing Unit. Part of a computer that executes the instructions of a program.

**Cryptocurrency:** A digital currency in which encryption techniques are used to regulate the generation of units of currency.

**Miner:** Blockchain network node that includes new transactions in the ledger with the use of algorithms.

**Node:** A piece of equipment, such as a computer or peripheral, attached to a network.

**Operators:** Companies that act as on-line casinos and/or gambling rooms.

**PCs:** Personal Computers.

**SFTP:** Secure File Transfer Protocol. Protocol that allows to setup an encrypted connection between heterogeneous systems to transfer files from one to the other.

**WPF:** Windows Presentation Foundation.
APPENDICES

Appendix A: Original Interview Responses

This appendix includes an original copy of the semi-structured interviews conducted in Spanish:

1. ¿Cuáles son los objetivos generales en la DGOJ?

P2: es el órgano que se encarga de regular, autorizar, supervisar, controlar, y, en su caso, sancionar las actividades de juego de ámbito estatal.

P3: La DGOJ es el organismo dentro de la Administración General del estado encargada de regular y controlar el mercado del juego en España, en especial el juego on-line o no presencial.

P4: Los objetivos de la organización son la regulación y control de las actividades relacionadas con todos los ámbitos del juego online o presencial.

P5: Velar por el correcto desarrollo del mercado del juego en los términos establecidos en la Ley 13/2011 y en la normativa que lo desarrolla y perseguir el juego ilegal en España.

2. ¿Disponen actualmente de sistemas centralizados o descentralizados?

P2: Si se refiere, por ejemplo, a sistemas centralizados de datos, creo que centralizados. La DGOJ cuenta con una base de datos propia aunque ese servicio también se apoya en servicios externos

P3: Nuestros sistemas son centralizados

P4: La mayor parte de los sistemas de la DGOJ están centralizados, aunque existen algunas bases de datos propias de las comunidades autónomas.

P5: Sistemas centralizados. Somos una Dirección General, y nos encontramos todos es un único edificio en Madrid.

3. ¿Qué tipos de comunicaciones hay entre la DGOJ y los operadores?

P1: Desde el punto de vista de la supervisión de la monitorización las comunicaciones entre organización y operador son las siguientes:

- Envío de ficheros de datos con información sobre datos de jugadores, transacciones económicas, etc.
- Información de incidencias que abrimos al operador por errores detectados en la calidad de los datos que recibimos por parte de los operadores.
- Recepción y envío de dudas y consultas.

P2: Los operadores, de acuerdo con la Ley de Juego, han de enviar cierta información a la organización de forma periódica (esta periodicidad dependerá del trámite), vía sede electrónica (de acuerdo con la ley 39 de la Administración Pública que se ha empezado a aplicar.
recentemente). Existe la posibilidad de que la comunicación organización-operador sea vía email para otros trámites, solicitudes, etc., cuando, por ejemplo, se encuentra abierto algún expediente o el propio operador ha iniciado una conversación por dudas o sugerencias.

P3: Disponemos de una sede electrónica donde se realizan múltiples procedimientos (registro electrónico, solicitud de nuevas licencias, envío de información, consultas, denuncias, etc). Por otro lado, nos conectamos vía SFTP diariamente a los servidores que cada operador tiene para depositar la información del juego.

P4: Que yo conozca existen requerimientos para solventar determinados problemas encontrados en formularios por parte de los gestores.

P5: Las comunícaciones con mayores garantías jurídicas se realizan a través de la sede electrónica. No obstante, existen comunicaciones constantes vía email, teléfono y presencial.

4. ¿Qué comunicaciones requieren un envío de transacciones?

P1:
- Envío de ficheros de datos como, por ejemplo, registros de usuario (RU), cuentas de jugador (CJ), registros de juego (JU), cuentas del operador (OPT), registros de ajustes de apuestas, catálogo de eventos... El envío de estos ficheros se realiza tanto mensual como diariamente por parte de los operadores. Además, de envíos extras que realizan cuando se les requiere que hagan subsanación de alguno de los ficheros enviados anteriormente. A través de un almacén con conexión sftp.
- Envío de fichero de incidencias. Por nuestra parte, enviamos como mínimo una vez al mes el fichero de incidencias actualizado a cada uno de los operadores. Se les adjunta documento con la información de todas las incidencias y documentación en el caso de que sea necesaria para la explicación de alguna de las incidencias abiertas. Se realiza a través del buzón de correo electrónico.
- Recepción y envío de dudas y consultas. Se envía documentación y/o muestras de error a través de Excel, documentos Word, pdfs... Todo ello a través del buzón de correo electrónico.

P3: Por un lado, hay una serie de comunicaciones fijas, trimestrales y anuales entre los operadores y la organización en los que nos envían información económica y de funcionamiento interno. Para esto los operadores se conectan a nuestra sede electrónica. También a través de la sede electrónica, los operadores realizan consultas y solicitan la homologación de nuevos juegos y la petición de nuevas licencias. Diariamente, los operadores depositan en un servidor propio la información de la actividad del juego, y vía SFTP vamos a recoger y analizar dichos ficheros.

P5: Existen comunicaciones de carácter periódico del operador a la organización: entre ellas, información sobre cambios en sistemas técnicos, información económica, etc. En la instrucción de cada uno de los procedimientos administrativos, se intercambia información: solicitud de licencias, de prórroga, de cambios en sistema técnico, sancionadores, etc.

5. ¿Cuánto suelen tardar los envíos y recibos de dichas transacciones?

P1: El envío/recepción de ficheros de incidencias, dudas y documentación es instantáneo.
Únicamente tiene el retardo que tenga el correo electrónico para su envío dependiendo del tamaño de documentos adjuntos.

P3: En la sede el tiempo que se puede tardar en subir un fichero, es el que tarda el operador en identificarse y rellenar el formulario pertinente. El SFTP tarda el tiempo que se necesita para copiar los ficheros desde el servidor del almacén. Al ser muchos ficheros, y algunos de ellos muy voluminosos, el proceso es largo, de varias horas al día.

P5: Ahora se hacen de forma telemática, por lo que son automáticas.

6. ¿Las transacciones incluyen firma electrónica o otros métodos de identificación?

P1: Todos los ficheros de datos que envían los operadores están firmados para garantizar la identidad del operador y dar fe de que es el propio operador el que los envía.

7. ¿Hay alguna transacción que necesite ser avalada por alguna tercera entidad?

P3: La sede electrónica exige que el usuario tenga un certificado electrónico generado por alguna entidad de autorización, generalmente la FNMT. Los ficheros con la actividad del juego deben ir firmados con un certificado válido.

P5: La sede electrónica dispone de las garantías en materia de integridad, no repudio y sellado de tiempo establecidas en el esquema nacional de seguridad y de interoperabilidad, a través del uso de certificados electrónicos.

8. ¿Hay alguna comunicación entre la organización y otros organismos oficiales? (Ej. Policía, Ministerio de Hacienda)

P2: Sí, hay comunicación por ejemplo con la Policía para ofrecer el servicio de verificación de identidad a los operadores. Con la AEAT también existe comunicación para los impuestos.

P3: Sí que lo hay, se reciben peticiones de información por parte de otros organismos oficiales, Policía, Guardia Civil, Jueces, Agencia Tributaria y Parlamento entre otros

P5: Sí, con las comunidades autónomas: las homologaciones de sistemas de juegos.

9. ¿Qué información hace pública la organización y con quiénes?

P2: La información se encuentra en su página oficial www.ordenacionjuego.es, y la deja en modo público, lo que se llama Portal de la Transparencia.

P3: La organización dispone de una página Web o Portal donde publica la regulación relativa al juego, información sobre los operadores legales, licencias, acceso a la sede electrónica y toda la información relativa al juego seguro y responsable

P5: En mi caso, nada es público. Los informes de mercado, de perfil de jugador sí que son públicos.

10. ¿Hay alguna situación en la que de forma automática haya que actuar?
P3: Está automatizada el copiado de ficheros de juego de los servidores de los operadores y la sede funciona de modo autónomo. En lo que respecta a infracciones, sanciones, fraude, juego ilegal y demás situaciones de riesgo no hay actuaciones automáticas, este tipo de situaciones se estudian de modo individualizado.

P5: La normativa contempla la posibilidad de requerir el cese de actividad ante determinados casos. La solicitud de información podemos hacerla en cualquier momento, pero se le da un plazo de contestación, no es algo inmediato.

11. ¿Hay alguna transacción que precise la confirmación o evidencia de entrega?

P1: Actualmente la información que intercambiamos vía correo electrónico no tiene confirmación de recepción siempre. En algunos casos sí que se realiza. Y sería muy útil que la tuviera.

P3: Sí, la sede se encarga de ellas. Cualquier procedimiento que se realice por la sede devuelve al operador un acuse de recibo.

P4: Cuando se produce una notificación de algún trámite de manera tanto electrónica como presencial. Si es presencial se requiere de un acuse de recibo, mientras que si es electrónica se requiere la identificación mediante registro electrónico para certificar su visualización.

P5: Todas: las que se rigen por el procedimiento administrativo, se canalizan por la sede. Las que no necesariamente se rigen por procedimiento administrativo, se pueden gestionar por ejemplo por mail. La evidencia es el propio email.

12. ¿Sería de utilidad tener la información de las transacciones replicada para evitar pérdidas, corrupción o daños?

P1: Sí.

P3: Sí.

P5: Esto ya está implementado a través de la sede. El peso que le damos al email es proporcional a la validez de este medio. Es decir, cuando todo es colaboración, el correo es útil. Cuando son temas más conflictivos, utilizas la sede para que todo quede evidenciado con las máximas garantías.

13. ¿Se ha aplicado alguna API en la base de datos?

P1, P2, P3, P4, P5: No lo sé.

14. ¿En caso de que se haya implementado, cuáles han sido los resultados? (Positivos o negativos)

P1, P2, P3, P4, P5: No lo sé.

15. ¿Sería posible la implementación de una máquina virtual en los equipos de la DGOJ para la gestión de las transacciones?
P3: Entiendo que sí. De hecho, creo que parte de nuestros servidores funcionan como máquinas virtuales.

P5: No lo sé.

16. ¿Hay algún proceso no mencionado que, aplicando tecnologías de este tipo, pueda ganar eficiencia o seguridad?

P1, P2, P3, P4, P5: No lo sé.

17. ¿Qué expectativas tenéis en vuestros sistemas informáticos de aquí a 5 años?

P5: Mejorar la usabilidad de las actuales herramientas. Mejora de los flujos de procesos. Gestión de alertas. Perfeccionar el modelo de datos y su mantenimiento a nivel global DGOJ.
Appendix B: Final Ethics Approval

DEVOLVED ETHICS APPROVAL APPLICATION SUMMARY

Student Name: Carlos Velamazan Mas  
Student Number: 20107938
Module Name: Dissertation  
Module Number: BCO6000
Programme Name: BSc Business Information Systems  
Supervisor: Dr Debbie Lamont

<table>
<thead>
<tr>
<th>To be completed by student and supervisor before submission to Ethics Approval Panel</th>
<th>Student Signature; Carlos Mas</th>
<th>Supervisor Signature; Debbie Lamont</th>
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<tbody>
<tr>
<td>Application for ethics approval</td>
<td>[X]</td>
<td>[X]</td>
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<tr>
<td>Participant information sheet</td>
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<td>Participant consent form</td>
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<td>Pilot questionnaire/s</td>
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<tr>
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<tr>
<td>Confirmation of interviewee participation</td>
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First Submission  [ ]  
Resubmission  [X]

Date: 06/12/2016

For use by the devolved ethics approval panel:

Panel Members  
Name  
Signature

Module leader, Chair:  
Dr Hilary Berger

Supervisor: Dr Debbie Lamont  
Debbie Lamont

CSM Ethics Committee Representative:  
Dr Jason Williams

Date: 23/11/2016  
Date of Reassessment: 

Outcome:

Project Approved  [ X]  
Reference number issued:  2016D0274

Chair’s Action  [ ]

Application not Approved  [ ]

Comments for projects not fully approved:

None

The original to be retained by the supervisor and a copy given to the student and module leader.
In the case of a resubmission being required this original form should be submitted with the resubmission not a new, blank, one.
### PART ONE

<table>
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<tr>
<th>Name of applicant:</th>
<th>Carlos Velamazan Mas</th>
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<tr>
<td>Supervisor (if student project):</td>
<td>Dr Deborah Lamont</td>
</tr>
<tr>
<td>School / Unit:</td>
<td>Cardiff School of Management</td>
</tr>
<tr>
<td>Student number (if applicable):</td>
<td>20107938</td>
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<tr>
<td>Programme enrolled on (if applicable):</td>
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<td>Project Title:</td>
<td>The application of Blockchain to the management of online gambling data</td>
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<tr>
<td>Expected start date of data collection:</td>
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<tr>
<td>Approximate duration of data collection:</td>
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<td>Funding Body (if applicable):</td>
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<tr>
<td>Other researcher(s) working on the project:</td>
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<tr>
<td>Will the study involve NHS patients or staff?</td>
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</tr>
<tr>
<td>Will the study involve human samples and/or human cell lines?</td>
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Does your project fall entirely within one of the following categories:

| Paper based, involving only documents in the public domain | No |
| Laboratory based, not involving human participants or human samples | No |
Practice based not involving human participants (eg curatorial, practice audit)  No
Compulsory projects in professional practice (eg Initial Teacher Education)  No
A project for which external approval has been obtained (e.g., NHS)  No
If you have answered YES to any of these questions, expand on your answer in the non-technical summary. No further information regarding your project is required.
If you have answered NO to all of these questions, you must complete Part 2 of this form

In no more than 150 words, give a non-technical summary of the project
This project will explain what is one of the new emerging technologies called Blockchain, why this technology structure is known to be more secure, reliable and faster than the actual ones and how can it be applied to several areas, emphasizing the online gambling control.

DECLARATION:
I confirm that this project conforms with the Cardiff Met Research Governance Framework
I confirm that I will abide by the Cardiff Met requirements regarding confidentiality and anonymity when conducting this project.
STUDENTS: I confirm that I will not disclose any information about this project without the prior approval of my supervisor.
Signature of the applicant: Carlos Velamazan Mas  Date: 16/11/2016

FOR STUDENT PROJECTS ONLY
Name of supervisor: Dr Debbie Lamont  Date: 23/11/2016
Signature of supervisor: Debbie Lamont

Research Ethics Committee use only
Decision reached: Project approved  
Project approved in principle  
Decision deferred  
Project not approved  
Project rejected
Project reference number: Click here to enter text.
Name: Click here to enter text.  Date: Click here to enter a date.
Signature:
Details of any conditions upon which approval is dependant:
### PART TWO

#### A RESEARCH DESIGN

<table>
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<th>Answer</th>
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<tbody>
<tr>
<td>A1 Will you be using an approved protocol in your project?</td>
<td>No</td>
</tr>
<tr>
<td>A2 If yes, please state the name and code of the approved protocol to be used</td>
<td>N/A</td>
</tr>
<tr>
<td>A3 Describe the research design to be used in your project</td>
<td></td>
</tr>
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</table>

This study adopts an interpretive philosophy, involving an inductive research strategy.

Semi structured interviews:
- Open-ended questions to collect qualitative information.
- Freedom of response will allow the researcher to gain opinions and thoughts of the participants.
- The researcher intends to have face-to-face interviews with at least 5 employees.
- Contact with the organisation will begin in December, with the interviews forecasted to take place in January/February.
- Each interview will be recorded and will be 30 minutes in length.

Sample:
- A purposive sample of 5 participants will be selected as they have the characteristics required for the study.

Participants:
- The types of samples chosen are to guarantee no discrimination against age, gender, race, disability etc.
- All participants will be over the age 18.
- The participant has the right to withdraw their data at any point.
- The researcher will only record age and gender of the participant.

Analysis:
- The quantitative data from the questionnaires will use thematic analysis to identify patterns and trends. Microsoft Excel will be use for the creation of graphs, tables and charts.

Consent:
Consent from participants is required from the interviewees by the completion of the consent form before they can take part in the study.
All data collected will be confidential and all participants will remain anonymous.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>A4 Will the project involve deceptive or covert research?</td>
<td>No</td>
</tr>
<tr>
<td>A5 If yes, give a rationale for the use of deceptive or covert research</td>
<td>N/A</td>
</tr>
<tr>
<td>A6 Will the project have security sensitive implications?</td>
<td>No</td>
</tr>
<tr>
<td>A7 If yes, please explain what they are and the measures that are proposed to address them</td>
<td>Click here to enter text.</td>
</tr>
</tbody>
</table>

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1 An Approved Protocol is one which has been approved by Cardiff Met to be used under supervision of designated members of staff; a list of approved protocols can be found on the Cardiff Met website here
### B Previous Experience

**B1** What previous experience of research involving human participants relevant to this project do you have?  
I have no previous experience.

**B2** Student project only  
What previous experience of research involving human participants relevant to this project does your supervisor have?  
Dr Debbie Lamont has 13 years of experience and a PhD.

### C Potential Risks

**C1** What potential risks do you foresee?  
Risks might include:

1. Arranging interviews – causing inconvenience to interviewees during their working day.
2. Personal information on the questionnaires.
3. Risks of not meeting the research deadlines.
4. Personal information and data storage must be taken into account.
5. The interviewee may not want to answer questions if the information is confidential or personal. The interviewee may be offended by the questions.
6. Participants may get anxious about what they have written/said to the researcher. This may progress into anger towards the researcher.

**C2** How will you deal with the potential risks?  
**Semi Structured Interviews**

1. Interviews will be arranged in advance at a location confirmed by the researcher and participant.
2. Only age and gender data from the participant will be collected.
3. The project development will be planned carefully.
4. All participants will be notified that the researcher will have sole access to the data collected. Data used in the written report will be anonymised and the participants will be coded to safeguard from identification.
5. A Participation Information sheet and Consent form will be sent to the interviewees to ensure they are aware of the topics up for discussion.
6. The participant will have the right to withdraw their data at any point without penalty.