

Tool for illegal work PowerStats

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<p>As companies began collecting and storing data wherever they could, the volume of data became huge and posed a challenge in interpreting and analysing it. With technology, applications and protocols becoming more and more powerful in terms of computing ability, and efficiency the tools to process the collected data have therefore been available to companies. The ability to transform the stored data into useful information was then attainable by companies and from this point on companies began implementing Business Intelligence which is the use of these technologies, applications and practices to transform the data into information.</p> <p>In this line of thought this thesis is commissioned by the "Bureau des Métiers", a Swiss company. One of its role is to control that the collective agreements are respected so that they wanted a tool that would make it easier to explore, present and analyse the collected data about illegal work. As this is a typical use of Business Intelligence, the aim of this thesis is to produce a useful Business Intelligence tool designed specifically for their needs.</p> <p>The following thesis will then first present both the theory of the concept and history of Business Intelligence. Next four different technologies have been selected based on the knowledge of the author's and on the market offers where the company is situated. Then the implementations of the tool above mentioned and the process of its development will be discussed. This development will be split into two parts to match the requirements of keeping the way of extracting data that the company already has. The first part is the process and treatment of the extracted data that takes place in an excel file with macro and the second part is a power BI file in which all the reports and diagrams are located and where the company will be able to explore the data in a meaningful way.</p> <p>The result of this thesis is a tool that will be delivered to the Bureau des Métiers consisting of an excel file containing the necessary macros which is linked to the power BI file where the reports are. In the conclusion the thesis will mention that the Bureau des Métiers is satisfied with the tool and further evolution will be discussed in order to free the tool from the treatment in an Excel file and thus directly access the database from the Power BI file.</p>	
Keywords Business Intelligence, Databases, Analysis, Decision taker, strategy, Bureau des Métiers, Power BI	

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Terms and Abbreviations

BDM	Bureau des Métiers
BI	Business Intelligence
CPP	Internal control
CRM	Customer Relationship Management
DAX	Data Analysis Expressions
DBMSs	Database Management Systems
ICE	External control
POS	Point-of-Sale
RDBMs	Relational Database Management Systems
SaaS	Software as a Service
Primary key	Column used to identify each record in a table
User friendly	Something easy to use or understand
i.e.	To explain exactly what someone means

1 Introduction

In a world where volumes of data have become so huge that a human brain can no longer compute all of it, technologies and methods are needed to analyse this data and help the workers to do their jobs. In this way of thinking Business Intelligence (BI) was born to answer the needs of companies. It encompasses the treatment of a huge amount of data and provides the workers with the tools they need. Nowadays a company who doesn't use a Business Intelligence solution loses competitiveness in a world where data analysis and prediction reigns as King. Without Business Intelligence collecting a huge volume of data no advantage is provided because if a Business Intelligence solution is not implemented the company doesn't have better efficiency or understanding.

This thesis has been commissioned by the Bureau des Métiers which is a company based in Switzerland. One of their tasks is to control the manual workers and their employers. These controls include how much the worker's salary, the existence of a social insurance, their working days. The reason is, that in Switzerland without special derogation, employees are not allowed to work on Saturdays and Sundays, likewise they must be reported officially for rights to be protected. For all these data collected, the Bureau des Métiers has to produce reports and analyses on several axes.

This thesis will begin with a theoretical part where Business Intelligence concept with its history, its development and its actual status will be discussed. Next four different technologies have been selected based on the knowledge of the author's and on the market offers where the company is situated., These four technologies represent a sample of what can be found on the market: each of them will be explained as well as their advantages and disadvantages. In chapter 4 this thesis will describe the development plan of the BI tool commissioned by the Bureau des Métiers. Chapter 5 will mention the requirements of the Bureau des Métiers and the explanation of the choice of the BI technology. The development of the tool with the actual code and screenshots will be explained in chapter 6. Finally, this thesis will make an assessment of the product created and briefly talk about how to upgrade or develop it further.

1.1 Objective of the thesis

The aim of this thesis is to answer the needs expressed by the Bureau des Métiers as for the treatment of all the data saved in their extranet and the creation of the reports. It will provide a new way for the Bureau des Métiers to process the extracted data and create the reports needed. The process of extracting the data must be the same as now and the management of all the data has to be easy and user friendly.

1.2 Scope of the thesis

The scope of this thesis includes converting the data into a new form usable by a Business Intelligence tool. In this case converting the data, is the means of transforming table-based data to relational database rows. One of the main point of this thesis was to compare and choose a Business Intelligence technology for the Bureau des Métiers in order to enable them to manage the data and personalize their reports. The final main part is the creation of the BI tool with the technology chosen to match their requirements and answer all their needs.

1.3 Out of scope

What isn't included in the scope is the automation of the extraction to be directly available in the Business Intelligence tool. It means that a manual interaction will be necessary to export the data from their extranet to the Business Intelligence tool created. The interpretation of the data and predictions are left to the Bureau des Métiers employees. Finally, the automatization of a report which can be exported from the Business Intelligence tool is also out of scope and open to further development.

2 Business Intelligence

In this part this thesis will explain the generalities of Business Intelligence. First it will explain its concept, describe its uses and its usefulness. Then the thesis will describe a short history of Business Intelligence, mentioning its origin and evolution overtime. Next the current state and use of Business Intelligence will be exposed. Lastly, the risks of implementing a Business Intelligence solution will be discussed.

2.1 What is Business Intelligence?

The term Business Intelligence (BI) is a relatively recent term. It is used to describe technologies, applications and practices; their goals are to collect, integrate, analyse and present business information. According to a Hitachi Solutions in a video (Hitachi Solutions Canada, n.d.), Misner Stacia, Luckevich Michael and Vitt Elizabeth in the book Business Intelligence (Misner, Luckevich, & Vitt, 2008) and the website Olap.com (OLAP, n.d.), Business Intelligence can be described using two main perspectives:

- Convert data into information
- Making better decisions faster

2.1.1 Convert data into information

For a company the first step to use BI is to collect a huge volume of data called raw data. By using methods and programs this data will be structured, processed and turned into useful information usable by a BI system. (Hitachi Solutions Canada, n.d.; Misner et al., 2008; OLAP, n.d.) The step of converting data into information is one of the crucial points of Business Intelligence. Companies collect data wherever they can and keep gathering it as efficiently as possible. Making good use of it is the crucial point of Business Intelligence. So that converting it into useful information is primordial.

2.1.2 Making better decision faster

Business Intelligence is about delivering relevant and reliable information to the right person at the right time. The decision takers need to take into account all the data available to make their choices. BI takes the vast amount of data and presents it in a meaningful and actionable way.(Hitachi Solutions Canada, n.d.) In this way the process of making the decision becomes simpler and faster using the BI systems when the information is represented in an easily comprehensive way. This will improve the company performance and promote its competitive advantage in the market.(Misner et al., 2008)

2.1.3 The reason why Business Intelligence is useful

The strategy of a company is mostly static and changes slowly, but the information obtained by the raw data is always new and change rapidly. In order to handle all the changes, the data must first be structured and processed before being presented to the decision makers. In this process the BI enables the decision maker to access the useful information faster and more efficiently, which will make the company react to its changing environment better and create a competitive advantage. (Misner et al., 2008)

2.2 Development of Business Intelligence

The first appearance of the term "Business Intelligence" is seen in Richard Miller Devens' 1865 work, Cyclopaedia of Commercial and Business Anecdotes. He uses it to describe the success of a banker, Sir Henry Furnese who had clear understanding of political issues, instabilities, and the market before his competitors. (Heinze, 2014)

BI is a framework for managing a company in an easy and efficient way. BI is only possible with a huge volume of data that requires technologies such as data storage and computing ability both for the analytics and the reporting. (Swain, 2008a)

In the following section we will discuss the evolution of the needs that led to the birth of Business Intelligence.

2.2.1 Evolution of technology

From the stone tablets of the Sumerian to books and then to the big digital data storage systems, a need to collect and store data has always been of primordial importance.(Swain, 2008a)

The challenge continue to this day: storing more and more information in smaller and smaller space.(Swain, 2008a)

The ability to collect, store and analyse data is central to the BI concept and relies heavily on the technology. It wasn't before the 20th century that technology became sufficiently advanced to be considered an agent of BI. ('Business Intelligence', 2019; Heinze, 2014)

It is only after 1940 that both data storage and computing power exploded with the growth of computer machines. As data kept growing, programmers developed Database Management Systems (DBMSs) the database technology was developed as an answer to the growing amount of data needed to be stored and managed. (Swain, 2008a) Data warehouses are large stores of relational data thought and designed to help analysts to

make decisions and to support BI. (Lepine, 2018) As analysis of data became a norm for businesses, data warehouses became common in companies and they sped up the transaction time with their logic of splitting data elements. (Foote, 2017; Heinze, 2014; Swain, 2008a)

With the ability to store and access large amount of data easily, fast transactional systems began to appear. Transactional systems are sources of data, each transactional system being designed to record one basic primary role and store one unique type of data. The role of transactional systems is to store a daily record of data in order to classify it for later analysis.

For example, Point-of-Sale (POS) systems are transactional systems designed to store sales transactions, collect payment and issue receipts to customers. They are saved in the record of this specific transactional system and are classified in a field of a Customer relationship management (CRM) database. The data of the sales is stored in a data warehouse and it can be connected to other data in order to make decisions. (Swain, 2008a)

2.2.2 Birth of BI

Noticing all the stored data, the CEO of companies expressed the need to build systems in order to help them extract and visualise the stored data. From then on the BI was born with the main following points: producing data and reports, organizing and visualizing them in an easily readable way. (Heinze, 2014; Swain, 2008a) The companies top management needs to be able to process and visualise the data easily was then the main motivation to develop new products which would answer the decisions makers' demands.

One must note that each company didn't do BI in the same way, due to the wide range of protocols, practices, level of technology and mainly because of their different needs. Therefore each company had their own process of interpreting the stored data and producing BI reports. (Swain, 2008a) The diversity of all the BI tool produced would then converge at some point and from then on the main functionalities that a Business Intelligence tool should possess could be found. A BI tool should then at least match four criteria; it should be user friendly, efficient, use centralized data and provide the opportunity to make standard dashboards in order to give a company a general way of processing the data.

2.3 Business Intelligence nowadays

Nowadays technology has become more mainstream and computing ability is millions if not billions of times better than it used to be in the 20th century. All the protocols, techniques and programs have been refined multiple times to better fit the business users and the needs of each company. It has become usual in companies to use BI and those who don't are at a competitive disadvantage. According to Forbes magazine in 2018 most companies with more than 100 employees use BI. (Columbus, 2018)

As inspired by Lebed Mona explanation on her blog (Lebed, 2017), the main features a BI tool should possess are:

- All data to be accessible in one place
- User friendly, business users shouldn't need extensive training to use the tool
- Data entry must be efficient and not time wasting
- Extract of data can be user chosen and available at all time
- Reports and dashboards can be created and easily readable
- Dashboards can be standardized

To sum up, BI projects were started by the IT departments, the only ones who knew it was possible and how to implement them. The CEO noticed that using BI solutions could save hours of work time for the employee who had to create a dashboard and make it available to the decision maker. The BI projects were then not only initiated by the IT department but also by the business one. (Swain, 2008a)

2.4 Business Intelligence perspective

BI is about giving people the tools to make the decisions based on the data they obtained.

It's designed to let decision makers ponder what-if questions. (Swain, 2008a)

It enables the decision makers to ask the right question instead of focusing on the analysis of the data. It only works if the decision makers can make use of the BI tools, which means that the BI tools must be user friendly and configurable to match a specific company way of making decisions. For it to work fully one must have the right kind of people at the right place and the BI attitude is to be spread to every level of the company leadership. (Swain, 2008a)

2.5 Business Intelligence risks

Business Intelligence offers a lot of advantages for a company but it does not mean that implementing a Business Intelligence solution in the process of a company comes worry free. There are several risk factors that have to be taken into account when implementing a new solution. Thereafter this thesis will focus on three of them, those which can be accounted for before the implementation of the solution.

The first risk to take into account is the employees themselves. you have to prepare them for a change in the functioning process and to accept a new way of working. One of the easiest way to overcome this risk is to involve the employees who will work with the Business Intelligence solution in the development of the solutions. If they can give their point of view and feel implicated in the project, they will adopt the new process more easily. The second risk is financial, it is really important to analyse all the impacts of the implementation of the BI solution. A BI solution tends to implicate a lot of department and to finally have a bigger scope than initially planned. To evaluate the scope and the budget necessary for the implementation, one must fully determine the needs for the BI solution in each department potentially involved. The last risk that will be discussed here is a problem that comes from the data; a Business Intelligence tool needs to be fed data to be fully functional and it is important for the data used by the tool to possess three characteristics. To begin with the data should possess a context which clearly describes its origin and what it represents. Next sufficient volume of data to be analysed by the tool is primordial. if you implement a fully functional tool but don't have enough data available, the analysis will be meaningless. In the same way too huge a volume of data can become problematic if the computing ability is not powerful enough or if the transfer from the old storage to the new one is difficult. Lastly the data must be fully reliable and it must be checked to be void of inconsistencies caused by problems or errors.(Swain, 2008c; Van Beek, 2016, p. 10)

3 Technologies of Business Intelligence

When a company wants to begin to implement BI in its process it faces multiple choice as the market hosts a wide range of applications which offer the users different functions. (Swain, 2008b) The following part will discuss what a BI application should at least provide to the user and it will follow with a more thorough exploration of 4 BI applications or technologies which could be used to insert BI inside a company process. These technologies have been chosen considering a census of those mostly used in the region where the Bureau des Métiers is located; they are:

- Power Pivot
- Power BI
- React.js
- Tableau

Everyone can define the boundaries differently but for this thesis we will consider the main BI functions everything from the storage of data to the visualising tools available. A BI tool should then provide a way to manage and store data like a DBMS. It should also offer various queries and analysis tools. Then another major point is to offer a front-end view where the user can personalize the data, perform data analysis and visualise it on various format (Reports, diagrams, ...). Lastly nowadays a BI tool should be available on different platforms such as web portals, mobile applications and so on. The exploration of four different tools or technologies with which BI could be done will then be discussed.

3.1 Power Pivot

In this section one will be introducing power pivot, main functions and talk about the advantages and disadvantages that it has for a medium sized company.

3.1.1 What is power pivot

Power Pivot is an excel add-in, which can be enabled in the options of an excel file. The name consists of the part "Power" to literally show that it offers powerful computing ability and "Pivot" that stands for the pivot table of Excel files. It then means that power pivot is a tool augmenting the power of the pivot table. (Wikiversité, 2018)

Power Pivot is a data modeling technology that lets you create data models, establish relationships, and create calculations. With Power Pivot you can work with large data sets, build extensive relationships,

and create complex (or simple) calculations, all in a high-performance environment, and all within the familiar experience of Excel. (Microsoft, 2019b)

This extension became a BI tool and is based on data cube principles. (Wikiversité, 2018)

Furthermore, Power pivot offers the Data Analysis Expressions (DAX) which allows the users to create queries including Excel formulas and some additional functionalities to create complex requests on relational databases. These requests can be used on personalized columns (calculated columns) or on Pivot table (Measures). (Microsoft, 2019b; Wikiversité, 2018)

See example of dashboards thereafter. (Figure 1, Figure 2)



Figure 1: Power pivot dashboard example (Microsoft, 2013)

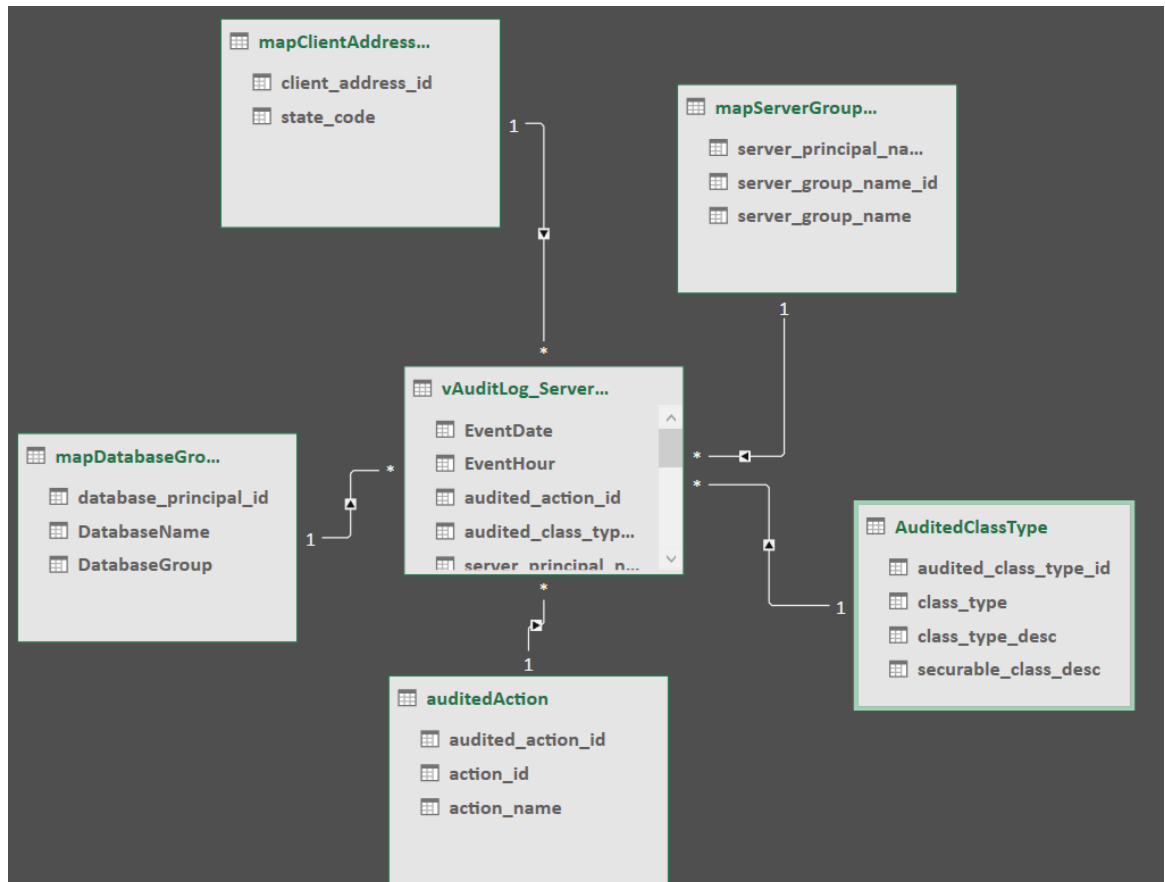


Figure 2: Power pivot relational database example (Microsoft, 2013)

3.1.2 Uses of power pivot

According to Microsoft Web Site (Microsoft, 2019b, 2019c), when the power pivot add-on is enabled it allows to:

- Upgrade computing ability by creating memory-efficient data model
- One can create calculated columns or measures with the help of DAX language
- Create data hierarchy (example Year > Month > Day)
- Import data from multiple types of data sources (Excel, Access, Web, ...)
- One can do Collaborative work with shared dashboards which can be controlled by an IT administrator to ensure security

3.1.3 Advantages

Talking about the advantages that could be found in Power Pivot we could first note that it is included in Microsoft office Excel versions from 2010 onwards. Next the fact that it supports multiple type of data source is another good point as well as the fact that it can manage a huge amount of data. Working in a comparable way as Excel it enables collaborative work. Next personalized analysis field are manageable and lastly as it is

offered by Microsoft the support of Power Pivot is therefore Microsoft which is a reliable and stable society.

3.1.4 Disadvantages

Despite the above mentioned advantages, one could mention the following disadvantages. First it is bound to Microsoft Excel for exports and visualisation. Excel does offer various ways of making reports, but it is not specifically designed for this, the visualisation and personalisation offered by Excel are not the most optimal to be user friendly. Next the reports available in Power Pivot are Excel based and come for pivot table, there is little flexibility present in the way it works as well as the customization of the user experience. In summary although it offers different ways of producing reports visually, it is not user friendly and easily customizable.

3.2 Microsoft Power BI

In this section one will be introducing Microsoft power BI, its main functions and talk about advantages and disadvantages that it has for a medium sized company.

3.2.1 What is power BI

Power BI is a cloud-based Microsoft analytics solution that lets you connect all your unrelated data sources into a coherent whole to visualize and share it through the company. (Microsoft, n.d.) Power BI also offers data warehouse capabilities, in order to provides the user with a visual tool to manage the relational database, data preparation and discovery. ('Power BI', 2019)

See Figure 3 and Figure 4 for an example of dashboard.

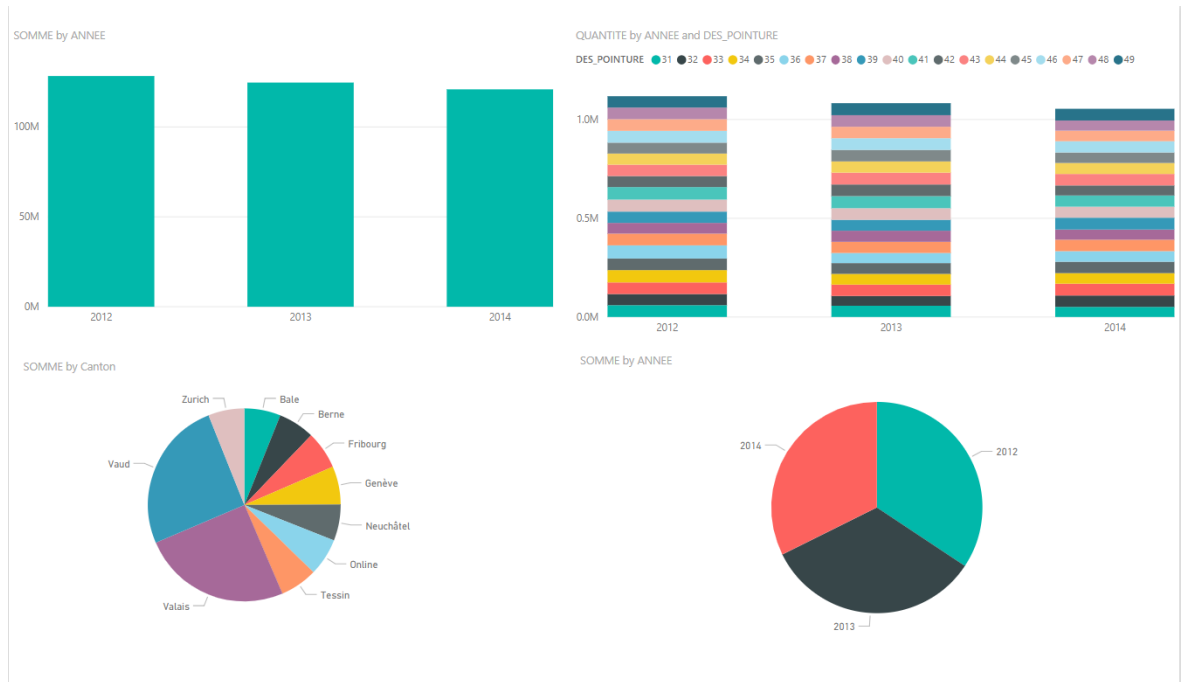


Figure 3: Power BI dashboard example (Guex, 2017)

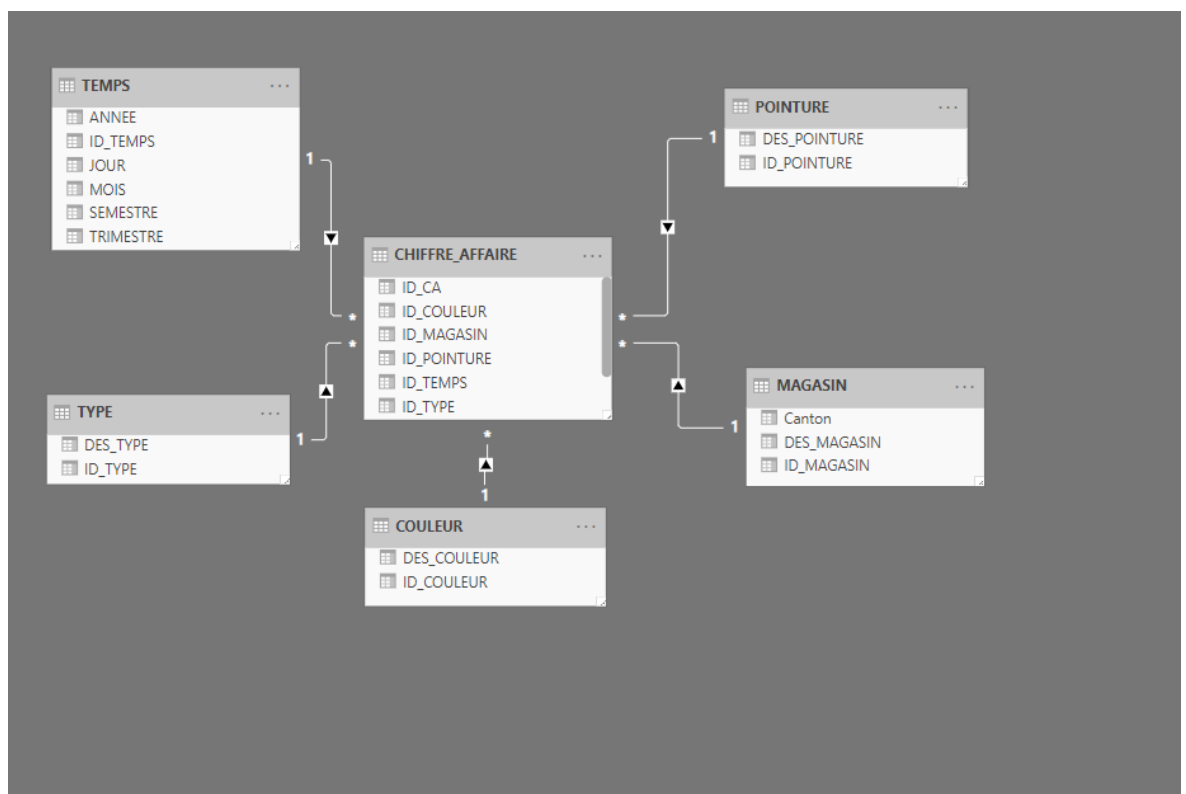


Figure 4: Power BI relational database example (Guex, 2017)

3.2.2 Uses of power BI

As explained in the official Microsoft web site (Microsoft, 2019a) and the Microsoft documentation online (Sparkman et al., 2019), Power Bi is composed of 4 main components that are listed below:

- Power BI desktop which is a windows desktop application where the user can create and manage files and dashboards
- Power BI service which is an online SaaS (Software as a Service)
- Power BI mobile for windows, IOS and android devices with which you can view live power BI dashboard and reports securely
- Power BI Report Server that allows you to publish BI reports to the on-premises server

All these elements enable users to create, share, visualize, supervise business information and insights in the most efficient way for them.

3.2.3 Advantages

Talking about the advantages that could be distinguished in Power BI, one could begin with the fact that Power BI supports almost all types of data sources existing and can manage a really huge volume of data. Next one of the very best point of Power BI is that there is a large variety of reports and visualisation available. Power BI is also user friendly. There are possibilities to create personalized analysis fields and columns based on preferences. The support for Power BI is Microsoft which is a reliable company. Furthermore, the free Desktop version already enables one to execute a lot of operations and get the gist of it. Finally, it is a cloud-based product with data backups more sustainable and available through space.

3.2.4 Disadvantages

One must also talk about the disadvantages. First of all, depending on the needs of a company the free version is not necessarily sufficient. It might then be necessary to purchase licences; the Pro version monthly price is 8.40€ per user, it is a self-service version, the Premium version monthly price is 4212.30€ for the whole enterprise, it offers of course more options to the company and there are no limits on the number of user. Then there are also some disadvantages as for it being a cloud based, the costs of having the cloud and the security risks that a cloud represents.

3.3 React.js

In this section we will define react.js and explain its use as a BI medium. One will also discuss the advantages and disadvantages a medium sized company obtain using it.

3.3.1 What is React.js

ReactJs is a free JavaScript library developed by Facebook in 2013. The main goal of this library is to make building web user interfaces easier. It can be combined with other technologies as it only manage the View layer in a Model View Component (MVC) model. (Wikipédia, 2019a)

One of the most famous user of React.js, except Facebook, is Netflix which uses it on the server side to gain in performance. As React.js is front-end oriented, it can be designed to fit the requirements of a company for data analysis and reports. Associated with relational database management systems (RDBMs) technologies, it can be used for BI purposes.

3.3.2 Uses of React.js

As a JavaScript library React.js must be created into an application. Within this application multiple components must be created and then each one of them can interact with one another and possess its own state, characteristics.

A business logic can then be implemented into the components and the logic to show the data on dashboards and manage them is implemented into methods written inside the components. The data management is linked to the database technology used and the react application will be implemented to extract the data directly from the database technology and then will format the data to be analysed and visualised on a created dashboard. Thereafter is an example of a simple dashboard that could be created with React.js. (Figure 5, Figure 6)

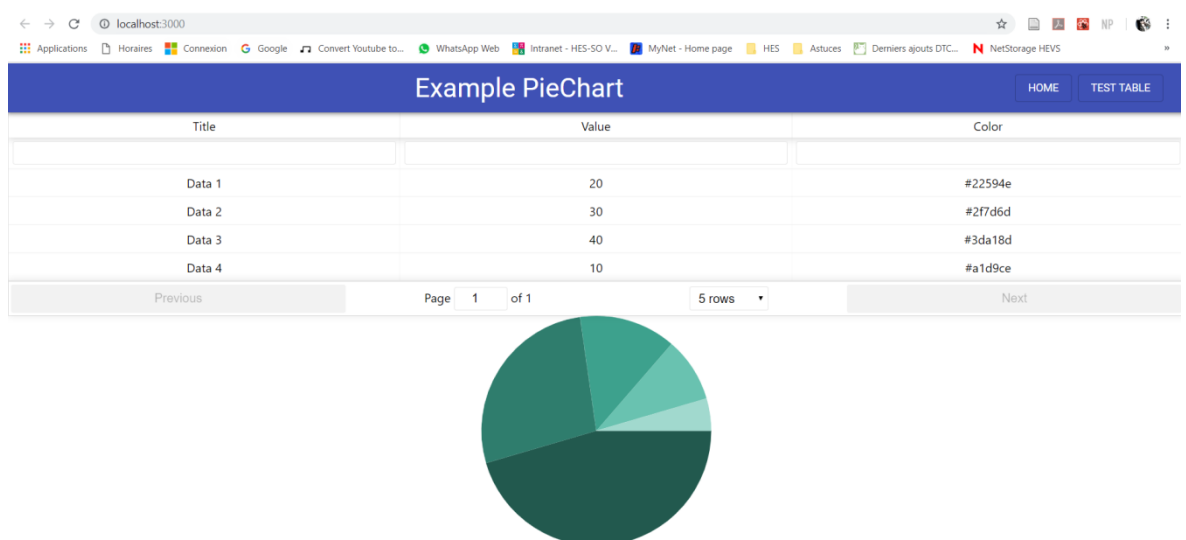


Figure 5: React.js dashboard with pie chart example

Example PieChart														
Title	Value	Color	test1	test2	test3	test4	test5	test6	test7	test8	test9	test10	test1	test2
Data 1	20	#22594e	test1	test2	test3	test4	test5	test6	test7	test8	test9	test10	test1	test2
Data 2	30	#2f7d6d	test1	test2	test3	test4	test5	test6	test7	test8	test9	test10	test1	test2
Data 3	40	#3da18d	test1	test2	test3	test4	test5	test6	test7	test8	test9	test10	test1	test2
Data 4	10	#a1d9ce	test1	test2	test3	test4	test5	test6	test7	test8	test9	test10	test1	test2

Previous

Page 1 of 1

5 rows

Next

Figure 6: React.js table dashboard example

3.3.3 Advantages

The advantages of React.js could be described as follow, first as it is a framework it supports all types of data sources because if for example one is currently still not supported, all that is needed to be done is to develop a new method to support the new data source. Then React.js is fast and able to manage a huge amount of data and it can be combined with database technology to support huge volumes. Next as it will be developed from scratch, the reports can be personalized freely and made to match the exact requirements of the company. The application will be designed to be user friendly based on the developer guidelines and project management. Lastly it is completely free to use React.js because it is an open source framework.

3.3.4 Disadvantages

One must also talk about the disadvantages. First of all, personalization and modification to the app needs a developer who knows React.js to do the update/creation based on the user demands and each update takes time and would cost the company the price to pay a developer to create this specific new functionality. One also needs to have a developer for the support which means that one will either need a contractor with JavaScript knowledge or have an employee knowing it and finally a server to store the application and make it run.

3.4 Tableau

In this section we will be introducing Tableau software, its main functions and talk about the advantages and disadvantages that it has for a medium sized company.

3.4.1 What is Tableau

Tableau is a BI software focused on the visualisation of the data. It allows the user to collect data from multiple data sources to produce visual reports and graphics from which

business users can gather insights and devise business strategies. (Software Advice, n.d.; Wikipédia, 2019b)

3.4.2 Uses of Tableau

Based on the official documentation of Tableau (Tableau Software, 2019a, 2019b, 2019c) and Wikipedia (Wikipédia, 2019b), it is composed of five main products:

- Tableau Desktop is a windows application where the user can create, manage and visualise dashboards and reports
- Tableau Server allows the users to use the solution on a server and then spread it securely to the whole organization. The data is not limited to pre-determined dashboards and reports but can be managed by everyone who has access to the server.
- Tableau Online is the analytic platform from Tableau which is fully hosted in the cloud and accessible from the browser or via applications
- Tableau Reader allows a user to view, export and print workbooks created by Tableau desktop
- Tableau Public is a free version of Tableau desktop with less functionalities but can still be shared on application and have multiple report templates

3.4.3 Advantages

Tableau advantages could be distinguished as follows. First it supports almost all types of data sources. Then a huge amount, volume, of data can be processed by the software fast and efficiently. There is a large variety of reports and visualisation that are available. The software is user friendly so we can create personalized analysis field and columns as per our wish. The public version, although very limited, is free and can give the user an idea of the software before buying it. Finally, it has a cloud-based version available making it more sustainable and available through space.

3.4.4 Disadvantages

It seems that Tableau only has one disadvantage, it's price. As the price asked by Tableau is greatly superior to any other BI software, tool, on the market it has a major impact. At the time this thesis was written, the price for a company to buy a licence for a single user was 70\$ per month for the Creator licence, which is absolutely needed to create everything. The company might also purchase two other licences with fewer rights; one is the Explorer at 35\$ per month per user and the other one, Viewer licence, with the least rights at 12\$ per month.

4 Development plan

The aim of this thesis is to develop a new BI application for the Bureau des métiers (BdM). It will be divided into three parts.

In the first part we will present and analyse the project idea, the requirements that the BdM has given us. Considering their needs a comparison between Power pivot, Power BI, React.js and Tableau will be done to determine which technology fits the expressed needs the most. After consideration the BdM has decided on of the Power Bi technology. This comparison is presented and necessary to help a reader understand the stakes of this thesis.

In the second part the actual development will be described. This part can be split into two phases. The development of the data treatment in an excel file with a macro comes first in which the data structure and the macro implementation will be discussed. The second phase is the creation and design of the Power BI file to fit the needs expressed by the BdM in the first phase in chapter 5. The development had to be split into two parts for the sole reason that the BdM, demanded to keep the way they have to export the data. The export of data consists of getting a table in the clipboard from their extranet and then pasting it in an Excel file. Which means, to be able to keep both the extraction method and automate the data treatment, the BI tool must be divided into two part.

In the last part this thesis will discuss the results obtained and express an evaluation of these results considering both writer's and BdM's point of view. After this evaluation this thesis will give some ideas of how develop further the results and the current state of the project.

5 Requirements for the illegal work tool PowerStats

The Bureau des Métiers is a company whose goal is to help small and middle size companies manage their administrative constraints. They have several missions that are mainly to represent and interact with the associations and union of workers, negotiate the collective work agreements, help with the training of artisans, counsel and oversight the fact that each company follows the rules. For this last mission they proceed to controls and save all the results of their controls in an already existing extranet platform they possess internally.

Once all the data is stored, they need to exploit it to produce reports, diagrams and so on. The requirements they expressed was that they need to be able to extract all the data from their extranet and input it somewhere easily to obtain smoothly readable, manipulated and they want to create reports and diagram from these data. With this requirement we can then make a link between the definition of the Business Intelligence given previously and see that in this case the transformation of data into useful information means that the Bureau des Métiers wants all the collected and saved data in their intranet to be transformed to be easy to read, diagrams and also want a way to drill through the data. Therefore, implementing a Business Intelligence in this kind of requirements make sense.

In the existing extranet the existing export function was a button which when pressed save a table of the data, filter by date that they can select on the extranet, to the clipboard. They can then paste the data table into an excel file and from them manually work on it to have exploitable results. This requirement matches another point of the theory about Business Intelligence tool which is that it must be user friendly and add value to the work done by the employee.

What was required from the BI tool to be created was to simplify the manipulation of the data. From the export they wanted in a way or another that after exporting it the data would be automatically manipulated by a program to display usable business diagrams, insights, reports that could be interpreted by the business workers. Another point they wanted was to be able to export the diagrams and reports from the BI tool to produce presentations.

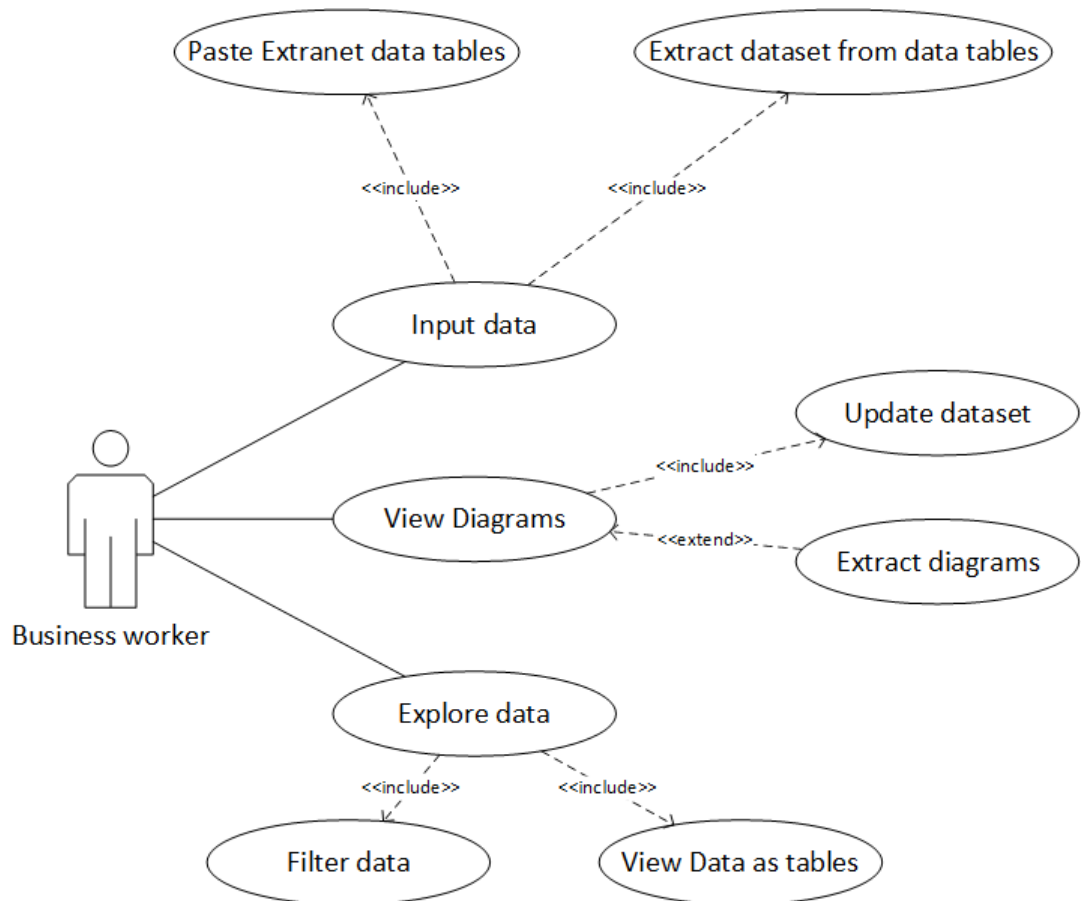


Figure 7: Use case diagram Power stats

5.1 BI tool comparison and choice of Power BI

In this comparison we will consider four different BI technologies for the project, Power pivot, Power BI, React.js and Tableau. We will shortly explain the advantages and disadvantages that were taken in account when the choice of the Power BI.

Above in this document we have discovered these four technologies and now to explain the choice made we will rank them according to the major criteria on which the BdM based their choice, the weight of the criteria goes from the highest to the lowest:

- Price, licences and installation
- Support and evolution
- Variety of reports and diagrams
- User friendly and ease of use

Concerning the price of the several software lets grade them from the cheapest to the most expensive:

- 1) React.js is a completely free JavaScript library and therefore comes first
- 2) Power pivot and Power BI are both ranked second due to Power BI possessing a free version with sufficient function and Power pivot is included in Microsoft Office Excel. As most society owns Excel for other reasons than BI, we will then consider power pivot as free.
- 3) Tableau is last because each user needs to buy a licence priced more than 50€

Now talking about the support and evolution each technology offers, the rankings are the following:

- 1) Power BI ranks first because for two reasons, firstly the support is Microsoft who's a well establish and famous company and its support are well rated, secondly because Microsoft has a dedicated support for Power BI software.
- 2) Power pivot comes second because Microsoft is the support but there is no dedicated support for power pivot
- 3) Tableau get third place as the firm Tableau Software offers support for his products
- 4) React.js comes last because the support is dependant of the developer and if the developer is not available the company will need someone knowing JavaScript at least and in most optimal case React.js library.

The following criteria is the variety of reports and diagram available and the rankings are:

- 1) React.js is developed specifically for needs expressed by the client and would then provide the most appropriate reports and diagrams and ranks first
- 2) Tableau has a huge amount of template available and ranks second
- 3) Power BI offers a wide range of choice and even the opportunity to create customized template
- 4) Power pivot ranks last as the choices are options available in Excel

Last criteria concern the ease of use of the software which produce the following rankings:

- 1) React.js as it can be designed to fit the user preferences rank first
- 2) Tableau is well designed, easy to master and user friendly and rank second
- 3) Power BI offers slightly worse as Tableau and ranks lower
- 4) Power pivot comes last

Based on these four rankings we will now establish the final ranking accordingly. For each criterion we will give them a weight going from 4 for the price to 1 for the ease of use and each rank gives points. The first rank gets 4 points and the last rank gets 1. After calculations are done, we obtain the followings:

- 1) Power BI ranks first with a total of 32 points, $4 * 3 + 3 * 4 + 2 * 2 + 1 * 4$
- 2) React JS ranks second with a total of 31 points, $4 * 4 + 3 * 1 + 2 * 4 + 1 * 4$
- 3) Power pivot follows with a total of 24 points, $4 * 3 + 3 * 3 + 2 * 1 + 1 * 1$
- 4) Tableau came last with a total of 19 points, $4 * 1 + 3 * 2 + 2 * 3 + 1 * 3$

6 Development / Design / Implementation

In this part the actual BI tool produced for this thesis will be explained and shown. It will be separated into two parts with the first being the treatment of the collected information from several data sources and the formatting needed to be done to transform data into useful information. The second part will be about the Power BI program and what was done with it to match with the requirements of the BdM.

6.1 Treatment of the intranet data

The Bureau des Métiers extracts all the data from their intranet with a platform named bmdesk (Figure 8). On this platform they have all the tools they need to input and save the data they collect.

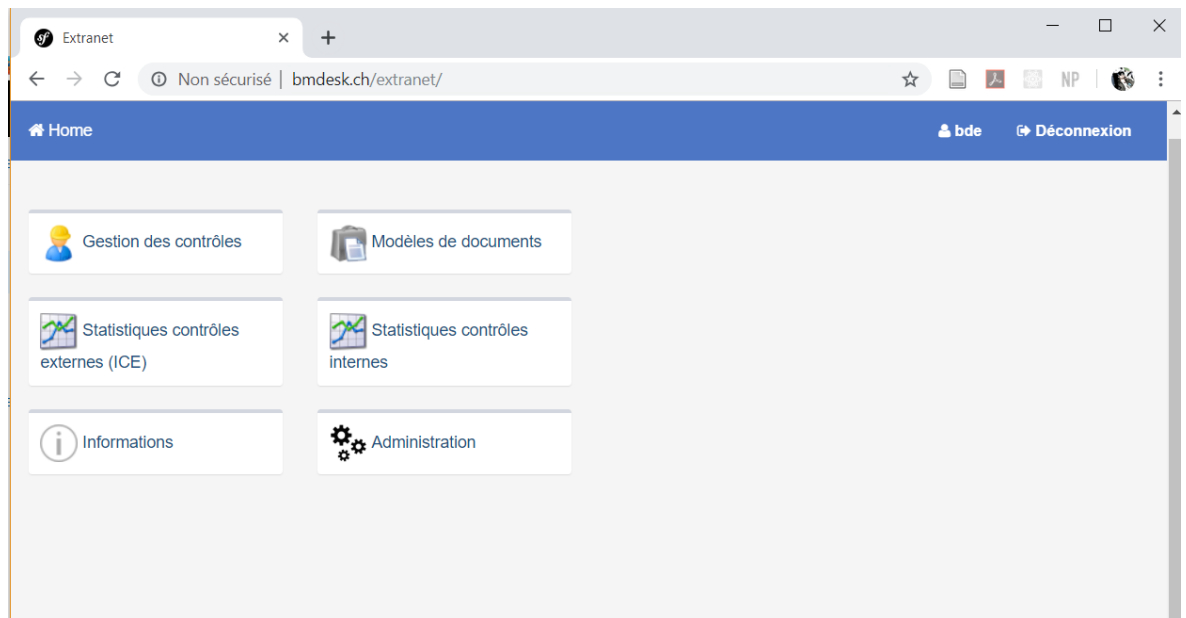


Figure 8: Intranet Bureau des métiers

The collected data can be extracted by visualising it on two tables; one for the external controls (ICE) (Figure 10) and another one for the internal controls (CPP) (Figure 12). They have only one solution to extract the data, i.e. copy the tables into the clipboard. Therefore, based on this extraction function the BI tool produced by this thesis uses an excel file where the tables copied from the extranet are pasted on two different sheets. For the treatment of the data to be efficient it is necessary to convert the tables from the extract to a relational database. Then one must populate the database based on the fields existing in the tables and the BdM needs. The figure of the relational database can be found thereafter (Figure 9), each table matching an excel sheet of the same name.

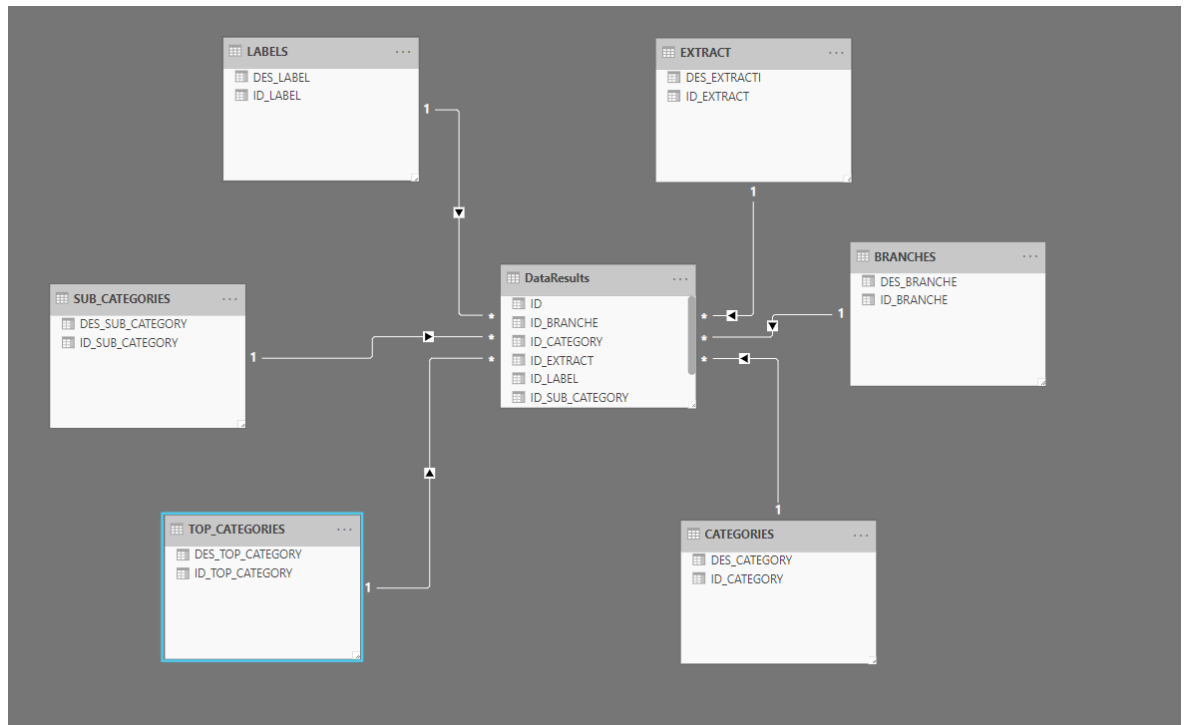


Figure 9: Relational Database of BdM data

Home

Statistiques pour les contrôles externes (ICE)

Période: Exercice 2012 Début: 01.01.2012 Fin: 31.12.2012 Calculer Copier

Raccourcis: Branches États Travail du samedi Travail au noir Exigibles Détachés

		États				Dossiers traités				Dossiers non traités		
		Dossiers reçus		Détachés		Dossiers traités		Détachés		Dossiers non traités		
Branches	Sous-commission	Suisses	Détachés	Suisses	Détachés	Suisses	Détachés	Suisses	Détachés	Suisses	Détachés	Dossiers
		Dossiers	Travailleurs	Dossiers	Travailleurs	Dossiers	Travailleurs	Dossiers	Travailleurs	Dossiers	Travailleurs	Dossiers
Construction métallique	cpmr métal	-	-	-	-	-	-	-	-	-	-	-
Electriciens	cpmr so haut	-	-	-	-	-	-	-	-	-	-	-
	cpmr électriciens	-	-	-	-	-	-	-	-	-	-	-
Inconnu à l'import	Inconnu à l'import.	-	-	-	-	-	-	-	-	-	-	-
	cpmr so centre	-	-	-	-	-	-	-	-	-	-	-
Nettoyage	cpmr nettoyeurs	-	-	-	-	-	-	-	-	-	-	-
	cpmr so centre	-	-	-	-	-	-	-	-	-	-	-
Paysagistes	cpmr paysagistes	-	-	-	-	-	-	-	-	-	-	-
SO	cpmr so bas	-	-	-	-	-	-	-	-	-	-	-
	cpmr so centre	-	-	-	-	-	-	-	-	-	-	-

Figure 10: External controls (ICE) Table for extract

Based on this method of export and the requirements expressed this thesis will then be creating the tool for the Bureau des Métiers to match the following process (Figure 11). Each step of this process needs to be manually executed or launched by the employee responsible for the gathering of the data. The process encompasses the steps from the extraction of the data to the export of the reports in the Power BI software.

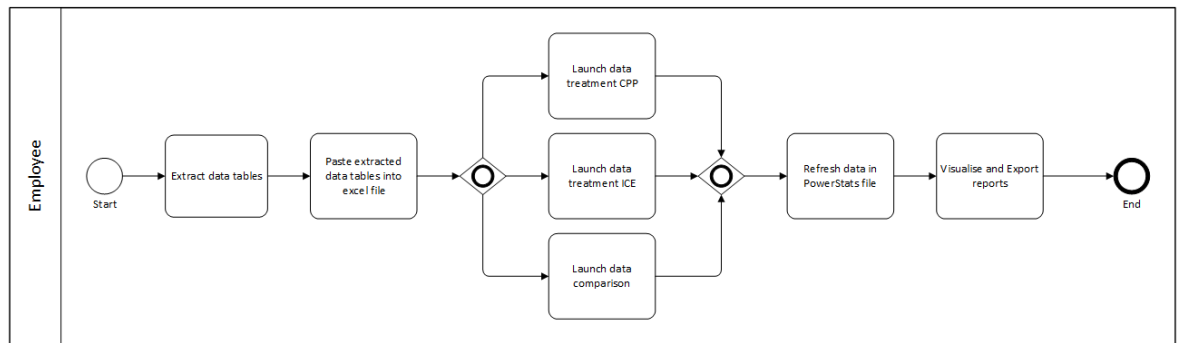


Figure 11: BPMN Process of PowerStats tool

Extranet

Non sécurisé | bmdesk.ch/extranet/stat/report/interne

Home

Statistiques pour les contrôles internes

Période: Exercice 2012 Début: 01.01.2012 Fin: 31.12.2012 Calculer Copier

Raccourcis: Branches Contrôles Infractions PC Travail au noir PC Travail du samedi PC Compléments PC Refus de renseigner CPP Rattrapages

		Contrôles							
		Entreprise normale		Membre		Non-membre		En infraction	
Branches	Sous-commission	Contrôles effectués							
		Nombre	Travailleurs	Nombre	Travailleurs	Nombre	Travailleurs	Nombre	Travailleurs
Construction métallique	cprr métal	-	-	-	-	-	-	-	-
Électriciens	cprr so haut	-	-	-	-	-	-	-	-
	cprr électriciens	-	-	-	-	-	-	-	-
Inconnu à l'import	Inconnu à l'import.	-	-	-	-	-	-	-	-
	cprr so centre	-	-	-	-	-	-	-	-
Nettoyage	cprr nettoyeurs	-	-	-	-	-	-	-	-
	cprr so centre	-	-	-	-	-	-	-	-
Paysagistes	cprr paysagistes	-	-	-	-	-	-	-	-
SO	cprr so bas	-	-	-	-	-	-	-	-
	cprr so centre	-	-	-	-	-	-	-	-
	cprr so haut	-	-	-	-	-	-	-	-

Figure 12: Internal controls (CPP) table for extract

6.1.1 Excel file as a relational database

In order to export the data, they have to paste it into an Excel file which needs to correspond to the relational database. To match the database, each sheet in the Excel file has to be considered as a table of the database and each row in the sheet is a data row, the first being the field label (See Appendix 2: Excel sheets for relational database). Thereafter one can find an example and explanation of one of the tables. (Figure 13).

6.1.2 Example and description of Excel sheet "Branches"

	A	B	C	D
1	ID_BRANCHE	DES_BRANCHE		
2		1 Electricité		
3		2 Métal		
4		3 Nettoyage		
5		4 Paysagisme		
6		5 Tuyauterie		
7		6 Techbat bvs		
8		7 Techbat hvs		
9		8 Techbat		
10		9 Inconnu à l'import		
11		101 Bois bvs		
12		102 Bois centre		
13		103 Bois hvs		
14		10 Bois		
15		111 Peinture bvs		
16		112 Peinture centre		
17		113 Peinture hvs		
18		11 Peinture		
19		121 Poseur sol bvs		
20		122 Poseur sol centre		
21		123 Poseur sol hvs		
22		12 Poseur sol		
23		131 location service bvs		
24		132 location service centre		
25		133 location service haut		
26		13 Location de service		
27		20 Bas		
28		21 Centre		
29		22 Haut		
30		23 Comité		
31		24 SECOND ŒUVRE		
32		99 TOTAL		
33		9999 inconnu		
34				
35				

Figure 13: Excel sheet for Branches Table

This figure represents the different rows that can be found in the extracted tables. Each row (called "*Branches*" in Figure 13) has several columns with values depending on the collected data on the extracted fields. For example one can input a group of employees working on the construction site of a new building several times on the extracted file. This would be the case if their employer hasn't registered them correctly or has made them work on Saturdays and Sundays without a prior official authorization, as working on those days is illegal in Switzerland. An employee would also be input on the file if their wage does not respect the minimum value stated in the collective agreements of work. Thus a worker might be found at least four times in the extracted tables for a same field of work. So this table is one of the most important one in the Excel file to avoid duplicating the entries to many times. It is designed with two columns, the first one being the primary key, i.e. the unique identification of a row in a table. The second column is the actual label corresponding to what is written in the extracted table and what the Bureau des Métiers will later use to filter the reports, diagrams and explore data. All the other Excel tables are designed using the same concept with two columns, one for the primary key and the other for the label.

6.1.3 Example of Exported table from extranet bmdesk

One can find below the examples of the exported tables containing the data that the bureau des Métiers obtains when they paste it from their extranet in the file produced by the thesis (Figure 14, Figure 15). We can see that it has the same design as in the extranet web page. Although it is not shown on the figure, it is difficult to manipulate as it contains hundreds of columns and tens of rows. An employee could easily get lost.

B17										
cprr so centre										
	A	B	C	D	E	F	G	H	I	
1			États							
2	Données du : 12/03/2019 à 14:50:01		Dossiers reçus				Dossiers traités			
3			Suisses		Détachés		Suisses		Détachés	
4	Branche	Sous-commission	Dossiers	Travailleurs	Dossiers	Travailleurs	Dossiers	Travailleurs	Dossiers	Ti
5	Construction métallique	cprr métal	11	7	16	50	35	34	44	
6	Électriciens	cprr so haut	-	-	-	-	-	-	-	
7		cprr électriciens	6	6	13	14	30	36	25	
8	Inconnu à l'import.	Inconnu à l'import.	5	2	1	0	24	7	1	
9		cprr so centre	-	-	-	-	-	-	-	
10	Nettoyage	cprr nettoyeurs	5	2	-	-	26	12	1	
11		cprr so centre	-	-	-	-	-	-	-	
12	Paysagistes	cprr paysagistes	6	2	1	3	29	17	5	
13	SO	cprr so bas	-	-	-	-	-	-	1	
14		cprr so centre	-	-	-	-	-	-	-	
15		cprr so haut	-	-	-	-	2	1	-	
16	SO bois	cprr so bas	12	12	26	43	43	36	45	
17		cprr so centre	6	2	30	73	15	3	47	
18		cprr so haut	3	2	25	60	13	7	51	
19		techbat bvs	-	-	-	-	-	-	-	
20	SO peinture	Inconnu à l'import.	-	-	-	-	-	-	-	
21		cprr so bas	20	10	5	8	64	64	10	
22		cprr so centre	29	3	12	13	60	22	20	
23		cprr so haut	2	0	3	7	14	9	6	

Figure 14: Excel sheet external controls (ICE)

B26										
	A	B	C	D	E	F	G	H	I	J
1			Contrôles							
2	Données du : 12/03/2019 à 14:5		Entreprise normale							
3			Contrôles effectués		Membre		Non-membre		En infraction	
4	Branche	Sous-commission	Nombre	Travailleurs	Nombre	Travailleurs	Nombre	Travailleurs	Nombre	Travailleur
5	Construction	cprr métal	12	106	10	90	2	16	8	7
6	Électriciens	cprr so haut	-	-	-	-	-	-	-	-
7		cprr électriciens	29	297	19	224	10	73	22	25
8	Inconnu à l'im	Inconnu à l'import.	-	-	-	-	-	-	-	-
9		cprr so centre	-	-	-	-	-	-	-	-
10	Nettoyage	cprr nettoyeurs	23	270	1	79	22	191	13	24
11		cprr so centre	-	-	-	-	-	-	-	-
12	Paysagistes	cprr paysagistes	16	98	3	41	13	57	11	7
13	SO	cprr so bas	-	-	-	-	-	-	-	-
14		cprr so centre	-	-	-	-	-	-	-	-
15		cprr so haut	-	-	-	-	-	-	-	-
16	SO bois	cprr so bas	9	89	2	37	7	52	4	5
17		cprr so centre	8	227	5	220	3	7	5	15
18		cprr so haut	3	14	1	11	2	3	2	1
19		techbat bvs	-	-	-	-	-	-	-	-
20	SO peinture	Inconnu à l'import.	-	-	-	-	-	-	-	-
21		cprr so bas	10	128	2	48	8	80	7	11
22		cprr so centre	10	167	3	136	7	31	9	16
23		cprr so haut	9	75	4	43	5	32	5	4

Figure 15: Excel sheet Internal Control (CPP)

6.1.4 Home dashboard for data treatment and automatization process

To make it easy to manage the data extracted from the extranet platform a "Home" excel sheet (Figure 16) is provided. This sheet is divided into two parts.

In the first part the users have 5 push buttons, linked to a macro, they can click on to execute the data treatment. The second part shows fields that the user needs to fill in manually as they concern data needed for their work which is not input in the extracted tables.

	A	B	C	D	E	F	G	H	I	J	K
1								SEANCES	AUDITIONS		
2		Clear Data					Electricité	4	3		
3							Métal	4	0		
4							Nettoyage	4	0		
5							Paysagisme	4	0		
6		ICE					Tuyauterie				
7							Techbat bvs	4	1		
8							Techbat hvs	4	0		
9							Bas	5	2		
10		CPP					Centre	4	3		
11							Haut	4	3		
12							Comité	1			
13							SECOND ŒUVRE				
14		CPP & ICE					TOTAL	38	12		
15											
16											
17											
18		Comparaison									
19											
20											
21											
22											
23											
24											

Figure 16: Home dashboard data treatment

One will split the first part with the buttons into three groups, the first group contains the button to clear data, the second the CPP, ICE and CPP & ICE buttons which manage the extracted data and the last group operates the comparison of data. We will proceed with this subdivision because each one possesses its own logic even if some points look similar.

6.1.5 Clear data pushbutton and its code

The first button erases the results of the previous extractions or manipulations of the file in order to have a clear board to make further operations. The code to clear all the data can be found bellow (Figure 17).

```

1 'Macro to clear all cells in the result sheet
2 Sub ClearCells ()
3     Set wb = Workbooks ("SourceFile_PowerStats.xlsm")
4     Set sheetData = wb.Worksheets ("DataResults")
5     Call ClearData (sheetData)
6     MsgBox ("Data result sheet cleared")
7 End Sub

```

Figure 17: Clear Data macro

6.1.6 Extracted data treatment macro and its buttons

The second and third button are respectively ICE and CPP which are designed to launch the treatment of the extracted tables corresponding to their names, Internal controls for the CPP (Figure 19) and external controls for ICE macro (Figure 18). Each one of these macros takes all the data on the sheets named ICE and CPP and proceeds to save it in the result sheet for further treatment by the Power BI tool.

```
1 'Macro to get data from the export of the intranet of Bureau des
metiers from the ICE page where table has to be paste in the format
2 'from 2019 where there is 156 columns and 30 lines. The export table
must be paste in the sheet2 named ICE
3
4 Sub ICE()
5     Set wb = Workbooks("SourceFile_PowerStats.xlsm")
6     Set sheetICE = wb.Worksheets("ICE")
7     Call ExtractTreatment(1, sheetICE)
8     MsgBox ("ICE Extract treatment finished and data in data result
sheet")
9 End Sub
```

Figure 18: ICE macro

```
1 'Macro to get data from the export of the intranet of Bureau des
metiers from the CPP page where table has to be paste in the format
2 'from 2019 where there is 198 columns and 30 lines. The export table
must be paste in the sheet3 named CPP
3
4 Sub CPP()
5     Set wb = Workbooks("SourceFile_PowerStats.xlsm")
6     Set sheetCPP = wb.Worksheets("CPP")
7     Call ExtractTreatment(2, sheetCPP)
8     MsgBox ("CPP Extract treatment finished and data in data result
sheet")
9 End Sub
```

Figure 19: CPP macro

Both these macros call up a subsidiary macro (Figure 20) where the treatment of the extraction is generalized and as it is operated several other functions are also called up. This treatment Sub will be explained bellow as well as all the functions used. We will first show the code of the treatment macro and then the functions will be explained in order of appearance. The treatment begins with declaring and setting all the variables necessary to the functions. Special care will be taken when working on the result sheet to be able to write after the last entry and so avoid over writing on existing data. Next comes the iteration through the first 4 rows to define with which Top category, category, sub category and label the value for a field of work must be saved. It is in this part of the code that the first sub function is called up (Figure 21).

```

01 'Treatment macro that will input data inside the DataResult sheet in
the format necessary for the powerBi File
02 Sub ExtractTreatment(ID_EXTRACT As Integer, sheetExtract As Work-
sheet)
03
04 'Setting global variables to be used in the macro
05 Set wb = Workbooks("SourceFile_PowerStats.xlsm")
06 Set sheetHome = wb.Worksheets("Home")
07 Set sheetData = wb.Worksheets("DataResults")
08 Set sheetTopCat = wb.Worksheets("TOP_CATEGORIES")
09 Set sheetCat = wb.Worksheets("CATEGORIES")
10 Set sheetSubCat = wb.Worksheets("SUB_CATEGORIES")
11 Set sheetLabel = wb.Sheets("LABELS")
12
13 'Local variables for Extract Treatment
14 Dim firstRow As Integer, lastRow As Integer, dataRow, idData As Inte-
ger, lastRowData As Integer, currentRow As Integer
15 Dim lastCol As Integer, currentCol As Integer, firstCol As Integer,
emptyCol As Boolean
16 'Setting local variables
17 firstRow = 5
18 firstCol = 3
19 emptyCol = False
20
21 'Get last column with data and save it
22 lastCol = sheetExtract.Cells(4, Columns.Count).End(xlToLeft).Column
23 'Get last row with data and save it to get the number of branches
24 lastRow = sheetExtract.Cells(Rows.Count, 2).End(xlUp).row
25
26 'Get last row from dataResults sheet and save the id of the row to
idData
27 lastRowData = sheetData.Cells(Rows.Count, 1).End(xlUp).row
28 lastRowData = CInt(lastRowData)
29 'If there are no data and only the columns title set the id at 1 and
the last row at 2
30     If (lastRowData = 1) Then
31         idData = 0
32         lastRowData = 1
33     Else
34         idData = sheetData.Cells(lastRowData, 1).value
35     End If
36
37 'Work on the sheet to get the datas needed
38
39 'Iterate through each column and for each columns find the combina-
tion of id needed
40 'Then for each branch save the value with the corrects ids
41 For currentCol = firstCol To lastCol
42     'Set the empty col value as False in case the previous column was
empty
43     emptyCol = False
44
45     'Set the id for the label and check for special case, if label is
empty
46     If (Not IsEmpty(sheetExtract.Cells(4, currentCol).value)) Then
47         'Special case, when it is prononcés or payés merged cells,
the first one correspond to the amount
48         If (sheetExtract.Cells(4, currentCol).value = "Prononcés")
Then
49             ID_LABEL = 3
50         ElseIf (sheetExtract.Cells(4, currentCol).value = "Payés")
Then
51             ID_LABEL = 5

```

```

52         Else
53             ID_LABEL = id(sheetLabel, sheetExtract.Cells(4, currentCol).value)
54             If (ID_LABEL = 0) Then
55                 emptyCol = True
56             End If
57         End If
58         'Special case, when it is prononcés or payés merged cells, the
59         'second one corresponds to the number
60         Else
61             If (ID_LABEL = 3) Then
62                 ID_LABEL = 4
63             ElseIf (ID_LABEL = 5) Then
64                 ID_LABEL = 6
65             Else
66                 emptyCol = True
67             End If
68         End If
69         If (Not emptyCol) Then
70             'Set the id for the top Category
71             If (Not IsEmpty(sheetExtract.Cells(1, currentCol).value))
72             Then
73                 ID_TOP_CATEGORY = id(sheetTopCat, sheetExtract.Cells(1,
74                 currentCol).value)
75             End If
76             'Set the id for the Category
77             If (Not IsEmpty(sheetExtract.Cells(2, currentCol).value))
78             Then
79                 ID_CATEGORY = id(sheetCat, sheetExtract.Cells(2, currentCol).value)
80             Else
81                 'Special case for Détachés TOP_CAT where CATEGORY is Empty
82                 If (ID_TOP_CATEGORY = 9 And ID_CATEGORY = 10) Then
83                     ID_CATEGORY = 11
84                 End If
85             End If
86             'Set the id for the sub Category
87             If (Not IsEmpty(sheetExtract.Cells(3, currentCol).value))
88             Then
89                 ID_SUB_CATEGORY = id(sheetSubCat, sheetExtract.Cells(3,
90                 currentCol).value)
91             Else
92                 'Special case for CATEGORY FI Totaux where there aren't any
93                 'Sub Category
94                 Else
95                     If (ID_CATEGORY = 12 And ID_SUB_CATEGORY <> 17) Then
96                         ID_SUB_CATEGORY = 17
97                     End If
98                 End If
99             End If
100         End If
101     Next
102 End Sub

```

Figure 20: Treatment macro

The first function used (Figure 21) in the treatment is a function that will find the ID's that match the column arrangement (Top category, category, sub category, label). The function is called up for each level and goes through the matching sheet to find the ID. In summary it is the same as going through a table and when finding a match with an id, sending it back to the main Sub to continue the treatment.

```

01 'Find in the sheet given as parameter based on the value given
02 'find the id in the first column that correspond to the value in the
    second column
03 Function id(sheet As Worksheet, value As String) As Integer
04     Dim lastRow As Integer, currentRow As Integer
05     lastRow = sheet.Cells(Rows.Count, 1).End(xlUp).row
06     For currentRow = 2 To lastRow
07         If (sheet.Cells(currentRow, 2).value = value) Then
08             id = sheet.Cells(currentRow, 1)
09             currentRow = lastRow + 10
10         End If
11     Next
12 End Function

```

Figure 21: ID finder function

The second function (Figure 22) is a function that with the given Ids for the column iterates through all the lines in the column and saves the data in the data results sheet. This function is primordial as in it each piece of information needed for the result is known. It is in this function that the information is written on the result sheet.

```

01 'Iterate through the rows of a col each respectively given as parame-
    ter for a sheet and save it in the result sheet given
02 ' Have to give the resultsdata row
03 Function IterateThroughBranche(sheetData As Worksheet, sheetExtract
    As Worksheet, currentCol As Integer, _
04     firstRow As Integer, lastRow As Inte-
    ger, ByRef lastRowData As Integer, ByRef idData As Integer, _
05     ID_EXTRACT As Integer,
    ID_TOP_CATEGORY As Integer, ID_CATEGORY As Integer, _
06     ID_SUB_CATEGORY As Integer, ID_LABEL
    As Integer, ManualInput As Boolean)
07
08     Dim currentRow As Integer, ID_BRANCHE As Integer, sheetBranche As
    Worksheet
09     Set sheetBranche = ActiveWorkbook.Worksheets("BRANCHES")
10
11     'Go through each Branch to fill data results sheet with the in-
    formations for this column
12     For currentRow = firstRow To lastRow
13         If (ManualInput) Then
14             ID_BRANCHE = id(sheetBranche, sheetEx-
    tract.Cells(currentRow, 7).value)
15         Else
16             ID_BRANCHE = idBranche(currentRow)
17         End If
18         If (Not ID_BRANCHE = 9999) Then

```

```

19         If (Not sheetExtract.Cells(currentRow, currentCol).value
= "-") Then
20             Call SetData(sheetData, inc(lastRowData),
inc(idData), ID_EXTRACT, ID_BRANCHE, ID_TOP_CATEGORY, ID_CATEGORY, _
21                 ID_SUB_CATEGORY, ID_LABEL, sheetEx-
tract.Cells(currentRow, currentCol).value)
22             End If
23         End If
24     Next
25
26 End Function

```

Figure 22: Iterate through rows function

In the function explained above, two others are also called up. The first one, (Figure 23) based on the row, saves the corresponding field of work (called "*branche*" in Figure 23) on the data result sheet. A switch function based on the row in parameter returns the Id of the matching field of work. It has been necessary to use a switch as the labels in the extracted tables didn't match the labels needed to explore data. It was thus impossible to make a link in the database so that the labels had to be input manually in the macro.

```

01 'Function that returns the id of the branch base on the line
02 Function idBranche(row As Integer) As Integer
03
04 Select Case row
05     Case 5
06         idBranche = 2
07     Case 7
08         idBranche = 1
09     Case 8
10         idBranche = 9
11     Case 10
12         idBranche = 3
13     Case 12
14         idBranche = 4
15     Case 13
16         idBranche = 131
17     Case 14
18         idBranche = 132
19     Case 15
20         idBranche = 133
21     Case 16
22         idBranche = 101
23     Case 17
24         idBranche = 102
25     Case 18
26         idBranche = 103
27     Case 19
28         idBranche = 6
29     Case 21
30         idBranche = 111
31     Case 22
32         idBranche = 112
33     Case 23
34         idBranche = 113
35     Case 24
36         idBranche = 121
37     Case 25

```

```

38         idBranche = 122
39     Case 26
40         idBranche = 123
41     Case 27
42         idBranche = 5
43     Case 28
44         idBranche = 7
45     Case 29
46         idBranche = 6
47     Case 30
48         idBranche = 5
49     Case Else
50         idBranche = 9999
51 End Select
52 End Function

```

Figure 23: Save Id branche function

The last function called up (Figure 24) sets the data with all the correct Ids into the data result sheet. It writes on the result sheet the information extracted. These results correspond to relational database rows.

```

01 'Fill the row of the sheet given in parameter with the values in the
02 parameter
03 Function SetData( _
04     sheet As Worksheet, RowData As Integer, _
05     id As Integer, ID_EXTRACT As Integer, ID_BRANCHE As Integer,
06     ID_TOP_CATEGORY As Integer, _
07     ID_CATEGORY As Integer, ID_SUB_CATEGORY As Integer, ID_LABEL As
08     Integer, value)
09
10     sheet.Cells(RowData, 1).value = id
11     sheet.Cells(RowData, 2).value = ID_EXTRACT
12     sheet.Cells(RowData, 3).value = ID_BRANCHE
13     sheet.Cells(RowData, 4).value = ID_TOP_CATEGORY
14     sheet.Cells(RowData, 5).value = ID_CATEGORY
15     sheet.Cells(RowData, 6).value = ID_SUB_CATEGORY
16     sheet.Cells(RowData, 7).value = ID_LABEL
17     sheet.Cells(RowData, 8).value = value
18
19 End Function

```

Figure 24: Write on dataresult sheet function

The fourth button on the Home dashboard is a combination of the first three ones. It begins with clearing all the data in the *Dataresults* sheet and then runs through both the CPP and ICE macro to get all the data from the extracted tables (Figure 25).

```

1 'Macro that does both the CPP and the ICE extract treatment
2 Sub CPP_ICE ()
3     Call ClearCells
4     Call ICE
5     Call CPP
6     MsgBox ("ICE and CPP Extract treatment finished and data in da-
7     taresult sheet")
8 End Sub

```

Figure 25: CPP & ICE Macro

6.1.7 Comparison data macro and its button

In the dashboard the button is called "Comparaison" which means comparison in French. It executes a macro (Figure 26) that takes into account fields in both extracted tables and the manually input fields on the home dashboard. This comparison is the core element required to produce diagrams in the power BI file. The principle of this macro is the same as the automated treatment of the extract tables. The difference lays in the function that iterates through the rows which instead of going through all the columns in the excel file, only goes through manually selected columns. See below an example of going through the column representing the number of controls in companies in the internal control extract. You can find the whole code for the comparison macro in Appendix 1: Comparison macro code.

```
57      'Col to be treated for the comparison of the number of ctrl in
CPP Extract
58      currentCol = 3
59      'Set the ID of the TOP_CATEGORY for the comparison
60      ID_TOP_CATEGORY = 3
61
62      Call IterateThroughBranche(sheetData, sheetCPP, currentCol,
firstRow, lastRow, lastRowData, idData, ID_EXTRACT, ID_TOP_CATEGORY, _
63                               ID_CATEGORY, ID_SUB_CATEGORY, _
ID_LABEL, False)
64
```

Figure 26: Comparison macro

6.2 Power BI dashboards and reports

This thesis has created a new Power BI file called PowerStats as per the decision of the BdM. The BI tool was created using the Power BI software and is linked to the Excel file where all the extracted data from the extranet is input with a simple copy paste action from the employee.

When all the extracted data has been processed by the several macros and is in the *Dataresults* sheet the user doesn't need the Excel file anymore to produce the reports and to access useful data insight in the power BI file. The power BI file can automatically obtain the new data inside the Excel file with a refresh button. In this way the reports are refreshed and up-to-date.

The power BI file is designed on the concept of the relational database previously explained in chapter 6.1 and all the tables are linked to the excel file which means that all the data existing in the power BI file is from the Excel file. Once the import of all the data has been done for the first time, every time users make a change in the Excel file, they

only need to refresh the power BI file with the "Refresh" button to obtain the most recent data from the Excel file. So for example if somebody changes the extract tables or inputs new ones or executes the macros once again the power BI can be easily actualized.

To match the requirements of the BdM the PowerStats dashboard created had to contain several elements; pie chart diagrams, stacked column diagrams and tables to explore the data based on different filters.

Power BI works in the same way as an Excel file with the option of creating sheets, the difference being that each sheet is a dashboard. In this thesis for the PowerStats BI tool 12 different dashboards have been created, each one containing one to four diagrams. Bellow one will show an example of each type of dashboard available. One will begin with a dashboard containing a unique pie chart diagram (Figure 27) which represents the internal controls of several fields of work in percentages.

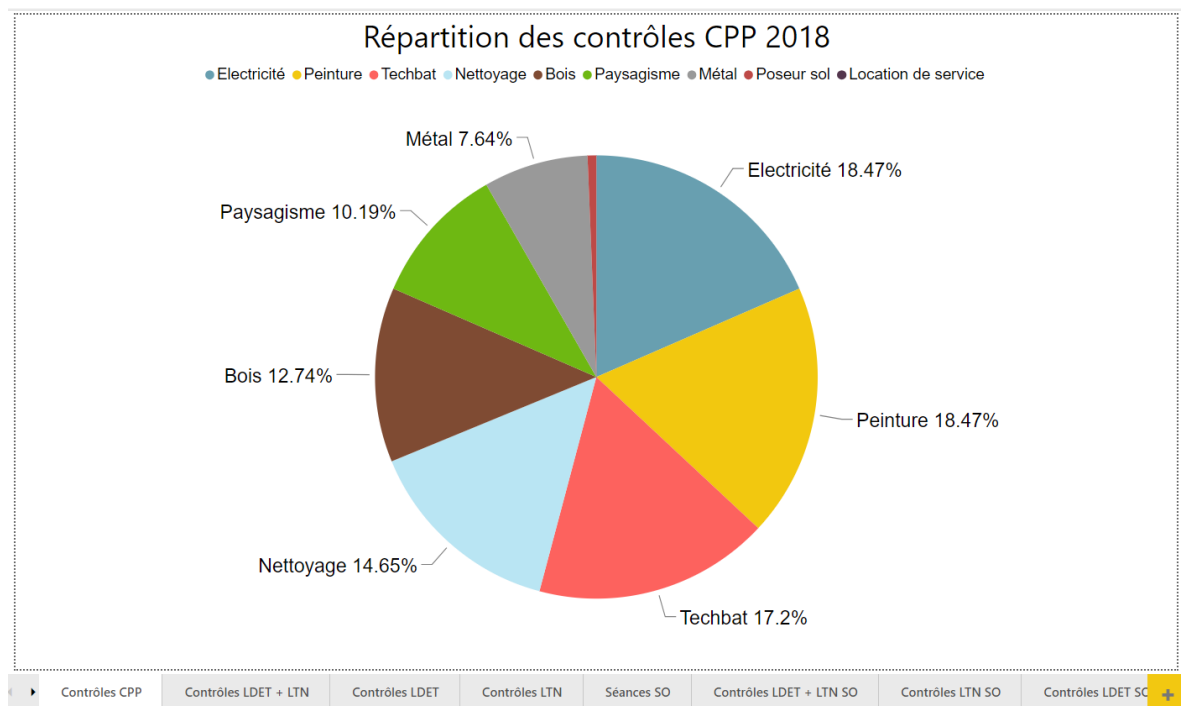


Figure 27: Unique pie chart dashboard

The first example (page 37) shows a dashboard containing only one stacked column diagram which represents illegal work for external controls of several fields of work (Figure 28) whereas Figure 29 (page 37) shows a dashboard with four different stacked columns diagrams . Both dashboards show different fields of work for illegal work, mentioning work on Sundays, Saturdays and undeclared work. The stacked column reports must be easily customizable and readable, because the Bureau des Métiers mostly uses them in their presentation.

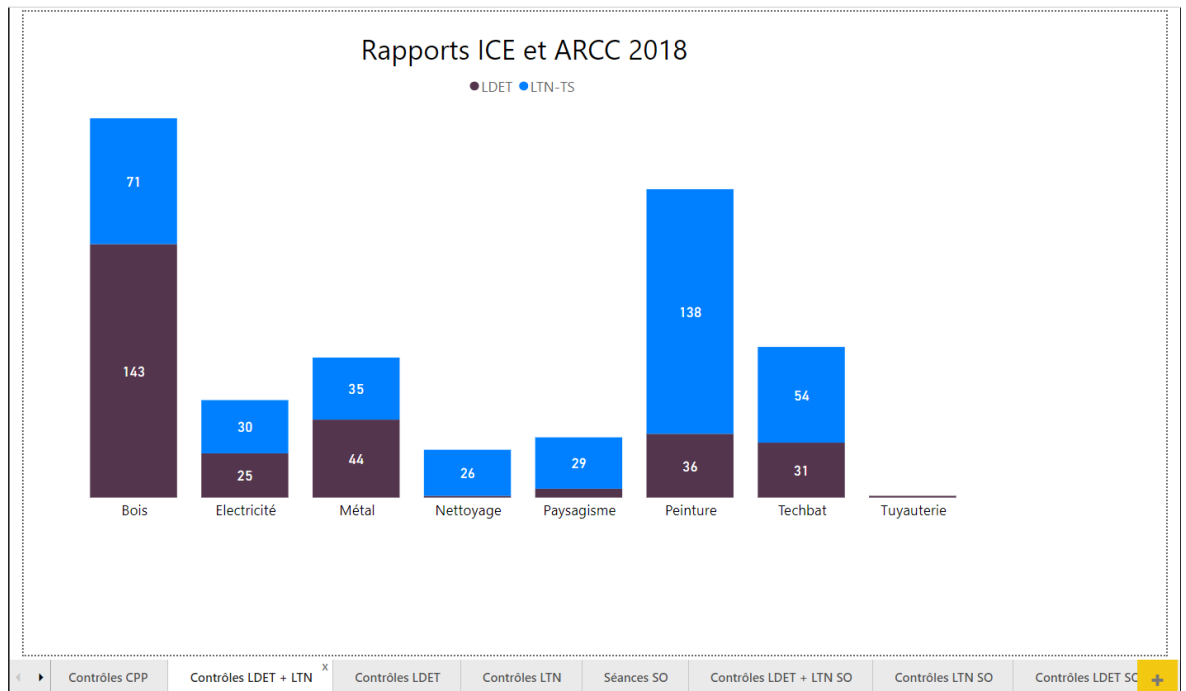


Figure 28: Unique stacked column dashbaord

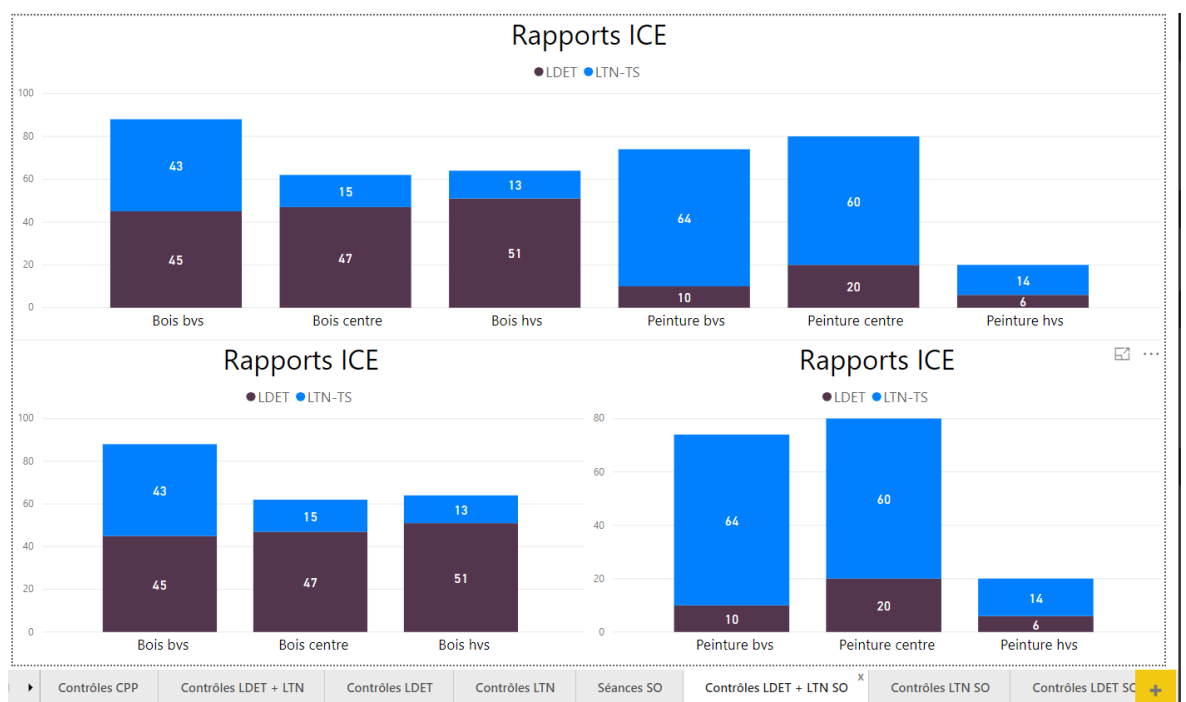


Figure 29: Multiple stacked column dashboard

Lastly one can find below a dashboard with a table to explore the existing data (Figure 30). The data, read from left to right, goes from the most global category to the detail one (*Label* column) and the user can apply a filter on each column. The employee can then choose the relevant field of work (hereafter "*Branche*" column in Figure 30) in order to see the values (hereafter "*Valeur*" Column in Figure 30). We can also choose if we want to see a Total of the values and how the rows should be displayed. This kind of dashboard target audience is the employees and is not meant to be used for presentations. The tables are meant to extract the values easily and write reports from them.

Nombre d'entreprise prononcées Entreprise location de service 2017						
Extraction	Groupe	Catégorie	Sous catégorie	Label	Branche	Valeur
CPP	Contrôles	Entreprise normale	Contrôles effectués	Nombre	Métal	12
CPP	Contrôles	Entreprise normale	Contrôles effectués	Travailleurs	Métal	106
Total						118

Montant prononcé entreprise normale 2017						
Extraction	Groupe	Catégorie	Sous catégorie	Label	Branche	Valeur
CPP	PC Compléments	Entreprise normale	Prononcés	Montant	Electricité	11470
Total						11470

◀	▶	JN	Séances SO	Contrôles LDET + LTN SO	Contrôles LTN SO	Contrôles LDET SO	Contrôles SO	Contrôles Techbat	Tableau CPP x	Tableau ICE	+
---	---	----	------------	-------------------------	------------------	-------------------	--------------	-------------------	---------------	-------------	---

Figure 30: Table to explore data dashboard

7 Evaluation

The objective of this thesis was to create a product to answer the needs of the Bureau des Métiers concerning the treatment of data exported from their extranet. They needed a tool to work with this data easily and quickly. The product needed to be simple to deploy and its use had to be easily mastered by an employee. Taking into account these requirements the Bureau des métiers examined the product delivered to them and they were convinced that it fitted all their demands.

The Business Intelligence tool created for this thesis is fully functional and user friendly. It is designed to be used by a business user and doesn't need prior knowledge in information technology. The tool has been designed to enable the user realise what is happening at every stage of the treatment of the data so as to get a precise feedback of all the actions.

The aim of the theoretical part at the beginning of this thesis is to give any reader, even one without any prior knowledge, a clear insight into the motivation and the reasons standing behind such a project. The reader can thus gain clear understanding of the concept of Business Intelligence, its challenges and objectives. A personal, objective evaluation of the work produced and the results obtained is then possible since the knowledge gained enables one to form one's own judgement on the BI tool created for the Bureau des Métiers.

The sources used to create this theoretical background were found in various media such as standard google research, google scholar research, eBooks from the online school library and official software websites. All the information gathered gave us an up-to-date and objective view of the world of Business Intelligence nowadays. The tool was thus created without the thesis author's prior knowledge biasing the process.

This thesis methodology consisted of a modified and personalized version of a Scrum methodology. As Scrum works for teams and this thesis was realized by a unique author the team management part of the Scrum methodology, i.e. reporting to a Scrum master was left out. Instead they were replaced by the listing and discussion with the product owner to clearly establish their needs. On those occasions, the owner clearly mentioned which functions were absolutely necessary and which were the "nice to have" ones. From this point on this thesis author worked with the "Sprint" iteration of Scrum methods. After each sprint a part of the final product was produced and submitted for evaluation to the product owner. The work with this modified version of Scrum enabled one to test a

functional prototype at each step of the process. The manager of the Bureau des Métiers could thus validate the direction of the implementation and make any further specification at each step if the need arouses.

As this thesis was commissioned by a company to create a tool they actually need, it has enabled the thesis author to gain better understanding of a project management issues and give him valuable experience for the collaboration with a company. The author has improved his skills in understanding the needs of a business owner and in translating them into a developer approach and technology wise choices. After comparing the technologies on the market, he then had to decided objectively without taking into account any personal preferences, which approach fitted best. This represented a real challenge but it has enabled him to form a more specific and neutral opinion about the use of Business Intelligence nowadays.

8 Further development

As of today, the BI tool produced for the Bureau des métiers is split into two different parts; one for the data treatment and another one for the analysis and the report functions. Although it is functional and meets all their requirements, the tool could still be further upgraded and these options have already been discussed with the Bureau des métiers. The first upgrade proposed would be to become free of this two-part tool, i.e. to abolish the data treatment part and to be able to, directly from the report tool, gather the data from the database. Another upgrade could be to increase security in the BI tool implementing a login with user and password, so as to prevent any user from exploiting the sensitive data without authorization. Lastly as the BI tool is on Power BI the possibilities of creating new reports is almost infinite and can be customized in any way the business owner might want. One of the major axis of upgrade would then be to train employees to use the tool as they would be able to create and modify new reports according to the changing needs.

To conclude, for a company to be able to fully exploit a BI tool and adapt it to their needs , they should have the necessary resources to upgrade the tool internally. It is not necessary for the company to have an employee able to create a new tool from scratch, but they should at least have one who could maintain it and proceed to customization and upgrades on a general level.

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Appendices

Appendix 1: Comparison macro code

```
01 'Macro that get the data needed to prepare for the comparison
02 Sub ComparisonData()
03
04     'Setting global variables to be used in the macro
05     Set wb = Workbooks("SourceFile_PowerStats.xlsm")
06     Set sheetICE = wb.Worksheets("ICE")
07     Set sheetCPP = wb.Worksheets("CPP")
08     Set sheetHome = wb.Worksheets("Home")
09     Set sheetData = wb.Worksheets("DataResults")
10     Set sheetTopCat = wb.Worksheets("TOP_CATEGORIES")
11
12     'Local variables for Extract Treatment
13     Dim firstRow As Integer, lastRow As Integer, dataRow As Integer,
idData As Integer, lastRowData As Integer, currentRow As Integer
14     Dim currentCol As Integer, ID_EXTRACT As Integer, sheetExtract As
Worksheet, idTopCat As Integer
15     'Setting local variables
16     firstRow = 5
17     ID_EXTRACT = 3
18
19
20
21     'Get last row with data and save it to get the number of branch
22     lastRow = sheetCPP.Cells(Rows.Count, 2).End(xlUp).row
23
24     'Get last row from dataResults sheet and save the id of the row
to idData
25     lastRowData = sheetData.Cells(Rows.Count, 1).End(xlUp).row
26     lastRowData = CInt(lastRowData)
27     'If there are no data and only the columns title set the id at 1
and the last row at 2
28     If (lastRowData = 1) Then
29         idData = 0
30         lastRowData = 1
31     Else
32         idData = sheetData.Cells(lastRowData, 1).value
33     End If
34
35     'For the Comparison only the TOP_CATEGORY is needed then all oth-
er ID are set to 0
36     ID_LABEL = 0
37     ID_CATEGORY = 0
38     ID_SUB_CATEGORY = 0
39
40
41     'Col to be treated for the comparison of the Seances, manual in-
put
42     currentCol = 8
43     'Set the ID of the TOP_CATEGORY for the comparison
44     ID_TOP_CATEGORY = 1
45
46     Call IterateThroughBranche(sheetData, sheetHome, currentCol, 2,
14, lastRowData, idData, ID_EXTRACT, ID_TOP_CATEGORY, _
47         ID_CATEGORY, ID_SUB_CATEGORY,
ID_LABEL, True)
48
```

```

49      'Col to be treated for the comparison of the Auditions, manual
input
50      currentCol = 9
51      'Set the ID of the TOP_CATEGORY for the comparison
52      ID_TOP_CATEGORY = 2
53
54      Call IterateThroughBranche(sheetData, sheetHome, currentCol, 2,
14, lastRowData, idData, ID_EXTRACT, ID_TOP_CATEGORY, _
55      ID_CATEGORY, ID_SUB_CATEGORY,
ID_LABEL, True)
56
57      'Col to be treated for the comparison of the number of ctrl in
CPP Extract
58      currentCol = 3
59      'Set the ID of the TOP_CATEGORY for the comparison
60      ID_TOP_CATEGORY = 3
61
62      Call IterateThroughBranche(sheetData, sheetCPP, currentCol,
firstRow, lastRow, lastRowData, idData, ID_EXTRACT, ID_TOP_CATEGORY, _
63      ID_CATEGORY, ID_SUB_CATEGORY,
ID_LABEL, False)
64
65      'Col to be treated for the comparison of the LTN-TS in ICE Ex-
tract
66      currentCol = 7
67      'Set the ID of the TOP_CATEGORY for the comparison
68      ID_TOP_CATEGORY = 4
69
70      Call IterateThroughBranche(sheetData, sheetICE, currentCol,
firstRow, lastRow, lastRowData, idData, ID_EXTRACT, ID_TOP_CATEGORY, _
71      ID_CATEGORY, ID_SUB_CATEGORY,
ID_LABEL, False)
72
73      'Col to be treated for the comparison of the LDET in ICE Extract
74      currentCol = 9
75      'Set the ID of the TOP_CATEGORY for the comparison
76      ID_TOP_CATEGORY = 5
77
78      Call IterateThroughBranche(sheetData, sheetICE, currentCol,
firstRow, lastRow, lastRowData, idData, ID_EXTRACT, ID_TOP_CATEGORY, _
79      ID_CATEGORY, ID_SUB_CATEGORY,
ID_LABEL, False)
80
81      'Get last row from dataResults sheet and save the id of the row
to idData
82      lastRowData = sheetData.Cells(Rows.Count, 1).End(xlUp).row
83      lastRowData = CInt(lastRowData)
84      'If there are no data and only the columns title set the id at 1
and the last row at 2
85      If (lastRowData = 1) Then
86          idData = 0
87          lastRowData = 1
88      Else
89          idData = sheetData.Cells(lastRowData, 1).value
90      End If
91
92      For idTopCat = 3 To 5
93          Call GeneralBranchesValue(sheetData, 3, idTopCat, lastRowDa-
ta, idData)
94      Next
95
96      MsgBox "Comparison data inputted"

```

Appendix 2: Excel sheets for relational database

	A	B	C	D	E	F
1	ID_EXTRA	DES_EXTRACTI				
2		1 ICE				
3		2 CPP				
4		3 Comparaison				
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
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21						
22						
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24						
25						
26						
27						
28						
29						

Home

CPP

ICE

BRANCHES

EXTRACT

T

Figure 31: Excel sheet for Extract table

	A	B	C	D	E	F
1	ID_TOP_CATEGORY	DES_TOP_CATEGORY				
2		1 Seance				
3		2 Auditions				
4		3 CTRL Entreprise				
5		4 LTN-TS				
6		5 LDET				
7		6 États				
8		7 Travail au noir et du samedi				
9		8 Exigibles				
10		9 Détachés				
11		10 Contrôles				
12		11 Infractions				
13		12 PC Travail au noir				
14		13 PC Travail du samedi				
15		14 PC Compléments				
16		15 PC Refus de renseigner				
17		16 CPP				
18		17 Rattrapages salaires				
19		18 Retaval				
20		19 Resor				
21		20 Contributions professionnelles				
22		21 PC (toutes)				
23		22 Bas				
24		23 Centre				
25		24 Haut				
26						
27						
28						
29						

Home CPP ICE BRANCHES EXTRACT TOP_CATEGORIES

Figure 32: Excel sheet for Top Categories table

	A	B	C	D
1	ID_CATEGORY	DES_CATEGORY		
2		1 Dossiers reçus		
3		2 Dossiers traités		
4		3 Dossiers non traités		
5		4 Dossiers classés		
6		5 Travail du samedi		
7		6 Travail au noir		
8		7 ICE		
9		8 CPP		
10		9 Rattrapages salaires		
11		10 PC (toutes)		
12		11 Détachés		
13		12 FI Totaux		
14		13 FI PC		
15		14 FI frais		
16		15 FI Infraction salariale		
17		16 Entreprise normale		
18		17 Entreprise de location de services		
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				

Home CPP ICE CATEGORIES

Figure 33: Excel sheet for Categories table

	A	B	C	D	E
1	ID_SUB_CATEGORY	DES_SUB_CATEGORY			
2		1 Suisses			
3		2 Détachés			
4		3 Sans infraction			
5		4 Suite SPT			
6		5 Avertissement			
7		6 Prononcés			
8		7 Payés			
9		8 Contrôles effectués			
10		9 Membre			
11		10 Non-membre			
12		11 En infraction			
13		12 Sans infraction			
14		13 Caisses sociales			
15		14 Travail au noir			
16		15 Travail du samedi			
17		16 Salaires			
18		17 FI Totaux			
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					

Figure 34: Excel sheet for Sub categories table

	A	B	C	D	E	F	G
1	ID_LABEL	DES_LABEL					
2		1 Dossiers					
3		2 Travailleurs					
4		3 Prononcés (Montant)					
5		4 Prononcés (Entreprise)					
6		5 Payés (Montant)					
7		6 Payés (Entreprise)					
8		7 CPP					
9		8 ICE					
10		9 Nombre					
11		10 Membre					
12		11 Non-membre					
13		12 En infraction					
14		13 Sans infraction					
15		14 Montant					
16							
17							
18							
19							
20							
21							
22							
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Figure 35: Excel sheet for Labels table