Microsoft Power BI Desktop for Data Analytics

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Abstract

This article reviews MS-Power BI Desktop that empowers managers to see and understand their data. By drag and drop, it is possible to discover trends and outliers from interactive dashboards, including combining data from multiple sources (from spreadsheets and data warehouses to big cloud data) at a glance. If asking questions is a key role of any manager (either using a browser, a tablet or a phone), business intelligence (BI) is the tool that allows the change managerial perspective of the problem and reveal deeper meaning of the data. Inevitable, basic technical jargons such as data mining or on-line analytical processing (OLAP) are introduced too. Three practical cases are disclosed while its layouts are discussed on a managerial and academic perspective.

Keywords: Knowledge Management, Business Intelligence, Business Analytics, MS-Power BI Desktop, Teaching and Learning.

1. INTRODUCTION

The use of data analysis tools has been widely considered during the last few years not only because of the increased availability of public databases but also because of a set of new user friendly and intuitive data processing and visualization tools, such as Microsoft Power BI and Tableau (www.tableau.com). Nevertheless, there is a gap between management training programs and the present industry practices. Since traditional management tools and approaches for obtaining and presenting information is directly connect to pervasive growth and expanding of IT technologies, decision supporting systems (DSS) are also a critical topic to be addressed by business students.

As well, the increasing amount of data generated inside of a company, including new interactive social media, demands firms to create new ways to analyze those data farm and generate knowledge to effectively enhance their innovation skills and performance and create value for their operation [1]. Certainly, the nowadays trend of artificial intelligence (AI) and deep learning, the increase of cloud storage and big data challenges, the development and business intelligence (BI) and business analytics (BA) tools have become increasingly important areas not only for researchers but also for business executives [2].

The first stage of adoption of computational tools for BI and BA were used almost exclusively for decision-making support activities. However and recently, the use of those tools to develop organizational capacity of learning and obtaining intelligence has been increasing [3]. In fact and according to several market surveys confirms this perspective. For [4], a survey (4500 respondents) conducted by IBM Institute reported that firms are increasingly gaining competitive advantage (in average, 58% more) from analytics use. Endorsing this view, [5] corroborates that the Gartner Institute presented BI and BA as a top priority for most of the analyzed firms.

From a technical perspective, the increasing complexity of data is creating severe difficulties for human interpretation since multi-dimensional data are hard to analyze because of mathematical and technical aspects such as data normalization, data correlation (linear and nonlinear) and metadata analysis. Positively, examining high complexity data coming from multiple sources requires a significant amount of time, usually not available for business professionals and their business's needs. On the contrary, businesses nowadays demand fast decision-making processes and effective analysis of increasing data in a decreasing amount of time context. Under this heavy constraint, enterprises must consider that the simple fact of having more information is not necessarily beneficial for

the organization since its information and knowledge processing capacity is limited as well [6]. Therefore, information systems are based on the development of filtering capabilities to attend the personal interpretation boundaries. Confirmed by [6], the increased ability of individuals and companies to receive, store, analyze and transfer information with fewer errors and adding value to the business operations is a requirement. As a result and according to Gartner Group, there are more than 25 relevant BI and BA tools in the market [7]. Among those, MS-Power BI and Tableau are the most popular and prominent ones.

The main objective of this research paper is to present and discuss the adoption benefits of Microsoft Power BI Desktop as a software tool to analyze and visualize large datasets, based on three case studies. Section 2 stands out a set of technical jargons to clarify key aspects about this management field. Section 3 discusses issues concerning BI and BA topics while section 4 and 5 highlights three case studies in a step-by-step scheme, including pertinent discussion regarding their outputs. As expected, a brief reflection is presented in the last section.

2. Technical Background

For a better understanding about why companies are adopting data analytical tools in its management environment, a few technical concepts must be introduced because some technical analysis is essential to understand when the decision making process (on which solution to adopt or investment/budget to choose from, for instance) is executed by business professionals.

According to [8], two clear definitions can be found: (A) OLTP, On-line Transaction Processing, is characterized by a large number of short on-line transactions (insert, update, delete). Its main emphasis relies on fast query processing, maintaining data integrity in a multi-access environment while its effectiveness is measured by the number of transactions per second. For reference, the internal transactional database scheme follows the entity relationship model (usually 3NF); a relatively low volume of online transactions brands (B) OLAP, On-line Analytical Processing. Yet, queries are often quite complex, involving aggregations and summarization of large quantity of data. Consequently, OLAP applications are widely used in data mining whose databases comprehends aggregated and historical data, stored in a multi-dimensional context (star schema). As presented in Figure 1, OLAP role is based on data warehouse solutions and data mining procedures for decision-making purposes. Basically, the master data transactions are performed in the background to generate deep insights from data and support the business strategies. Table 1 presents a detailed comparison for a better understand of OLTP and OLAP systems.

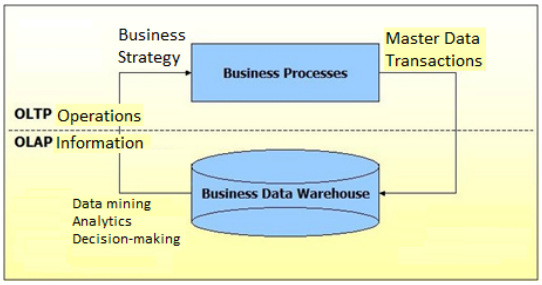


Fig. 1. OLTP and OLAP scope diagram [8].

Table 1. List of detailed features regarding OLTP and OLAP systems [8]

Characteristics of data	OLTP System Online Transaction Processing (Operational System)	OLAP System Online Analytical Processing (Data Warehouse)
Source	Operational data; OLTPs are the original source of the data.	Consolidation data; OLAP data comes from the various OLTP Databases
Purpose	To control and run fundamental business tasks	To help with planning, problem solving, and decision support
What the data	Reveals a snapshot of ongoing business processes	Multi-dimensional views of various kinds of business activities
Inserts and Updates	Short and fast inserts and updates initiated by end users	Periodic long-running batch jobs refresh the data
Queries	Relatively standardized and simple queries that returns a relatively few records	Often complex queries involving aggregations
Processing Speed	Typically very fast	Depends on the amount of data involved;

		batch data refreshes and complex queries may take many hours; query speed can be improved by creating indexes
Space Requirements	Can be relatively small if historical data is archived	Larger due to the existence of aggregation structures and history data; requires more indexes than OLTP
Database Design	Highly normalized with many tables	Typically de-normalized with fewer tables; use of star and/or snowflake schemas
Backup and Recovery	Backup religiously; operational data is critical to run the business, data loss is likely to entail significant monetary loss and legal liability	Instead of regular backups, some environments may consider simply reloading the OLTP data as a recovery method

2.1. Big Data and Data Mining

To understand the concept of big data, one must not only think about a huge database. In this case, the challenge regards the need of its performance such as power processing, memory and dashboards generator. According to [9], big data is closely related to the HACE theorem, that is, large-volume datasets should respect the following characteristics: (A) Heterogeneous (with different data nature); (B) Autonomous sources with distributed and decentralized control; (C) Complex, from a data transaction perspective; (D) Evolutional relationships among data.

Heterogeneous data considers huge volume of data from different dimensionalities, data structures and natures. For example, the city council demographic database may hold personal data such as name, age, address, family members, etc. On the other hand, municipal hospital requires historical diseases, medical treatments, examinations from different sources and formats such as CT Scans, X-Rays and ultrasound videos. DNA analysis will generate a third database (and so on). Under such circumstances, the heterogeneous features imply dissimilar types of representations of information for the same individual. As expected, each schemata to represent each patient leads to major challenges if the analyst tries to compute data aggregation by combining data from all sources [9].

According to the previous example, it is clear that autonomous data sources denotes distributed and decentralized controls from big data applications. By being autonomous, each data source is able to generate and collect information without involving (or relying on) any centralized control. A parallel comparison can be made when a web server can work on a stand-alone basis but, according to the web page accessed, multiple information can be retrieved from several different web servers to generate one single HTML page. It is also critical that sources of assorted countries respect dissimilar legislation and privacy rules that must be considered when using analytical data tools.

Under this context, the use of data mining systems must be contextualizing. Any mining procedure requires computational intensive computing units for data analysis and comparisons, including efficient data storage technologies. For companies with less demand, usually a single server and desktop processing resources are sufficient to process the available data and generate useful results. When the amount of data achieves terabytes of size, multiple processing nodes (with parallel processing power and memory management) should be considered instead, such as MapReduce or ECL (Enterprise Control Language). The role of these components is to make sure that each single data mining task (like finding the best match of a query from a database within billions of records) is split into many small tasks each of which is running on one or multiple computing nodes.

Strategically, big data mining brings new opportunities for companies to move beyond the traditional relational databases queries and to rely on even non-structured data such as social media text, image and videos, e-mails and sensors networks. Confirming this view and according to [9], major business intelligence companies (IBM, Oracle and Teradata, for example) have all featured their own products to help customers acquire and organize these diverse data sources and coordinate with customers' existing data to find new insights and capitalize on hidden relationships.

2.2. Business Intelligence (BI) and Business Analytics (BA)

Both terms share the same goal, that is, to help companies to make better decisions using available and measurable data. The formal difference relies on the methodology itself. Howner Dresner, in 1989 from the Gartner Group, defined BI as an umbrella definition of several other definitions related to decision making based on facts [10]. For [11], a unique definition of BI is hard to find since "it is hart to have a fully comprehension of the BI concept because the applications are not autonomous systems and do not provide support for specific goals, such as other corporative systems such as supply chain management (SCM) and customer relationship management (CRM)".

The BI concept happened when the increased amount of unstructured data from multiple sources lead to data warehouses, data mining and data ETL (Extraction, Transformation and Loading) operations to allow business professionals to analyze large databases for strategic planning purposes. On the other hand, BA expands the BI with a wider mathematical and statistical approach (predictive tools and artificial intelligence algorithms) to setup solutions aligned with the executive needs, industry demands and corporate evaluations by sales and investment managers, for instance.

3. BI&BA Market

The Gartner Group has been providing over the years, relevant reports with impartial analysis about many different aspects of the technology, software and industries fields. Based on [12], the magic quadrant for Analytics and Business Intelligence Platform is a graphical representation of the BI&A tools available, based on 15 capabilities criteria. Some interesting trends that can be extracted from this report: (A) BI&A solutions are being developed more and more as cloud based solutions, with storage, applications, reports and access control, security and audit tools stored in an online platform. For single users and demo licenses, usually a supplier-based cloud is provided. For large corporate users, a private cloud can be build using the client or a third parties' infrastructure. (B) Data analysis is becoming completely intuitive and visual. This means that the solutions suppliers are investing a lot of effort to present the solutions as far as possible from an IT specialized service. The focus is business and managers must be able to perform all the steps using a friendly interface to access data, organize, perform mathematical and statistical operations and prepare useful reports from the information obtained. (C) Traditional BI models that were more IT specialized are declining in adoption (since 2015) and the rise of analytics platform is the drive for the solutions development, especially with the possibility of self-service tools for data analysis and also publishing and sharing capabilities. (D) Augmented analytics represents the third generation of platforms, which is also rapidly increasing, based on machine learning and more advanced artificial intelligence (AI) architectures, such as deep learning networks.

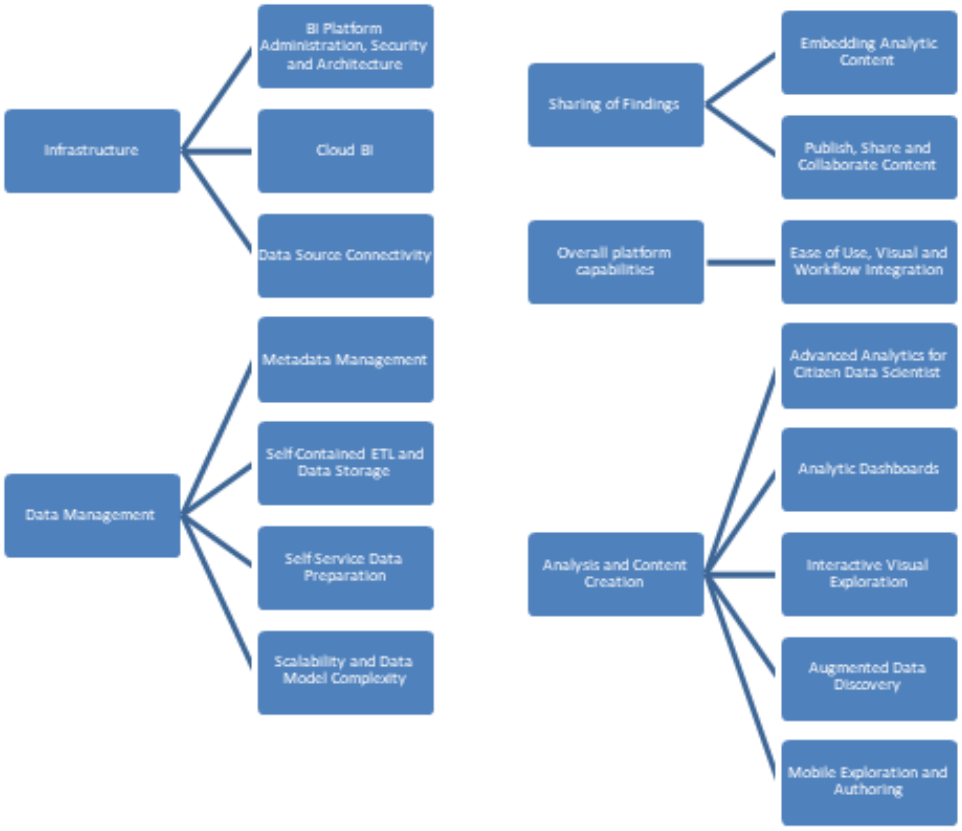


Fig. 2. The five use cases and fifteen capabilities criteria considered by the Gartner Magic Quadrant for Analytics and Business Intelligence Platforms [12].

The Gartner Magic Quadrant for Analytics and Business Intelligence Platforms is presented in Figure 3 ("Ability to Execute" criteria in measured by the y-axis while the "Completeness of Vision" is represented by the x-axis). A low capacity of ability of execution combined with low completeness of vision (or limited vision of data) is the first quadrant, named "NICHE PLAYERS". This classification does not mean that the solutions are of low quality or present poor results. On the contrary, the name niche players make it clear that those solutions are focused on specific applications or technologies, such as the Oracle solution, which is based specifically on the integration of Oracle architecture. The second quadrant denotes low capacity of execution ability combined with a more expanded completeness of vision ("VISIONARIES"). This section brings software technology giants such as SAP, IBM, SAS, Salesforce and Sisense. Those tools can be considered advanced tools with the ability to increase specific aspects of visual data manipulation and user-friendly report customization. "CHALLENGERS" are displayed in the third quadrant (advance ability to execute procedures but with a restricted completeness of vision). In the fourth quadrant, three market leaders should be highlighted: Microsoft, Tableau and Qlik. Certainly, Microsoft is the most complete solution in the present market for data analytics. This happens because of the full solution provided by Microsoft not only enriched by Power BI Desktop but also because the company provides a whole ecosystem of integrated applications, ranging from Excel to SQL Server and Share Point solutions.

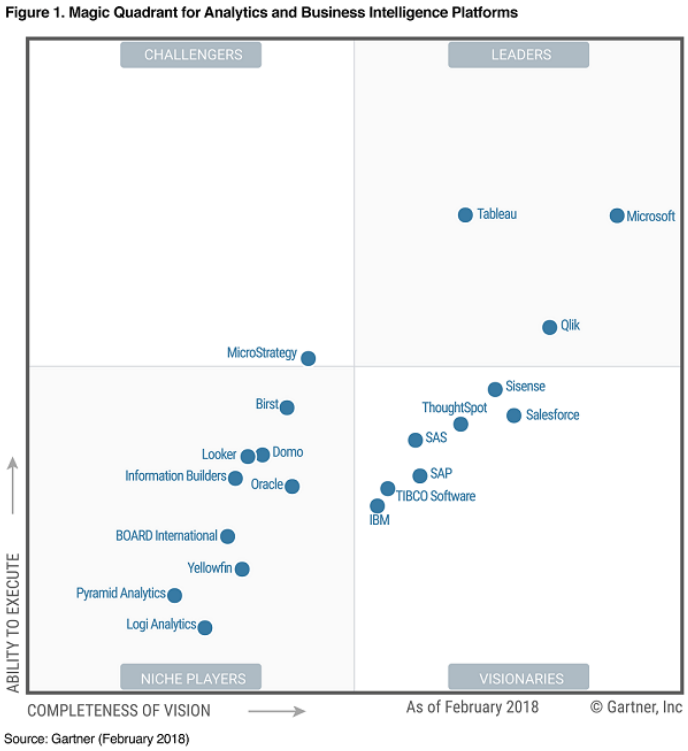


Fig. 3. The Gartner Magic Quadrant for Analytics and Business Intelligence Platforms [12].

3.1. Microsoft Power BI (Desktop)

MS-Power BI cannot be considered one single software but a collection of software services, apps and connectors that work together to turn unrelated sources of data (spreadsheets, relational databases, collections of cloud-based and on-premises hybrid data warehouses) into coherent, visually immersive and interactive insights. One vital characteristic of Power BI is the fast performance, user friendly, intuitive interface and the efficient integration with other popular Microsoft tools such as Excel and SQL Server, making it a feasible tool to be considered for adoption in small and medium enterprises.

Designed to run exclusively for Windows platforms, another alternative is the online solution or SaaS (Software as a Service) that can be fully integrated with Office 365. This version is called MS-Power BI Service. These possibilities allow users to play different roles in different architectures and execute what their roles really demand from an analytical tool such as generating managerial reports, looking for insights or analyzing data correlations.

Another strong positive aspect from MS-Power BI platform is Microsoft provides an integrated API (Application Programmable Interface) for software developers and for companies with their own software development teams that allow them to integrate MS-Power BI to their current information systems and also to create and expand the capabilities to customized needs.

For reference, there is a specific server module called MS-Power BI Report Server that works inside the corporate network or intranet to prepare and deliver reports to users integrated with the Active Directory, Outlook and SharePoint solutions.

4. Case Studies

In this section, three practical case studies are highlighted using the MS-Power BI Desktop as a data analytic and visualization tool. The first one is based on a procurement database, the second is based on IT expenditure analysis and the third example is focused on HR and employment contracts.

4.1. Case I: Procurement Analysis

Procurement is the process of finding, agreeing terms and acquiring goods, services or works from an external source, often via a tendering or competitive bidding process. For [1], this process is used to ensure the buyer receives goods, services or works at the best possible price, when aspects such as quality, quantity, time and location are compared. As expected, corporations and public bodies often define processes intended to promote fairness and open competition for their business while minimizing risk, such as exposure to fraud and collusion. This includes purchasing decisions covering delivery and handling, marginal benefit and price fluctuations. Henceforth, any procurement process, if good data is available, should make use of BI approaches.

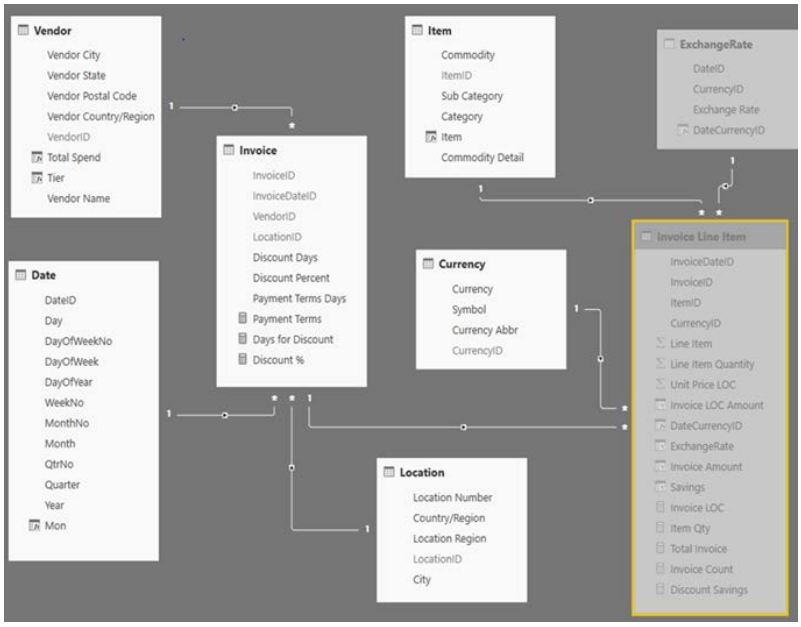
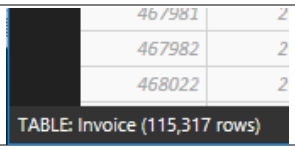
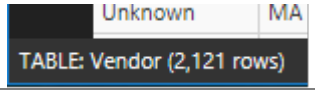
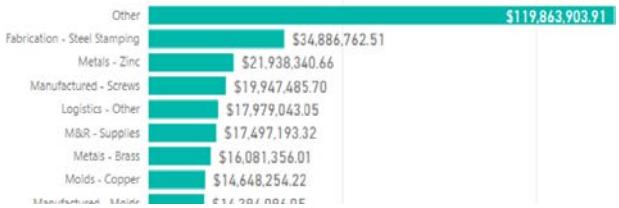
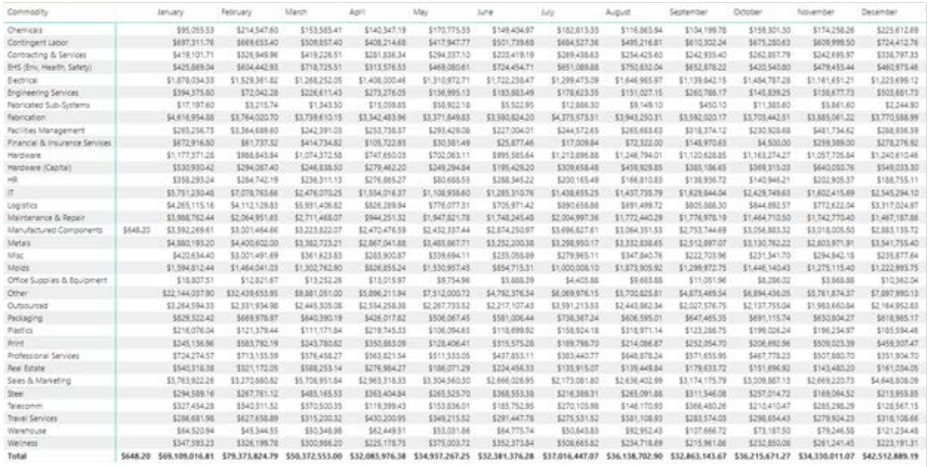


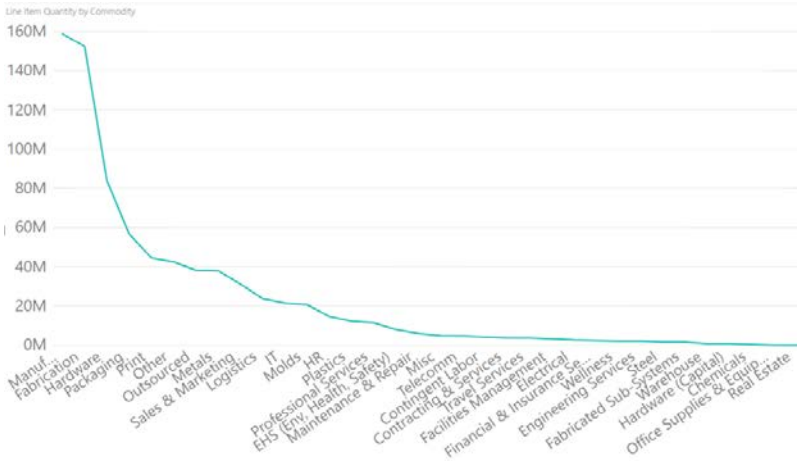
Fig. 4. Relationships model of a fictitious company (procurement relational database from obvience.com).

Table 2. Different questions imply dissimilar graphs.

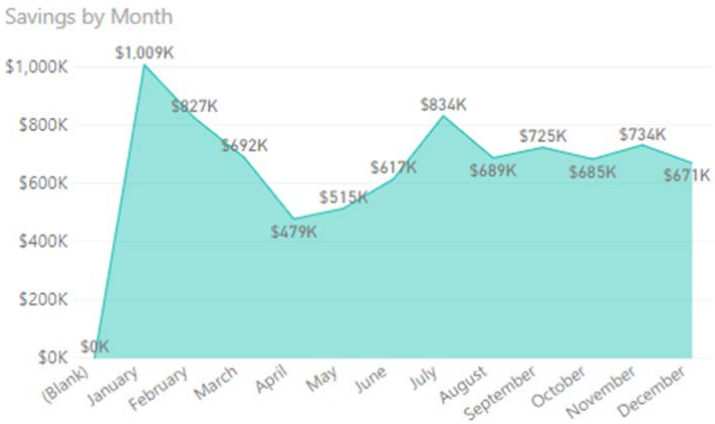
How many transactions of buying (procurement) did this company do?	
How many suppliers does this company hold?	
Which countries does this company encloses?	
What were the two types of product (Commodity Detail) that this company bought most (use the Stacked Bar Chart)? How much was its total buying?	
Layout a pivot table (Matrix chart) that shows the total expenses charged (invoices) per month for each commodity (item).	

Commodity	January	February	March	April	May	June	July	August	September	October	November	December
Chemicals	$95,055.53	$214,547.60	$153,585.41	$140,347.19	$170,775.33	$149,404.97	$182,813.33	$116,863.94	$104,199.78	$158,301.30	$174,258.26	$225,612.69
Contingent Labor	$697,311.76	$669,653.40	$509,857.40	$408,214.68	$417,947.77	$501,739.68	$684,527.38	$495,216.81	$610,302.24	$675,280.63	$609,999.50	$724,412.76
Contracting & Services	$419,101.71	$326,949.96	$419,226.51	$281,836.34	$294,357.10	$203,419.19	$269,436.63	$254,425.60	$242,935.40	$262,857.79	$242,695.97	$338,797.33
EHS (Env, Health, Safety)	$425,869.04	$604,442.93	$718,725.51	$313,576.53	$469,060.61	$724,454.71	$651,088.88	$750,832.04	$652,876.22	$435,540.80	$479,433.44	$460,973.48
Electrical	$1,870,034.33	$1,529,361.82	$1,266,252.05	$1,408,200.46	$1,310,972.71	$1,722,236.47	$1,299,473.39	$1,646,965.97	$1,139,842.15	$1,454,787.28	$1,161,651.21	$1,223,698.12
Engineering Services	$394,375.80	$72,042.28	$226,611.43	$273,276.05	$136,995.13	$183,883.49	$178,623.35	$151,027.15	$260,788.17	$145,839.25	$158,677.73	$503,681.73
Fabricated Sub-Systems	$17,197.60	$3,215.74	$1,343.50	$15,099.85	$50,922.18	$5,522.95	$12,886.30	$9,149.10	$450.10	$11,385.60	$5,841.60	$2,244.90
Fabrication	$4,616,954.86	$3,764,020.70	$3,739,610.15	$3,342,483.96	$3,371,849.63	$3,930,824.20	$4,379,573.51	$3,943,290.31	$3,592,020.17	$3,703,442.51	$3,885,061.22	$3,770,588.99
Facilities Management	$283,256.73	$3,364,689.60	$242,391.03	$253,736.37	$293,429.06	$227,004.01	$244,572.63	$265,663.63	$318,374.12	$230,928.68	$481,734.62	$298,936.59
Financial & Insurance Services	$672,916.80	$61,737.32	$414,734.82	$105,722.83	$30,381.49	$25,877.46	$17,009.84	$72,322.00	$148,970.63	$4,500.00	$298,389.20	$278,276.92
Hardware	$1,177,371.28	$988,843.84	$1,074,372.58	$747,650.03	$702,063.11	$995,585.64	$1,213,896.88	$1,248,794.01	$1,120,620.85	$1,163,274.27	$1,057,705.84	$1,240,610.48
Hardware (Capital)	$530,930.42	$294,067.40	$246,838.50	$279,462.20	$249,294.84	$195,429.20	$309,658.48	$459,929.85	$385,186.65	$369,319.03	$640,050.76	$549,033.30
HR	$358,293.24	$284,742.19	$236,311.13	$276,865.27	$80,688.55	$268,345.22	$200,165.49	$166,810.83	$138,936.72	$140,946.21	$202,905.37	$168,755.11
IT	$5,751,230.48	$7,078,765.66	$2,476,070.25	$1,554,016.37	$1,108,938.60	$1,285,310.76	$1,438,655.25	$1,437,735.79	$1,629,844.04	$2,429,749.63	$1,602,415.69	$2,545,294.10
Logistics	$4,265,115.16	$4,112,129.83	$5,931,406.82	$826,289.84	$776,077.31	$705,971.42	$890,656.88	$691,499.72	$805,886.30	$644,892.57	$772,622.04	$3,317,024.97
Maintenance & Repair	$3,988,762.44	$2,064,951.83	$2,711,468.07	$944,251.32	$1,947,821.78	$1,748,245.48	$2,004,997.36	$1,772,440.29	$1,776,976.19	$1,464,710.50	$1,742,770.40	$1,467,187.88
Manufactured Components	$648.20	$3,992,269.61	$3,001,464.66	$3,223,822.07	$2,470,476.59	$2,432,337.44	$2,874,250.97	$3,696,827.61	$3,064,351.53	$2,753,744.69	$3,054,883.32	$3,018,006.50	$2,883,135.72
Metals	$4,880,193.20	$4,400,602.00	$3,382,723.21	$2,667,041.88	$3,483,067.71	$3,252,200.38	$3,298,950.17	$3,332,838.65	$2,512,897.07	$3,130,762.22	$2,803,971.91	$3,341,755.40
Misc	$420,634.40	$3,201,491.69	$361,623.83	$283,905.87	$339,694.11	$235,098.69	$279,965.11	$347,840.76	$222,703.96	$231,341.70	$294,842.18	$235,877.64
Molds	$1,594,812.44	$1,464,041.03	$1,302,762.90	$826,855.24	$1,330,957.43	$854,715.31	$1,000,008.10	$1,073,905.92	$1,299,972.75	$1,446,140.43	$1,275,115.40	$1,222,993.75
Office Supplies & Equipment	$18,807.51	$12,821.67	$13,252.26	$13,015.97	$9,754.96	$5,688.39	$4,403.88	$9,683.88	$11,061.96	$8,256.02	$3,868.88	$12,362.04
Other	$22,144,037.90	$32,439,653.95	$9,881,051.00	$5,896,211.94	$7,512,000.72	$4,792,376.34	$6,069,976.15	$5,700,825.81	$4,873,469.54	$6,894,436.05	$5,761,874.37	$7,897,990.13
Outsourced	$3,264,594.33	$2,331,934.98	$2,446,305.08	$2,594,258.38	$2,267,733.52	$2,217,107.43	$3,591,213.53	$2,443,862.34	$2,027,576.75	$2,137,755.04	$1,983,660.84	$2,164,952.63
Packaging	$829,322.42	$669,976.97	$640,390.19	$426,017.62	$506,067.45	$581,006.44	$738,367.24	$606,595.01	$647,485.55	$691,115.74	$632,804.27	$818,985.17
Plastics	$216,076.04	$121,379.44	$111,171.84	$219,745.33	$106,094.65	$113,699.92	$158,924.18	$318,971.14	$123,286.75	$199,026.24	$196,234.97	$185,594.46
Print	$245,136.96	$583,782.19	$243,780.62	$350,883.09	$128,406.41	$315,575.28	$189,798.70	$214,066.87	$252,054.70	$206,892.96	$509,023.39	$458,307.47
Professional Services	$724,274.57	$713,155.59	$578,458.27	$563,821.54	$511,535.05	$437,853.11	$383,440.77	$648,878.24	$571,655.95	$467,778.23	$507,860.70	$351,904.70
Real Estate	$540,916.38	$321,172.05	$588,253.14	$276,984.27	$186,071.29	$224,456.33	$135,915.07	$139,449.84	$178,633.72	$151,696.92	$143,480.20	$161,034.05
Sales & Marketing	$3,763,922.26	$3,272,880.82	$5,708,951.84	$2,963,316.33	$3,304,560.30	$2,666,026.95	$2,173,081.80	$2,636,402.69	$3,174,175.79	$3,508,887.13	$2,669,220.73	$4,648,308.09
Steel	$294,589.16	$267,761.12	$485,165.53	$363,404.84	$265,525.70	$368,553.38	$216,389.31	$265,091.88	$311,546.08	$257,014.72	$169,064.52	$213,953.85
Telecomm	$327,454.28	$340,311.52	$570,300.35	$119,389.43	$153,836.01	$185,752.95	$270,103.98	$146,170.93	$366,480.26	$210,410.47	$285,296.29	$126,567.15
Travel Services	$286,681.98	$627,658.89	$315,200.32	$430,200.95	$349,215.52	$291,447.78	$275,531.52	$591,108.93	$283,574.03	$298,654.43	$279,924.23	$318,108.66
Warehouse	$64,520.94	$45,344.55	$50,348.98	$62,449.51	$53,031.66	$64,775.74	$50,843.83	$92,952.43	$107,666.72	$73,187.50	$79,246.58	$121,234.48
Wellness	$347,593.23	$326,199.78	$300,966.20	$225,178.75	$375,003.72	$352,373.84	$508,665.82	$234,718.69	$215,961.66	$232,850.08	$261,241.45	$223,191.31
Total	**$648.20**	**$69,109,016.81**	**$79,373,824.79**	**$50,372,553.00**	**$52,083,976.38**	**$54,937,267.25**	**$52,381,376.28**	**$37,016,447.07**	**$36,138,702.90**	**$32,863,143.67**	**$36,215,671.27**	**$34,330,011.07**	**$42,512,889.19**

Plot a Line Chart that shows the relation between commodities of the products that this company buys and their quantities.



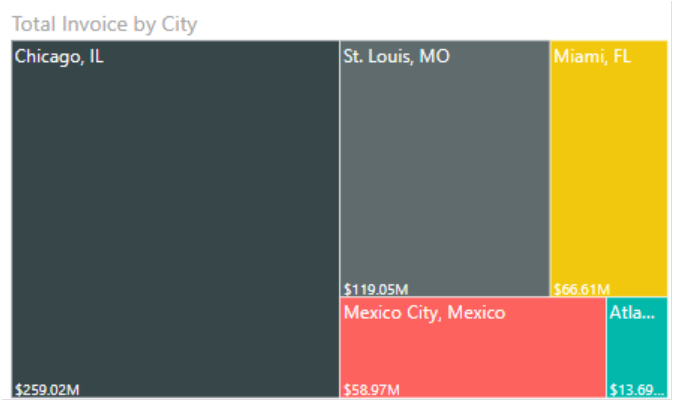
Using the Area Chart, show the discount savings by month.



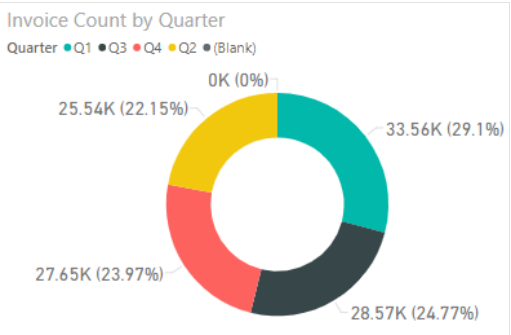
Show the discount savings on a global geographical perspective (Maps).

Country/Region	Discount Savings
USA	$4,648,482
Mexico	$3,828,934

Using the Treemap visualization mode, show the total buying per city.



Using the Donut Chart, layout the percentage of invoices per quarter.



4.2. Case II: Information Technology Expenditures Analysis

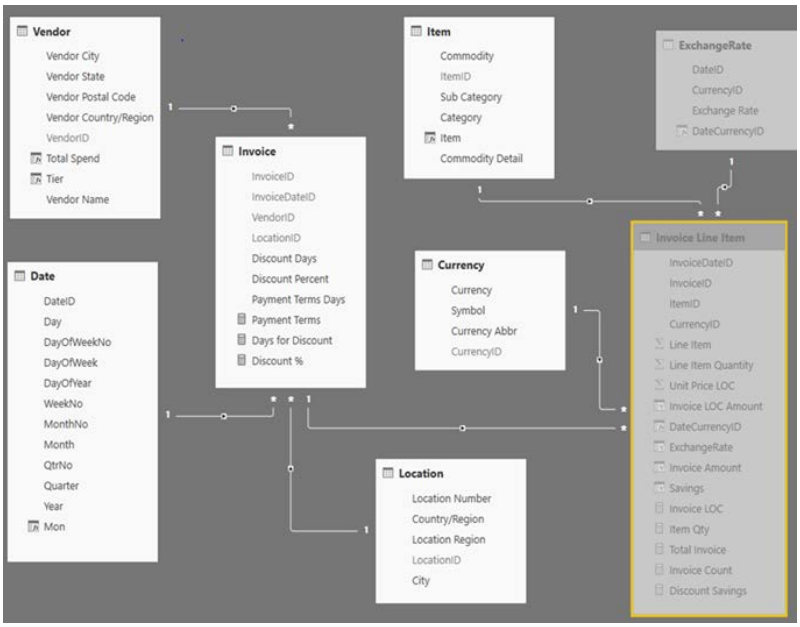
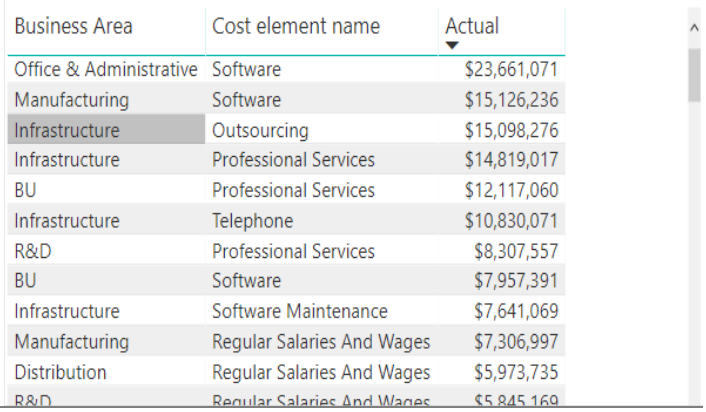
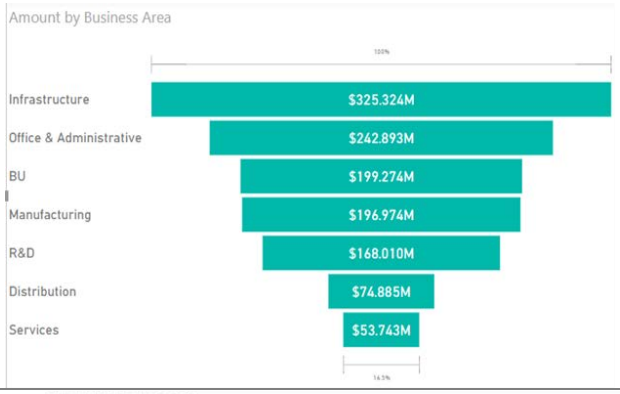
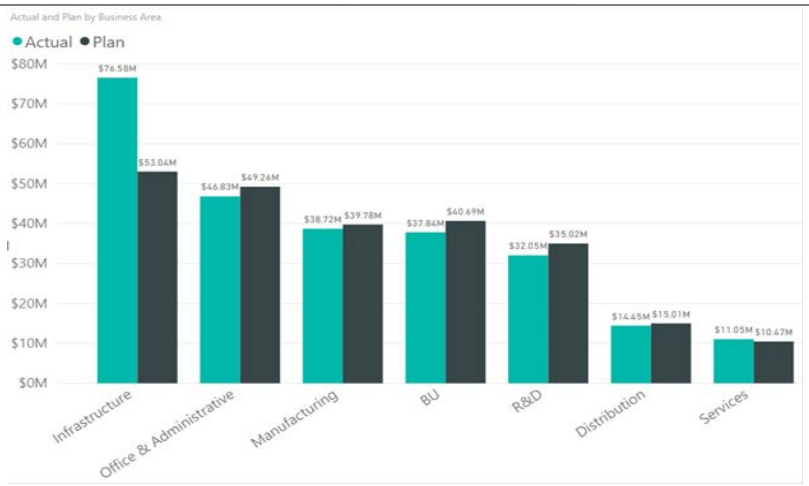


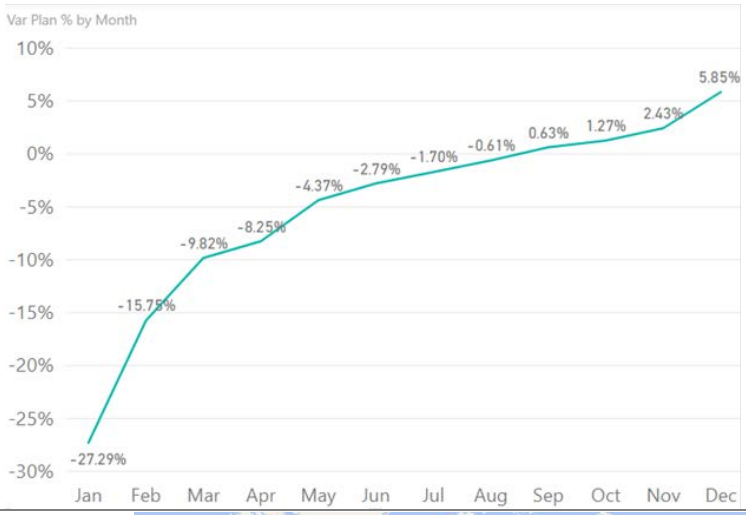
Fig. 5. Relationships model of a fictitious company (IT spending star database from obvience.com).

Table 3: Again, diverse queries denote different layouts.

Using a standard table, presents the highest six expenditures of this IT company per business area and type of commodity, as well.	
Present the total costs per business area using a Funnel chart.	
Layout a Cluster Column Chart to show the Plan VS Actual difference of the expenditures per business area.	

Business Area	Cost element name	Actual
Office & Administrative	Software	$23,661,071
Manufacturing	Software	$15,126,236
Infrastructure	Outsourcing	$15,098,276
Infrastructure	Professional Services	$14,819,017
BU	Professional Services	$12,117,060
Infrastructure	Telephone	$10,830,071
R&D	Professional Services	$8,307,557
BU	Software	$7,957,391
Infrastructure	Software Maintenance	$7,641,069
Manufacturing	Regular Salaries And Wages	$7,306,997
Distribution	Regular Salaries And Wages	$5,973,735
R&D	Regular Salaries And Wages	$5,845,169

Create a Line Chart that displays the evolution of the planning variation percentage of the costs in a monthly basis.

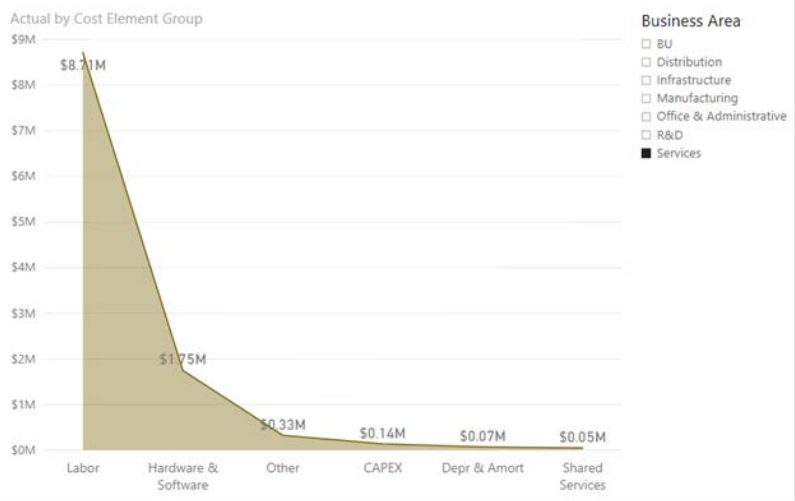


Layout a map that shows the total costs of IT per each country.

Plot a Matrix Chart that shows the relation among IT with business areas and expenditures.

IT Area	BU	Distribution	Infrastructure	Manufacturing	Office & Administrative	R&D	Services	Total
BU Support	$19,339,577		$22,723	$196,973,748		$168,010,292		$384,346,340
Enablement			$9,563,363				$53,742,675	$63,306,038
Functional	$179,933,974				$242,922,694			$422,856,668
Governance		$74,884,588	$6,208		($29,689)			$74,861,108
Infrastructure			$315,732,060					$315,732,060
Total	**$199,273,551**	**$74,884,588**	**$325,324,354**	**$196,973,748**	**$242,893,006**	**$168,010,292**	**$53,742,675**	**$1,261,102,214**

Using the Slicer and Area Charts, illustrate the actual costs per commodity according to each business area.



4.3. Case III: Employment Contract Analysis

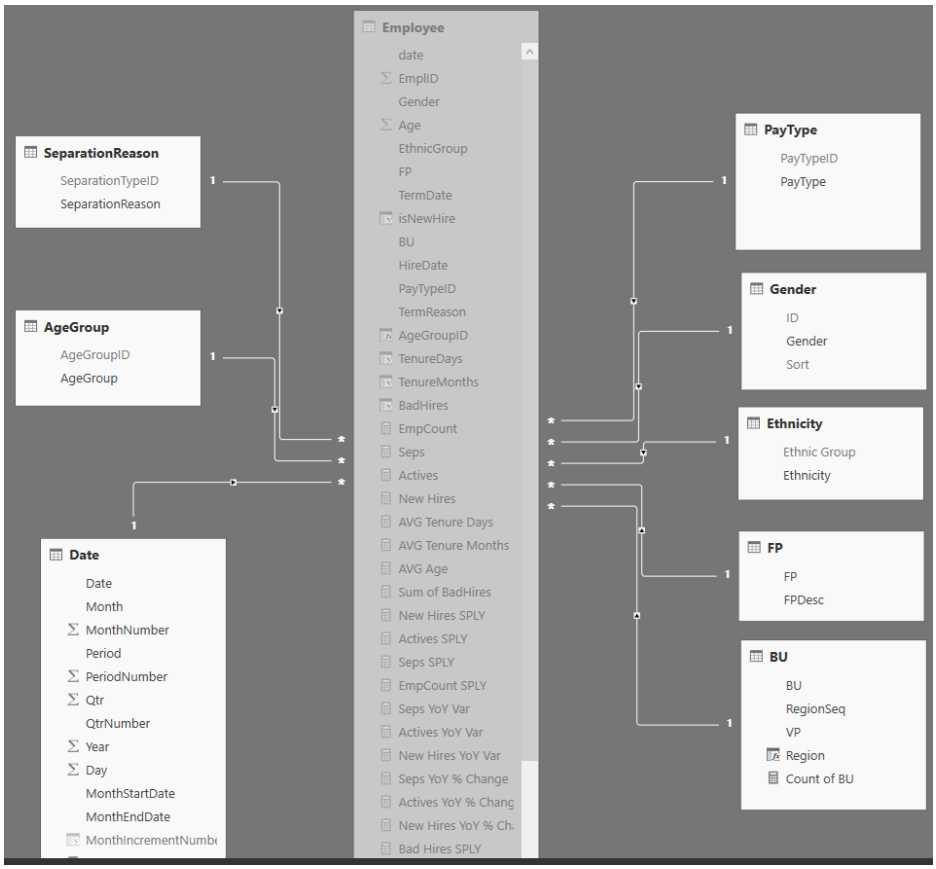
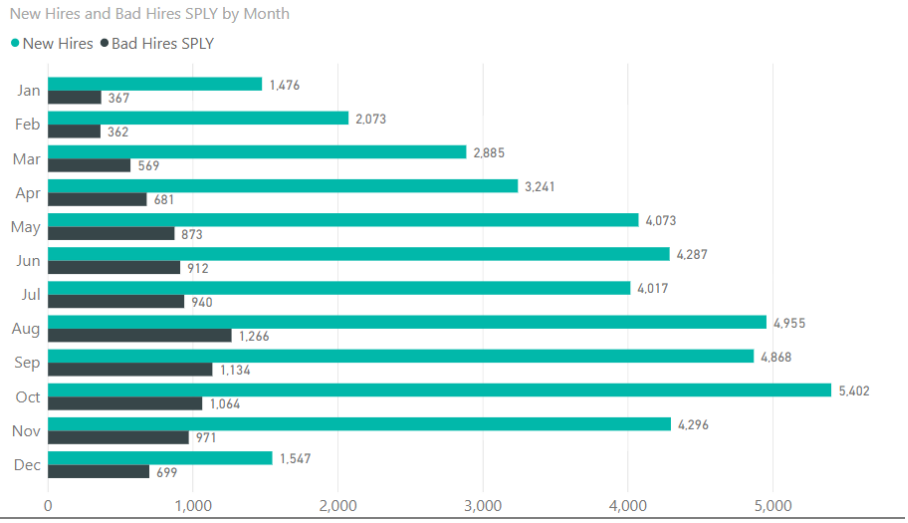
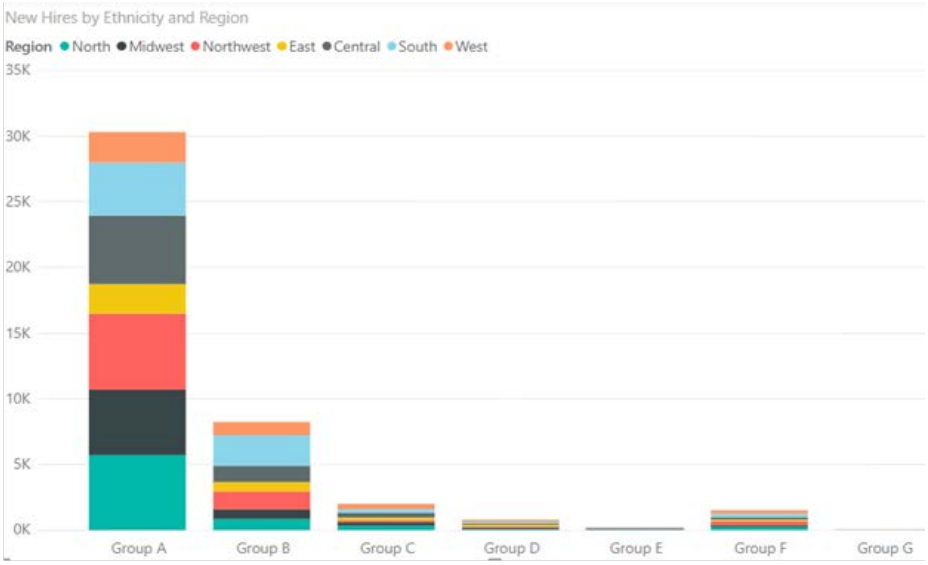
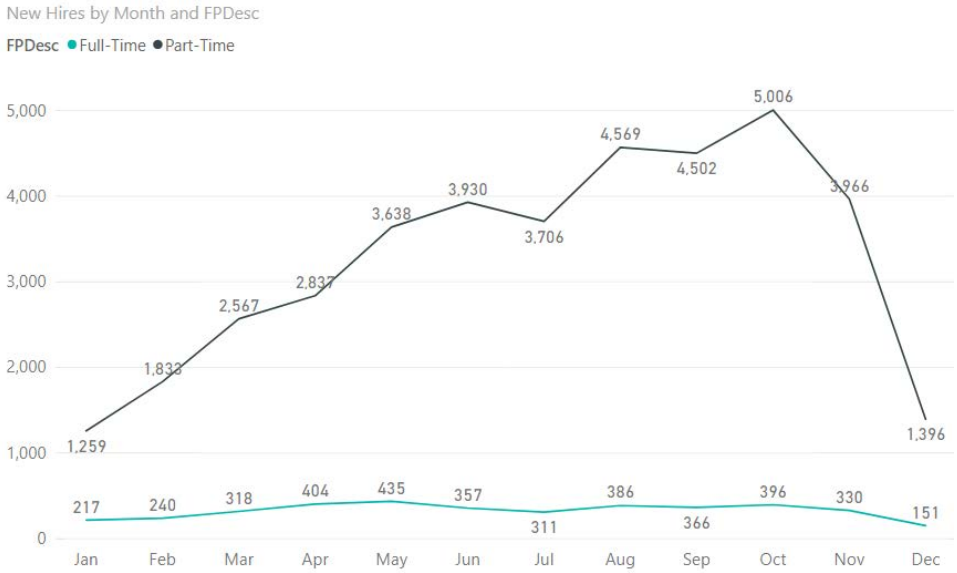


Fig. 6. Relationships model of a fictitious company (IT expenditure database from obvience.com).

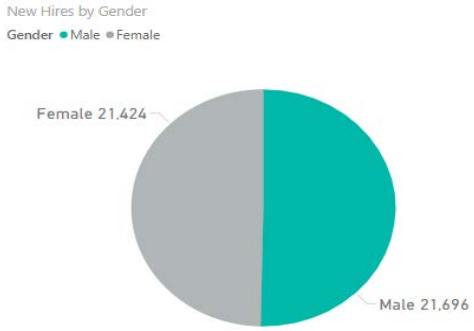
Table 4: Once more, assorted requests conveys distinctive charts and tables

Using a Clustered Bar Chart, present the new hiring staff but including a comparison with the bad hires of the same period of last year.	
Layout a Clustered Bar Chart with the new hires by ethnicity and regions.	

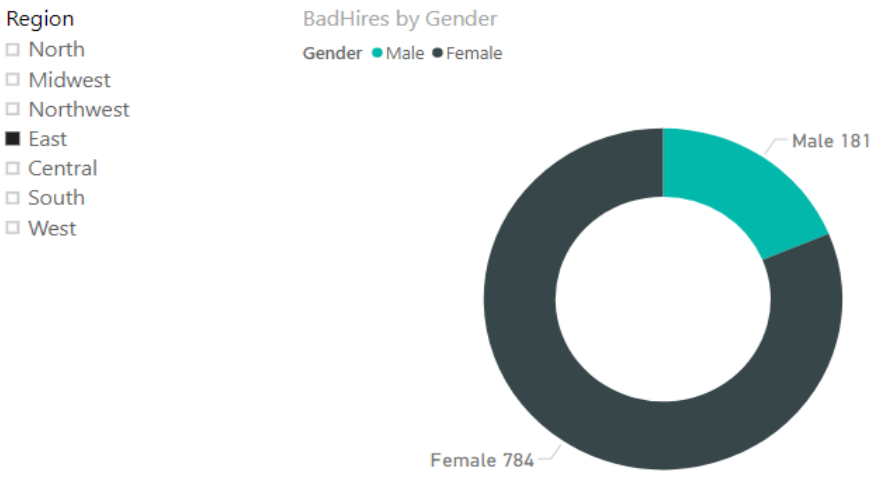
Plot a Line Chart with the new full and part-time hires per month.



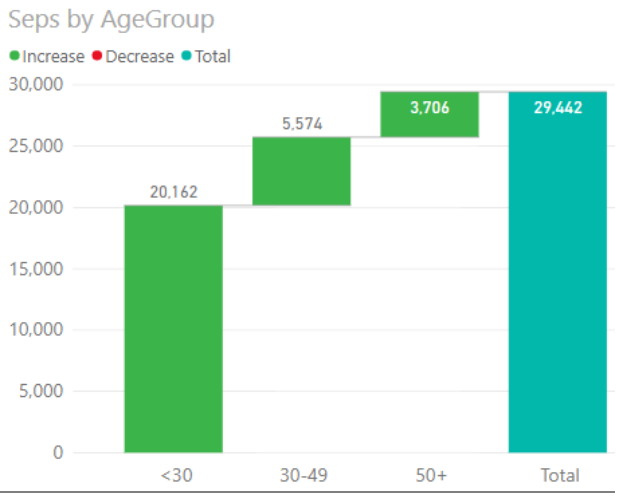
Create a Pie Chart that displays the hiring per gender.



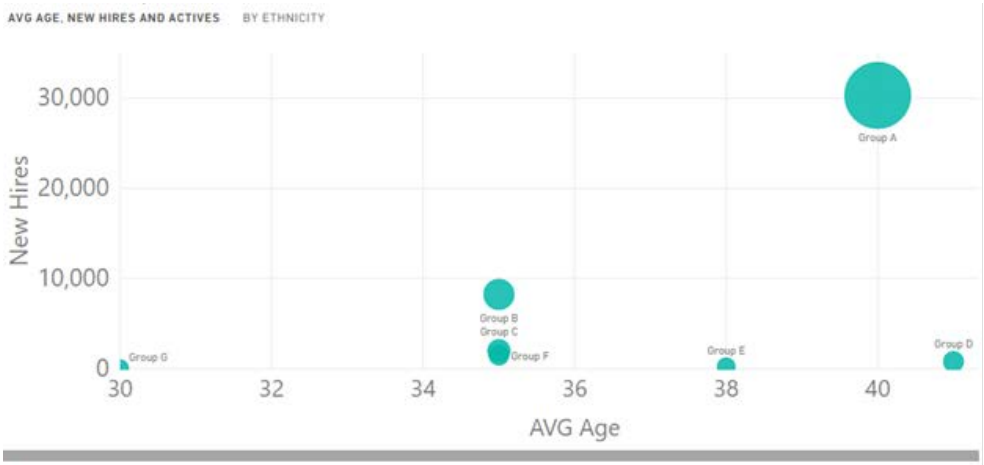
Using the Slicer and Donut Charts, illustrate the bad hires per gender and according to each region.



Plot a Waterfall Chart that shows the relationship between group's age and employees that left their job.



Using the Scatter mode, illustrate the new hires versus active ones per ethnicity and their respective average age.



Ethnicity	AVG Age	New Hires	Actives
Group A	40.00	30,313	25,559
Group B	35.00	8,236	3,935
Group C	35.00	1,999	1,235
Group D	41.00	790	777
Group E	38.00	213	127
Group F	35.00	1,516	741
Group G	30.00	53	27

Using the Matrix Chart, show the number of dismissed employees that per ethnicity.

SeparationReason	Group A	Group B	Group C	Group D	Group E	Group F	Group G	Total
Involuntary	4,548	2,078	335	110	39	276	8	7,394
Voluntary	16,169	3,720	996	353	122	656	32	22,048
Total	**20,717**	**5,798**	**1,331**	**463**	**161**	**932**	**40**	**29,442**

5. Discussion

In today's complex and turbulent environment, knowledge management has become increasingly crucial in decision-making. For example, knowledge plays a major role in the planning phase of any project. Moreover, forecasters guide decision makers in generating complex decisions and characterized by an increased risk and uncertainty factor. Although knowledge in organizations is supported by information technology, technology itself is not sufficient. Of great importance are the people with knowledge. People are the main determinant of the success or failure of knowledge management. As suggested by [13], acquiring knowledge is not the real problem that organizations face, rather the main challenge is the lack of skills to manage such knowledge in order to ensure effective decisions.

If facts constitute our data, the organization of those facts in a database leads us to information. Asking questions belongs to human in order to get answers that will influence managers on the decision-making process and respectively actions to achieve future goals and aims. This is where BI, in general, and MS-Power BI Desktop, in particular, may help to get those answers. Certainly and based on the outputs given by Table 2, 3 and 4, it is possible to understand the settings of each company and draw conclusions about the current status of each business.

Case I relates to procurement and supply chain management of a major automotive industry, one of the biggest industries worldwide. According to KPMG's Global Automotive Executive Survey 2015, the global auto industry had already reached sales of over 90 million units for just light vehicles. Furthermore, this number is expected to rise steadily with sales in 2020 estimated to reach a staggering 111 million.

As well, the automotive industry relies heavily on supply chains and procurement. Thousands of parts and components go into making a car, motorcycle, truck or tractor and no auto manufacturer has the capabilities to produce it all in-house. From small components like rubber bushings and spark plugs to complicated devices like touch screen infotainment systems and anti-lock braking systems, a huge variety of these components are sourced from third-party manufacturers. Meanwhile, automakers learnt several lessons that can improve supply chain and procurement [14]: (A) Change focus from price to quality: Manufacturers have already realized that price cannot be the only consideration when looking for suppliers. Opting for the cheaper option can have undesirable results, to say the least. (B) Establish relationships with suppliers: Many times, auto manufacturers deal with multiple suppliers for the same or similar products. This leads to inconsistencies and issues, something that can be eliminated through cooperation with suppliers and focusing on single-supplier structures for all the components. (C) Use technology: Using supplier management software can streamline the whole procurement process. These benefits include greater supplier intelligence, improved supplier information and performance management and even has a relationship management component. (D) Learn from recalls: Examining the reasons behind a recall, either internal or that of a rival's, can lead to clarity on potential issues. Based on these information, steps can be taken to avoid suppliers who manufactured these parts and improve overall product quality.

According to Table 2, this automaker purchased 115,317 units of materials from their 2,121 suppliers last year, both in USA and Mexico. It seems the bulk of their expenses are products classified as others, steel stamping, zinc and screws, among others. In fact, manufacturing, fabrication, hardware, packing and print hold the major costs of purchasing of this international manufacture. As well, the highest supplies purchases were undertaken in the first trimester of the year. As expected, the same pattern may be found with the discounts savings, particularly in the USA (55% of the total). This means that the financial budget must be approved before Christmas, especially if bank credits are involved. Moreover, the due payment to suppliers should be extended as further as possible while the selling products to customers must be cashed as early as possible to avoid banks fees and loans. Meanwhile, the suppliers are located in five different cities: Chicago, St. Louis, Mexico City, Atlanta and Miami. Due to their spatial dispersion, the possibility use of a Geographic Information System for route and deliveries trucks tracking and a warehouse Logistic Information System may play a key role in this enterprise for saving costs, too.

Case II concerns the expenditures on technologies in a single year by an IT consulting firm like Eleks, ITGix, Crystalloids and Mobiversal. Quite often, common industries such as banks and insurances prefer to invest in IT outsourcing regarding their business processes, application services and infrastructures solutions in an effective way. These companies try to achieve significant benefits that help them operate more efficiently and effectively without having to invest in a full-fledged IT department. According to [15], five reasons can be found on why IT outsourcing works for businesses: (A) Reduced spending with IT outsourcing: Both capital and operating expenses can be reduced because of no need to purchase computer hardware and dedicate expensive square footage to develop a data center. Moreover, firms do not have the expenses of hiring employees to perform IT functions, software development and hardware installations. Along with reduced payroll come reduced expenses for training and benefits. (B) Increased focus on core business: For most companies, IT is a support function, not a core competency. Henceforth, outsourcing IT functions lets management to focus on their core competencies and business development, rather than struggling with technology issues. (C) Access to experts and the latest technology: Because IT is the vendor's core competency, they make sure their employees are trained and certified in the technologies they support and will make sure systems are patched and upgraded accordingly. (D) Reduced risk and increased flexibility: Technology is expensive and making wrong decisions is costly. An IT services provider has a solid base of experience that assists with the making of the right technical decisions and helps the company transition to every new platform. (E) Increased employee morale: Offloading IT work lets employees focus on the jobs they were hired to do. Because employees no longer have to perform tasks they are not an expert at and are more productive at their core tasks, they become more satisfied with their work and less likely to burn out and leave.

Consistent with Table 3, the bulk of expenditures regard software, outsourcing and professional services. Curiously, the actual costs were always below the planned one with the exception of the infrastructures (76.58

versus 53.04 million, that is, an increase of 44%), making this department with the highest cost of all. Why this outlier? Similar to case I, the major planning variation of costs is on the first trimester of the year and, probably, the same course of action can be stressed here, as well. However, this international company is headquartered in thirty-one countries (instead of two). Analogous to other IT consultancy companies, it is ruled by a matrix organizational system (six Business areas such as Services, R&D, Distribution and Manufacturing versus seven IT areas like Enablement, Infrastructure, Governance and Functional) instead of the traditional hierarchical one. This happens because the majority of this IT services work on projects with a limited time life in an outsourcing framework. At last, labor costs always represent the major expenses of each Business area.

Case III regards a Human Resources firm such as Mercer, Hay, Deloitte, Accenture and Price Waterhouse Coopers. Mostly, these businesses provide recruitment outsourcing, onsite management and on-demand talent delivery services. Their aim is to deliver employers with human capital solutions that result in measurably improved employee and organizational performance while minimizing employment practice risk. This means to assist the client to identify needs, develop an action plan and facilitate change to enhance the success of each organization based on, quite often, on training services to improve productivity, efficiency and communication and employee morale.

Along with the first chart of Table 4 and considering an extrapolation of last year's figures, it is expected that between 20% and 25% of the new hiring of personnel can be classified as bad hiring. Ethnicity A (Caucasians) concentrates over 60% of the total hiring industry where the West and the East of USA regions show a lower appetence for HR consultancy services when compared with the other five areas (North, Midwest, Northwest, Central and South). Part-time positions clearly excel full-time ones. December, January and February are the months with the least number of hire contracts while August, September and October reach its peak. For the gender, no predominance of males or females can be stated. Yet, this conclusion is not valid if the region factor is considered for the bad hires. For instance, the East region presents a four times ratio between females and males on this matter. Forty years old, average persons are the most significant hire age group, particularly for Caucasians. Blacks, Latinos and Asians follow next. Peculiarly, resignation jobs on a voluntary mode hold 80% ratio when faced involuntary separation reasons. This leads to the conclusion that job offers do not match employee's expectations, particularly for youngsters below 30 years old. It is up to the managers to understand and justify this and other patterns of behavior.

6. Last Contemplation

The proposed paper analysis concerns the adoption of MS-Power BI as a tool to perform data analytics and to understand its possible applications based on three practical case studies (procurement, IT expenditure and HR analytics) in a user-friendly and intuitive interface context, allowing a successful extraction of information from the present databases and using distinctive tools for data visualization.

As previously discussed, BI and BA tools are one of the key areas of investment in medium and large companies while a two-digit increase rates trend is expected to continue for the following years. A spillover effect of this writing encloses the coach of undergraduate and master students in Business Administration degrees to provide a practical approach for their qualification as business professionals with MS- Power BI Desktop who must be able to handle those analyses in a self-service basis.

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