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An Essay on How Data Science Can Strengthen Business

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ABSTRACT

Data science combines several extensions, including, e.g., statistics, scientific methods, artificial intelligence (AI) and data analysis to extract value from raw data. Analytical applications and data scientists can then verify and defer the results to discover patterns and trends. In this way, they allow business leaders to gain enlightened knowledge about the market. Companies have kept a wealth of data with them. As modern technology allowed for the creation and storage of ever-increasing amounts of information, data volumes popped. The wealth of data collected and stored by these technologies can bring regenerative benefits to organizations and societies around the world, but only if they can interpret it. That's where data science comes in. So, the applied economics refers to the application of economic theory and analysis. In this article we intend to present several software that are available for the application of economic analysis. Analysis can be performed on any type of data and is a way of looking at raw data and find useful information. There are several technologies available for economic analysis, with more or less characteristics, some of which are not only intended for this single purpose, and cover a wider spectrum of functionalities. Some of the technologies we will use are, e.g., Rstudio, SPSS, Statis and SAS/Stata. These are very common technologies when talking about economic or business analysis. The intention is to demonstrate how each of these software analyse the data and subsequently the interpretations that we can draw from that scrutiny. Organizations are using data science teams to turn data into a competitive advantage by refining products and services and cost-effective solutions. We will use some different algorithms to verify how they are processed by the different technologies, namely we will use metrics such as maximum, minimum, covariance, standard deviation, average and multicollinearity and variance, even the use of types of regression models.

Keywords: Data science; Applied data; Technology; Organizations.

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Un Ensayo sobre Cómo la Ciencia de Datos Puede Fortalecer la Empresa

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RESUMEN

La ciencia de datos combina varias extensiones, como la estadística, los métodos científicos, la inteligencia artificial (IA) y el análisis de datos para extraer valor de los datos en bruto. A continuación, las aplicaciones analíticas y los científicos de datos pueden verificar y diferir los resultados para descubrir patrones y tendencias. De este modo, permiten a los directivos de las empresas adquirir conocimientos esclarecedores sobre el mercado. Las empresas han conservado una gran cantidad de datos. A medida que la tecnología moderna permitía crear y almacenar cantidades cada vez mayores de información, los volúmenes de datos se disparaban. La riqueza de los datos recopilados y almacenados por estas tecnologías puede aportar beneficios regeneradores a organizaciones y sociedades de todo el mundo, pero sólo si saben interpretarlos. Ahí es donde entra en juego la ciencia de los datos. Así, la economía aplicada se refiere a la aplicación de la teoría y el análisis económicos. En este artículo pretendemos presentar varios programas informáticos que están disponibles para la aplicación del análisis económico. El análisis se puede realizar en cualquier tipo de datos y es una forma de ver los datos en bruto y encontrar información útil. Existen varias tecnologías disponibles para el análisis económico, con más o menos características, algunas de las cuales no sólo están destinadas a este único fin, y cubren un espectro más amplio de funcionalidades. Algunas de las tecnologías que utilizaremos son, por ejemplo, Rstudio, SPSS, Statis y SAS/Stata. Se trata de tecnologías muy comunes cuando se habla de análisis económico o empresarial. La intención es demostrar cómo cada uno de estos programas analiza los datos y, posteriormente, las interpretaciones que podemos extraer de ese escrutinio. Las organizaciones están utilizando equipos de ciencia de datos para convertir los datos en una ventaja competitiva mediante el perfeccionamiento de productos y servicios y soluciones rentables. Utilizaremos algunos algoritmos diferentes para comprobar cómo son procesados por las diferentes tecnologías, concretamente utilizaremos métricas como máximo, mínimo, covarianza, desviación estándar, media y multicolinealidad y varianza, incluso el uso de tipos de modelos de regresión.

Palabras clave: Ciencia de datos; Datos aplicados; Tecnología; Organizaciones.

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1. Introduction and context of Data Science for companies

As a specialty, Data Science is young. It grew out of the fields of statistical analysis and mining or mining. The Data Science Journal (DSJ), founded in 2002, maintains in its focus and design that in recent decades there has been an unprecedented explosion in the human capacity to acquire, store and manipulate data and information. We are experiencing a historic revolution in the creation, communication and use of knowledge. The DSJ has explored what this means for conducting research and data management. Data Science is considered by the Journal as "*data science*", that is, the evidence-based study of socio-technical developments and transformations that affect scientific policy, research conduct and methods, data systems and standards and infrastructures that are an integral part of the research. The desire to work as a data scientist is something that has gained notoriety in recent years. This is reflected in the increase in the number of vacancies available in the market and in the good salaries offered by companies to well-trained professionals. The roles of a data scientist can include developing strategies for analysing data, preparing data for analysis, exploring, analysing and visualizing data, building models with data using programming languages such as Python and R, and implementing models in applications for management. The data scientist does not work alone. In fact, the most effective Data Science is done as a team. In addition to a data scientist, this team may include a business analyst who defines the problem, a data engineer who prepares the data and how to access it, an information technology designer who oversees the underlying processes and infrastructure, and an application runner that implements the models or analysis results into applications and products. Data Science is one of the most interesting fields that exist today. Its importance comes from the fact that companies are sitting on a treasure trove of data. As modern technology has allowed the creation and storage of increasing amounts of information, data volumes have exploded. According to Nogueira (2019), at the 'Grow with Google' event held in Brazil in 2019, "*Digital broke the barrier of the physical in the age of information technology*", emphasizing that 90% of the data in the world was created only in the last two years.

This phenomenon of the technological revolution that we are experiencing affects the job market. New opportunities and innovations that require more specialized knowledge are emerging daily, e.g., Airbnb, Uber and YouTube, Zoom, Teams or Webex, and therefore we need to create them as certain professions disappear, which does not make it easy to workforce retraining. During the labour market transition and adjustment process, the real solution is simple: better leaders in the workplace. Managers need to be better listeners, coaches and collaborators. Without people nothing works and nothing is produced. Great managers help employees to learn, grow and recognize the efforts of colleagues making them concerned about the company. Within environments like this, employees thrive (Gallup, 2022, p. 3). Also according to the same Google source, a survey carried out by this institution also shows that 96% of people search online before choosing a company to visit or contact. Within this reality, 'Google My Business' was developed, a tool that helps small and medium-sized companies gain visibility on the web. According to the same source, the three main aspects considered by *genus consumerous*, using Smith's term (2014), when choosing a business are: 77% reviews and comments, 75% discounts, promotions and news, and 69% directions, such as maps and addresses. According to consumers, companies that respond to comments are 1.7 times more trustworthy than companies that do not (76% vs. 46%) in a sample of 15,904 adults aged 18-64 (Google, 2016). This secular prodigy that has been taking place is nothing more than the creative destruction that has been explained by Schumpeter (1942), as a process of elimination and subsequent reconstruction with another combination of factors of production and innovation within society, which leads to economic progress. This concept was initially used to refer to production processes aimed at increasing productivity. In this way, creative destruction came to be associated with innovation. In other words, new creations and innovations arise by dismantling what is instituted and established, as an unverifiable force. Most enterprise data is still in internal, mostly untouchable, databases. "*Unstructured data, especially in the form of images and video, remain challenging for organizations to use due to the complexity of building and maintaining cutting-edge algorithms*" (Aaser *et al*., 2021,

p. 3). The wealth of data collected and stored by various technologies can have transformative benefits for business organizations, but only if we can interpret it. That's where Data Science comes in.

Data Science uncovers trends and produces the information companies can use to make better decisions and create more innovative products and services. "*The more data and channels that an organization adds, the better the technology performs as it learns about each individual customer to meet their immediate needs in real time*" (PEGA, 2022, p. 8). Perhaps most importantly, Artificial Intelligence (AI), as a software-based program, helps companies increase their productivity. Companies have to admit that Machine Learning (ML) models teach organizations with the large amounts of data they are provided or owned, e.g., in decision support, business intelligence, optimization and programming diligent and dynamic, rather than relying primarily on business analysts to see what they can discover from the data. According to Hill *et al.* (2022, p. 1) "*While data and digital technologies were once enablers of efficiency and cost-cutting, today, they're the engines of innovation and revenue growth, offering unprecedented opportunities to develop new products and services, and even reimagine their businesses*". But there is a potential downside. The use of uncontrolled AI for certain business functions can raise regulatory and ethical issues that can lead to accountability. Optimizing AI for maximum benefit requires a new approach. When considering some recent advances in AI, e.g., Sandeep *et al.* (2022), Fakir *et al.* (2022), Dondapati *et al.* (2022), the problem arises of examining how to balance safety with effectiveness through judicious control over when "*transparent*" versus "*opaque*" AI is used (Walker, 2017).

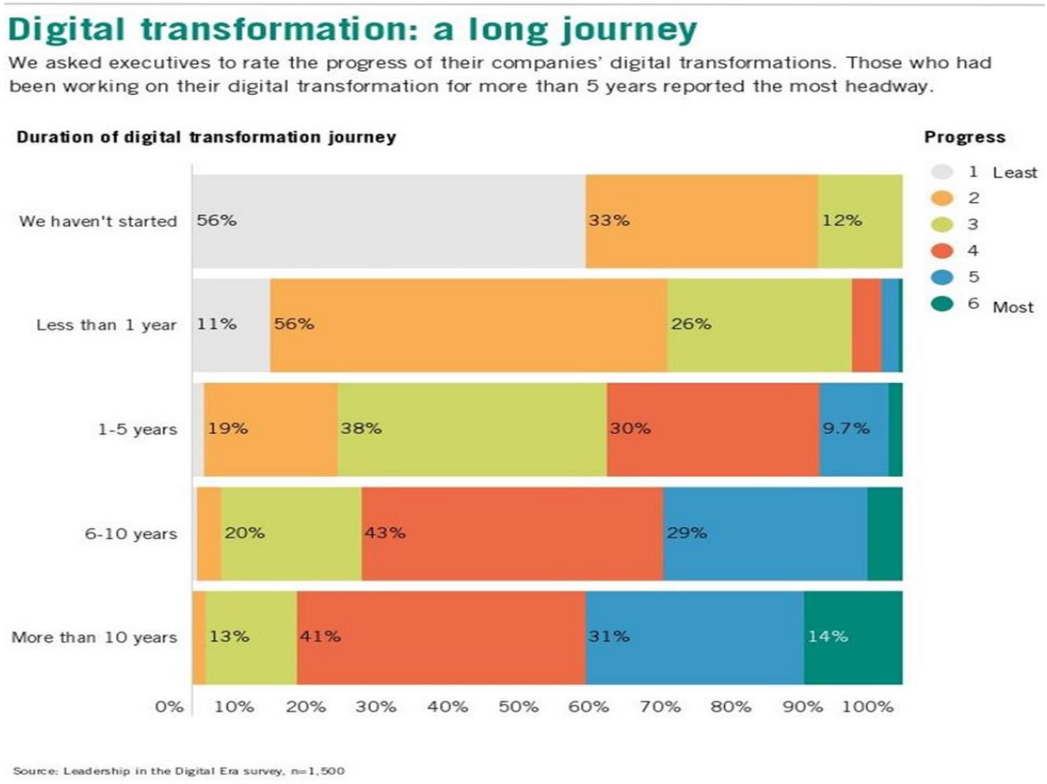
ML models extract knowledge and predictive power from business data. They are one of the main sources of innovation in business management. AI means getting a computer to mimic human behaviour in any way. The concept of ML is another subset of AI, or even synonymous with one another (Goretzko, 2021, p. 37), and consists of the techniques that allow computers to discover realities from data and provide AI applications. In addition, the *deep learning*, which is a subgroup of ML, which allows computers to solve more complex problems. Data Science being a subset of AI refers more to the overlapping areas of statistics, scientific methods and data analysis that are employed to extract meaning and insights in business. With this we can ensure that data is the foundation of innovation, but its value comes from the information data that scientists can extract and then work with. In the widespread changing business environment, innovation is the main requirement to gain a sustained advantage over competitors. Innovation helps companies to grow faster than others, survive in the competitive business environment and eventually become the market leader (Gupta, 2021).

The potential for business innovation is underpinned by the complexity and value created over time. A pertinent note must be given in relation to rigor, which is a kind of performance infrastructure of the transformation effort and permanent adaptation to technology. The information as a whole needs to maintain a disciplined and led cadence of dedication. Otherwise, doubts and uncertainties germinate as if they were a robust tracking of fortuitous initiatives on the part of managers. Rigor allows the successful execution and sustainability of the virtuous effects of the treatment of corporate data. For all these reasons, in the digital economy, data are the most important resources for the future trajectory of a company, complemented, of course, by other resources. Business, product and even people management decisions are made based on an increasingly complex reading of information. According to the World Economic Forum (WEF) 2020 report on jobs of the future, analytics and data science will be the jobs most in demand by companies by 2025. Along with other careers such as AI and Big Data specialists, the Forum predicts the creation of 97 million new jobs in the world (WEF, 2020, p. 6). The data and AI professions require skills in Data Intelligence and Storage Technologies, small-scale roles such as Big Data Developers alongside large-scale roles such as data scientists. Cloud engineering and computing require basic technology skills such as computer networking capabilities and disruptive technology, human-computer interaction between functions, the Green Economy cluster, business skills based on digital marketing, as well as business mastery in area of manufacturing operations. As resources are used by scientists, it is possible to visualize and predict trends, e.g., in the market, in production, in marketing, in sales. This predictability, therefore, helps company managers to choose where to allocate their resources and develop future stratagems.

2. The importance of Data Science for comparative advantage

There has been a growing number of organizations using data science teams to turn data into a competitive advantage, in order to improve products and services over time, which is increasingly faster in business. Data science and ML use cases include a) determining customer churn by analysing the data collected in call centers so that marketing can take steps to retain them, b) concern about improving efficiency economic and financial analysis by analysing traffic patterns, weather conditions and other factors so that logistics companies can improve delivery speeds and reduce context costs, c) improve customer diagnosis by analysing data that can measure effectiveness and diagnose symptoms that can foresee and solve potential problems and deal with them proactively, d) optimization of the supply chain essential for the final product, predicting when the installed capital stock can or has to be replaced, e) the detection of fraud in financial services, recognizing the existence of a certain possibility that contains suspicious behaviour and anomalous actions, and f) the improvement of sales, creating a set of recommendations to customers based on past purchases. A large majority of non-tech companies are late in connecting data, but new tools can put them in the race (Aase et al., 2021, p. 3) to prioritize Data Science in their management where they can invest with strong ambition. According to the Gartner for Supply Chain Report (2022), data related to community responsibility and opinion were identified, regarding the profile of the 25 largest supply chain companies in the world. All presented a profile that demonstrates excellence in supply chain management. In the first of three articles by these authors, published as part of the "Leading in the Digital Era" series of the Business Harvard School Working Knowledge, in mid-2020, they sought to understand the challenges of managers in leadership in the era of digital transformation. In partnership with Harvard Business School's Global Research Centers and Salesforce's Ignite team, they held 21 roundtables with more than 175 executives from companies around the world, from top managers to digital start-ups. In addition, they also interviewed over 1,500 senior executives from over 90 countries. The results of the conversations and interviews are mirrored in Figure 1, which refers to the rout of lengthy of digital transformation.

Figure 1 - Digital transformation: a long journey



Source: Hill *et al.* (2022, p. 2).

The firmness with which the authors stood was that 97% of respondents "coincided" or "strongly agreed" that organizations will not be competitive "*unless they radically adapt to the demands of the digital era. All but 2 percent indicated that their organizations were 2 benchmarks and digital transformation*" (Hill *et al*. (2022, p. 2). Customers use to do each, taking into account the supplements, the technological structural transformation and the best practices for accelerating supply chain performance. The Gartner Supply Chain Top 25 2022 survey found that the top three areas of capability for implementing and updating supply chain technology are planning (88%), visibility (84%) and transport management (69%), results that are not exactly a surprise given the interruptions in the upstream and downstream supply of the distribution networks during 2020/2021. The three main technologies used by the companies were the analytics and big data (88%), robotic process automation (84%) and digitization (76%). The future of companies goals include more team spirit across components, suppliers and higher levels of collaboration, using data for better decision performance and to leverage the supply chain ecosystem. Data has become a strategic asset, helping to change the supply chain and reactive planning mindset. The process of analysing and acting on data is iterative rather than linear, but this is how the data science lifecycle typically flows for a data modelling project. Achieving distinction in the development of new products will require leadership skills towards all employees and customers throughout the product design, previously evaluated in terms of uncertainty, costs, prices, claims management and expectations of return on invested capital stock. In most cases, companies will focus their resources on a few product categories consistent with their expectations of developing competitive differentiation, more through price than volume (Balasubramanian et al., 2022, p. 3-4).

Planning requires architecting a project and its possible results, starting with the construction of a data model. Data scientists often use a variety of open source libraries or in-database tools to build AI models. Managers often want help with ingesting data, profiling data, and visualizing resources. They need assertive tools with processing power. As for the evaluation of the data management model to implement, data scientists must reach a high percentage of accuracy for their models before they feel confident in implementing them. Model evaluation will typically generate a comprehensive set of evaluation metrics and visualizations to measure the performance of the model itself against the new data and also rank it over time to enable optimal behaviour in production. Model evaluation goes beyond raw performance to take into account the expected behaviour of the manufacturing baseline. Explanation of models requires being able to explain that the internal mechanics of ML model results in human terms, which is not always possible, although it will become increasingly important. Data scientists want automated explanations of the relative weight and importance of factors that generate a forecast and model-specific explanatory details to compare them to the model's predictions. However, running an ML model, training it, and putting it on the right systems is often a difficult and labour-intensive process. Its return depends, from the outset, on the premise that "*the first issue with ML-based personnel selection is data quality*" (Goretzko, 2021, p. 39). This can be facilitated by operationalizing models such as scalable and secure Application Programming Interfaces (APIs) or by using ML models in the database, but the model chain used does not end here. There is a lack of monitoring of the models, a stage in which they must always be controlled after their execution to ensure that they work correctly and in line with what is intended by management (Hammoudi *et al.*, 2016). The data on which the model is trained may no longer be relevant for future predictions after a certain period of time, e.g., in fraud detection. That said, the challenges of implementing Data Science projects, despite the promise of data science and huge investments in teams of data analysts, cause many companies to lack awareness of the full value of their data. Further research is needed to explain this accomplish. The challenges of putting into practice Data Science can be seen in Figure 2.

Figure 2 – Challenges of implementation Data Science

Source: own elaboration.

When looking to hire talent with this training and create programs based on Data Science, some companies experience somewhat inefficient teamwork flows, with different people using different tools and processes that don't work well together. Without disciplined and centralized management, there is a possibility that executives may not see the full return on their investments. This leads us to a dilemma, as we will see next.

3. The trade-off between confusing environment and integrated enterprise platform

Many companies have realized that without an integrated internal platform, data science work is inefficient, insecure and difficult to scale. This realization led to the development of Data Science platforms. These platforms are software hubs around which all data science work takes place. A good platform alleviates many of the challenges of implementing Data Science. Data helps companies transform their management information into knowledge faster and more efficiently. With a centralized ML platform, data scientists can work in a collaborative environment using their favourite open source tools, with all their work synchronized by a control system. As a matter that is still latent and fresh, the Data Set environment naturally presents several challenges. According to ResearchAndMarkets.com's 2022 Report, Europe's e-waste management market was valued at US$12,823.8 million in 2021 and is estimated to grow by 12.0% annually between 2021-2031, driven by the rapid expansion of consumption of electronic goods, along with falling prices, planned obsolescence, rapid advancement and updating of technology, continued industrialization and urbanization, and the growing need to minimize the health risks of electronic waste. First of all, data scientists cannot carry out their tasks with their own economic efficiency because they are dependent on managers. As access to data must be granted by an Information Technology (IT) administrator, data scientists end up waiting some time for the data and resources needed to analyse it. Once access is gained, the data science team can process and analyze the data using different and possibly incompatible tools. For example, a scientist might develop a model using the R language, but the application in which it will be used is written in a different language.

That's why it can take weeks, or even months, to implement models into fruitful applications. On the other hand, application development technicians cannot access usable ML. Sometimes the ML models that developers receive need to be recoded or else they will not be ready to be deployed on

application platforms. As hotspots can be inflexible, models cannot run in all scenarios and resizing is left to the application's project manager. IT administrators spend a lot of time on technical information support. Because of the proliferation of open source tools, IT may have an ever-growing list of tools to offer technical support. A data scientist in marketing, for example, may be employing different tools than a data scientist in finance or the manufacturing process. Teams can also have different workflows, which means that the IT team must continually rebuild and update the technology and team assignment environments. Business managers are a long way from Data Science. Data Science-based workflows are not always integrated into business decision-making systems and processes, making it difficult for project managers to collaborate in a different way known to data scientists. Without better integration, business managers find it difficult to understand why it takes so long to go from prototype to production. If so, they are less likely to support investment in projects they believe are excessively slow (ResearchAndMarkets.com's, 2022).

A data science platform reduces redundancy and drives innovation by allowing teams to share code, results and reports. It removes workflow bottlenecks, streamlining performance and embedding best practices within companies. Data Science platforms bring benefits. In general, the best data science platforms authenticate (a) the work of the most productive data scientist teams, helping to accelerate and deliver models faster and with fewer errors, (b) an easier work for data scientists with large volumes and varieties of data, and (c) providing AI that is reliable and credible, yet enterprise-grade, unbiased, auditable and reproducible. Data Science platforms are built for collaboration by a variety of users, including expert data scientists, citizen data scientists, data engineers, and ML engineers or experts. For example, a Data Science platform can allow data scientists to implement models as APIs, making it easier to integrate them into different applications. Data scientists can access tools, data and infrastructure without having to wait for the IT team. As early as 2017, the global data science platform market is expected to grow by around US$385.2 billion by 2025 with a high Return on Investment (ROI) through the implementation of cutting-edge data science platform, based on research progress and markets (CISION, 2017). However, the resources of a data manager are essential and must therefore be considered. First the user interface, based on the project that encourages collaboration. Prioritization and flexibility follow, through, e.g., GitHub, GitLab and Bitbucke. Next comes the inclusion of enterprise-grade features, to make Data Science more autonomous to track all work and easily deploy models to production. Finally, there must be a guarantee of equipping the model easier because the operationalization of the model is one of the most important stages of the ML lifecycle.

4. Data Science Methods and Tools

As it is a broad sector, Data Science requires basic knowledge of logical reasoning, statistics, interpretation of information and analysis. However, it also requires specific knowledge dependent on the scientist's area of activity, e.g., economics, engineering, health, education, programming with regard to the domain of resources. Here are some of those resources:

a) The R language

R is a programming language that can be used on different systems and integrated with other languages. Due to its versatility, it also benefits from data reorganization and reporting. It can be used to develop business strategies, statistical reports and other analytical resources for businesses (R Development Core Team, 2008; Lathiya, 2020).

b) The Python language

Python, on the other hand, aims to extend the ideal of R to different applications. With the use of algorithms, this language is able to detect relevant information from databases. It also has good integration with other languages, as well as offering cross-platform compatibility. As an open source programming language, Python also has digital repositories with different resources that the programmer can use to create the applications they want. An interesting use of Python is for scientific

research. For researchers, it has large banks with information from their experiences, and it is important that they are used to extract the most relevant perspectives and have agile tools to discriminate them. Using Data Science, this information becomes more accessible and, therefore, can be transformed into an action plan for researchers (Python Programming Language, 2022).

c) Microsoft Power BI

Developed by Microsoft, this program covers all basic, intermediate and advanced topics in business BI and data analysis. This resource helps managers to organize the information obtained about the business. It has integration with the Office package, which facilitates the transfer of information. It was also designed to be agile in its use, allowing different sectors of the company to have access to goals and business plans. In BI, data is used to validate and scale projects and products more securely (Microsoft, 2021), especially in small and medium enterprises.

d) Cloud systems

In recent years, however, technological evolution has expanded the range of possibilities with cloud computing, which provides online tools, and which has been gaining more and more space among companies around the world. The question arises of where to store the data. Cloud banking is the most effective solution for organizations. In tools like Oracle, scientists can store data, create algorithms and feed content as needed. The cloud also facilitates the sharing process. When a team has multiple scientists, it is essential that everyone has access to the processes and results. In remote companies, the cloud contributes to this scenario because it is easier to access, while protecting information from potential harmful intrusion. Globalized companies can offer services to clients in different countries, also requiring global teams. As a result, the flexibility of the cloud makes the data analysis process more accessible to scientists in different locations. Once decided on the cloud modality, the manager will have chosen to subscribe to his management system, that is, the monthly maintenance cost will consist mainly of the lease of licenses and the lease of the infrastructure (MicroUniverso, 2022).

e) Tableau 2020

Tableau 2020 allows to visualize data and create opportunities for company managers or key decision makers to discover patterns in data, e.g., each customer's purchasing behaviour, sales trends or production hurdles. Tableau 2020 is a data visualization and transformation tool. It has functions such as cloud storage, graphical representation and BI strategies. With it, the project manager can choose which information will be his focus and use it to validate or propose the planning. A feature of programming is that there are digital repositories of functions and codes. In them, the programmer can find new commands, ask questions about their use and apply them in their own work. The data manager can also make use of these features, exploring ways to improve the capture and extraction of information with updated algorithms (Tableau 2020 A-Z: Hands-On Tableau Training for Data Science, 2020).

f) STATA

It is a software for statistical treatment and for Data Science, fast and accurate. STATA, from StataCorp LLC, is a complete and integrated software package that provides all your Data Science needs, from data manipulation, to visualization, to statistics or automated reporting. In addition, it is reproducible research that can solve problems, reveal opportunities and inform decisions with a rich set of comprehensive features for statistical analysis (R Development Core Team, 2008).

g) STATIS

The STATIS method (Structuration des Tableaux à Trois Indices de la Statistique), proposed by L'Hermier des Plantes (1976) and developed by Lavit (1988) and Lavit et al. (1994), has its theoretical foundations in the work of Escoufier (1973, 1976). It is a method of exploratory analysis of multivariate

data, which is based on linear algebra and, particularly on Euclidean vector spaces, and which aims to compare configurations of the same individuals or the same variables in different time horizons or different experimental situations in order to find a common, stable, and representative structure of multiple data arrays. Intrastructure analysis performs global comparison of multiple data matrices. Compromise analysis describes the structure common to the various data matrices through the determination of the compromise and its Euclidean image. The analysis of the intrastructure makes it possible to highlight the variables responsible for the similarities (or differences) between the various matrices. Finally, the interpretation of the trajectories comes from the image of the commitment and the trajectories that describe the evolutionary behaviour of each individual or variable are traced.

5. The Business Intelligence

Business Intelligence (BI), has been increasingly applied and worked in all types of companies to achieve more planned and assertive decision making. Because BI collects, analyses and works with very relevant data, it makes all the difference for any business to manage its content well and grow every day. BI is the key technology for users to extract valuable information from a vast amount of data for decision making. Data warehouses and online analytical processing systems were developed to contribute to the decision-making process (Guessoum *et al*., 2022). BI consists of collecting, storing, organizing, analysing, interpreting and applying data and information to help a company make decisions. In other words, BI transforms raw data into important and strategic information and insights for any type of business, in an increasingly competitive and dynamic market context, with increasingly demanding consumers, where BI becomes paramount. It makes companies have very relevant data to be able to make coherent and affirmative decisions. That said, we can say that one of the main objectives of BI is to provide a base of organized information and, thus, help companies to be able to work their planning and strategies in a coherent and consistent method. In this way, they identify opportunities and points for improvement, as well as find possible threats or risk prevention. All this information can be delivered, e.g., in reports, infographics, dashboards or presentations. That is, BI, literally, is able to define where a company will go. The main advantages that BI brings to business are several and are shown in Table 1.

Table 1 - The Main Advantages that BI brings to the Enterprise Business

Dynamic World	In an increasingly dynamic world, where information is constantly updated and changing, BI is able to analyse the entire flow of information constantly. In the same way, the amount of data is increasing and more requested. This is precisely what BI will seek, organize and work on.
Analyze and Interpret Data	BI links the entire amount of information, and thus transforms it into very relevant data so that the company has all the conditions for assertive decision making. Likewise, it analyses the market efficiently, including monitoring the competition and its consumers. It really transforms raw data into very useful information by business for each product.
Opportunities and Risks	In this way, BI helps to find market opportunities. At the same time, it identifies points for improvement and also controls potential risks and threats. In this sense, it leaves the company much more prepared and planned.
Process Optimization	In addition, BI makes data analysis much more agile, as well as providing faster possible process adjustments that are necessary. In other words, it accelerates positive changes and improves a company's internal routines, mainly because BI is based on what it needs to make adjustments that can optimize the company's activities and bring efficiency to production processes.

Cost Reduction	Data Intelligence in a company can focus on what really needs to be known with regard to the production section. Thus, it uses fewer resources without losing efficiency or competitiveness. And this can be worked on to make strategic investments logically and consistently.
Information Management	As a result, a company's information management will be efficient and organized. And so, it will bring valuable and enlightening tastes and data. With this, all the planning and strategy of the company will be based and worked in function of concrete information.
Invoicing	The invoicing of a company will tend to grow more and more, because its decisions will be worked according to the compass found by BI.
Comparative Advantage	In this way, BI can become a competitive advantage for the company to be able to stand out in the market, as well as to place itself at the forefront of the competition and deepen the creation of a comparative advantage.

Fonte: Marcos (2021) and own elaboration.

Goldberg et al. (2022), in the conclusions of their study, concluded that there is enormous statistical evidence not only through consumers, who gave their feedback on products and behaviours in line with the structure of their attributes, to the extent that companies also gained valuable information from this feedback. Many companies specializing in IT and Data Science platforms include a wide range of services that provide a comprehensive end-to-end experience of any intended project, and prepared to accelerate the implementation of the chosen model and improve the results of Data Science. However, for this strategy to work, it is important that all sectors of the company are focused on each part of the process, using their knowledge and skills to contribute to the completion of each step. Here Data Science is fundamental because it helps in the analysis and conclusion of each stage of the project, in addition to contemplating the relevant information for the next step. The influence of Data Science in organizations allows for a closer monitoring of processes, which in turn contributes to a more agile and leaner management and work ecosystem. With streamlined workflows, employees can focus on specific tasks with a more grounded and confidential performance.

6. A Model of Application Using the Income Statement

The Income Statement (IS) is part of each company's Annual Report and shows the details of Earnings and Costs during the given fiscal time period, normally the calendar year (Epstein, 2022). Through the IS, we can verify whether a company, during the fiscal period, made a profit or a loss. Like the Balance Sheet (BS), the IS follows a standard format that companies must follow. Its general structure is shown in Table 2 in currency units (u.c.). To understand where the variables included in the IS appear, below is their normal arrangement. In the business world, several terms and indicators are used that seek to summarize the economic and financial performance of companies or organizations, having more analytical or technical information. One of the most important indicators is the “Earnings Before Interest, Taxes, Depreciation and Amortization” (EBITDA) which, by eliminating the effects of financing decisions, allows analysing and comparing the performance and/or profitability of a company or between companies. EBITDA shows the actual profit from a company's operating activities. However, it is important to note that, as the name implies, the financial effects of interest and taxes, depreciation and amortization are not taken into account. Regardless of whether some analysts like this indicator more or less, the truth is that its usefulness in certain situations is indisputable. For example, through EBITDA it is possible to calculate the productivity of a company, as it is not dependent on financial effects. Therefore, in this way, it is easier to see if the business works efficiently and productively. The indicator “The Earnings Before Interest and Taxes” (EBIT) is used to

analyse the performance of a company's core operations without the costs of the capital structure and tax expenses impacting profit.

The EBIT is also known as operating income since it both exclude interest expenses and taxes from their calculations. The Net Income (NI), positive or negative, is the last value of a company's IS. This value corresponds to the turnover, less operating costs plus financial and extraordinary results, after deduction of taxes. In the analysis of the NI, the normal accounting principles underlying the accounting of Revenues and Costs subsist. The IS reflects the Earnings and Costs that the company incurs during the fiscal year. From what the company sold, we remove what it cost for what it sold (Cost of Sales), minus the costs of keeping the company in operation (Marketing, General and Administrative costs and Other Operating costs), minus the amortization of equipment used in the company (Depreciation and Amortization), minus the company's financing costs (Interests and Others, Net and Extraordinary Income/Changes), minus the taxes it may have to pay on the income generated (Provision for Income Taxes).

What's left is NI or profit. First of all, it should be noted that Earnings and Costs are generated at the moment when daily events occur in the company, and not necessarily on the date on which the company receives or pays the money related to them. This is, by the way, the big difference between the IS and the Cash Flows Map. In summary, EBITDA is the sum of EBIT plus Depreciation and Amortization (Jin, 2021). Thus, when a company agrees to sell something to a customer, it immediately registers the sale and the cost of what it sold in its income statement, and if the payment is not ready, it will have a debt from the customer in its BS. Likewise, every month the company will recognize part of the cost of the holiday and Christmas allowance for its employees, even though it is known that it will only pay them later. It is from the IS that we will look for the variables that help us to determine whether a company is on the path of good economic and financial performance in relation to its activity (IS). Net Income for the year increased from +252,470 c.u. to -445 772 c.u., but with the use of Data Science, in the company of this fictitious example, you can find a software and a digital platform that can discriminate and explain this big difference in two years (N and N-1). For this, we are going to test seven indicators and show how Data Science can enlighten us. The simulation will be performed with the following indicators: a) EBITDA/Revenues, b) EBIT/Revenues, c) Staff Expenses/Cost of Sales, d) Revenues/Net Income, e) Staff Expenses/Revenues, f) Supplies and external services/Cost of Sales, g) EBITDA/Supplies and h) external services and EBIT/EBITDA.

The NI of the exercise went from +252,470 c.u. to -445 772 c.u., but with the use of Data Science the company of this fictitious example can find a software or a digital platform that can discriminate and explain this difference from one year to the next. For this, we will use the techniques listed in point 3 and show how Data Science can enlighten us. Some of the methods are similar to each other and that's why we decided to focus on just two of the techniques. R and Python are two programming languages that can be used to analyse data using embedded packages and writing code. STATIS is a method that needs to be used with a programming language. STATA can be used with python since there is a package that allows us to almost emulate the STATA system in the Python programming environment.

It can also be used as a single program. Tableau and Power BI are two technologies commonly known for their user-friendly dashboards. With the Income Statement, we will be comparing R and Power BI to distinguish the knowledge needed to use one and the other and to discover which one is best to deal with business intelligence problems.

Table 2 – The Structure of the Income Statement

Profits and Losses	Periods	
	N	N-1
(+) **Revenues**	155 280	286 721
(+) Exploration subsidies	23 542	0
(+) Allocated gains/losses of subsidiaries, associates and joint ventures	15 876	40 187
(+) Variation in production inventories	-45 271	-33 597
(+) Work for the entity itself	24 879	23 729
(-) **Costs of Sales**	98 783	168 310
(-) Suppliers and external services	16 320	31 566
(-) Staff expenses	69 897	112 563
(-) Impairment of inventories	50 261	45 261
(-) Impairment of debts receivable	42 320	27 955
(-) Provisions	62 130	40 395
(-) Impairment of non-depreciable/amortizable investments	10 267	5 687
EBITDA – Earnings Before Interest, Taxes, Depreciations and Amortizations	-79 889	317 040
(-) Depreciation and amortization expenses/reversals	75 234	45 280
(-) Impairment of depreciable investments/amortizations	110 325	62 415
EBIT – Earnings Before Interest and Taxes	-265 448	371 035
(+) Interest and similar income obtained	25 687	14 621
(-) Interest and similar expenses incurred	100 523	55 644
(-) Tax over the period's income	105 488	77 542
Net Income	-445 772	252 470

Source: own elaboration.

As a form of context we can say that R is a very common programming language for data manipulation, analysis and visualization. It is relatively simple to learn, however it implies that there is some learning. As for Power Bi, because of its construction, it is a platform that allows data analysis, but unlike R, it is focused on experience and simplicity for the user. While in R everything is done at the programming level, in Power Bi the intention is that everything is done through its graphical interface. In order to be able to do any type of analysis either in R or in any other platform, we first have to read the file with the database, that is, in this case, load the file that contains the Income Statement or create the database by inserting the data. In the case of R, we can insert the data through the console itself, possible to see in Table 3.

Table 3 – Constitution of the Data set in R

```
Periods <- c("n", "n-1")
Revenues <- c(155280,286721)
ExploirationSubsidies <- c(23542,0)
AllocatedGains <- c(15876, 40187)
VariationProduction <- c(-45271, -33597)
WorkEntity <- c(24879, 23729)
CostsSales <- c(98783, 168310)
SuppliesExternalServices <- c(16320, 31566)
StaffExpenses <- c(69897, 112563)
ImpairmentInventories <- c(50261, 45261)
ImpairmentDebts <- c(42320, 27955)
Provisions <- c(62130, 40395)
ImpairmentAmortizableInvestments <- c(10267, 5687)
EBITDA <- c(-79889, 317040)
DepreciationExpenses <- c(75234, 45280)
ImpairmentInvestments <- c(110325, 62415)
EBIT <- c(-265448, 371035)
InterestObtained <- c(25687, 14621)
InteresExpenses <- c(100523, 55644)
Tax <- c(105488, 77542)
NetIncome <- c(-445772, 252470)
```

Source: Own computation.

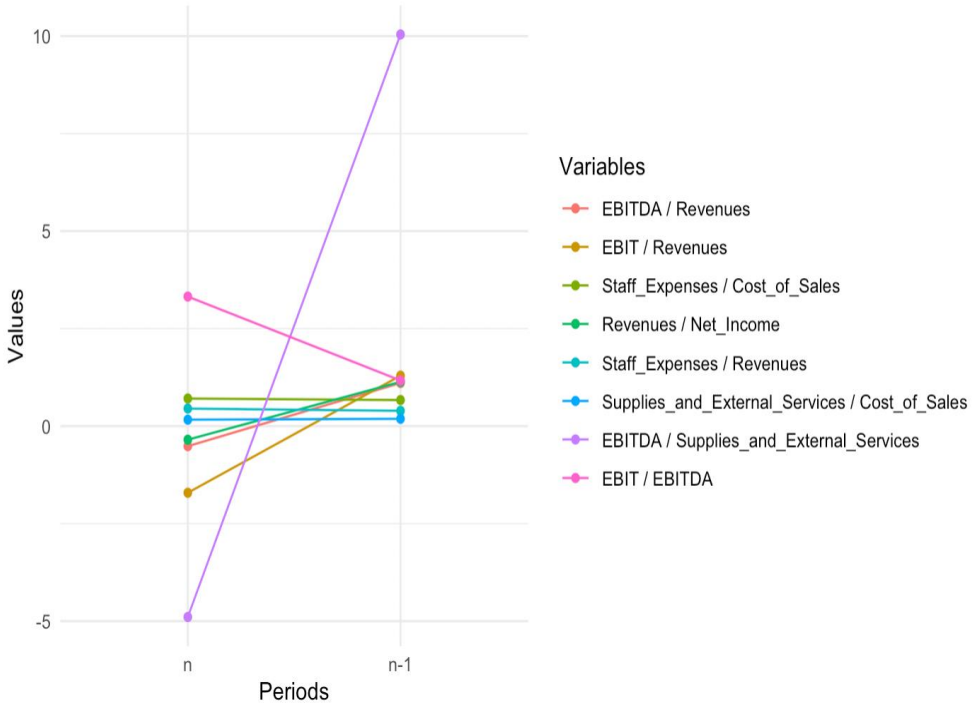
After having the dataset formed we can start the analysis. In this case we create the data set through the console and then for each of the operations we intend to do we assign a name to a new variable and store the value of the calculation there, Table 3. After carrying out the calculations, we can make graphical visualizations of the data that make up the data set or even of the analysis that we have just performed, as observed in Figure 4.

Table 4 – Calculation of ratios in R

```
a <- mydata$EBITDA / mydata$Revenues
a

b <- mydata$EBIT / mydata$Revenues
b

c <- mydata$StaffExpenses / mydata$CostsSales
c

d<- mydata$Revenues / mydata$NetIncome
d

e<- mydata$StaffExpenses / mydata$Revenues
e

f<- mydata$SuppliesExternalServices / mydata$CostsSales
f

g<- mydata$EBITDA / mydata$SuppliesExternalServices
g

h<- mydata$EBIT / mydata$EBITDA
h
```

Source: own computation.

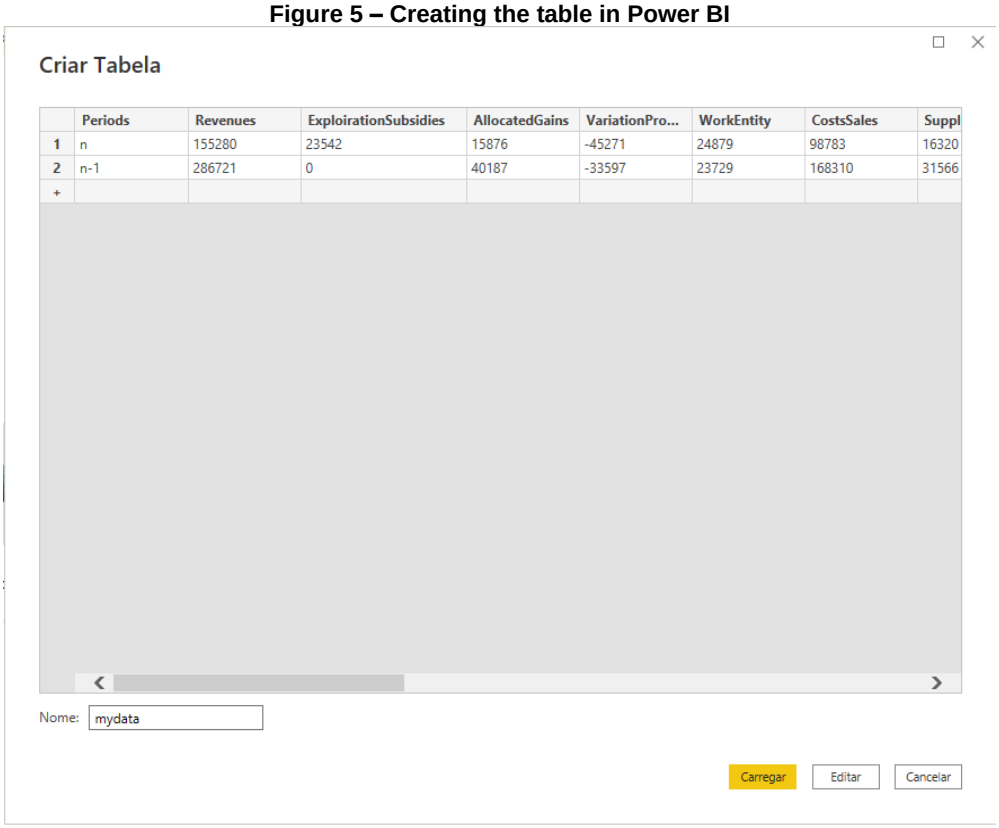
Figure 4 – Graphic demonstration of the calculated ratios in R



Source: own computation.

When we use Power BI we also have two ways to create a database. We either load a pre-existing file just like in R, the biggest difference being that through Power BI we have a graphical interface to do it or we can create it by hand too, using the data entry option on the home page tab, as in Figure 5.

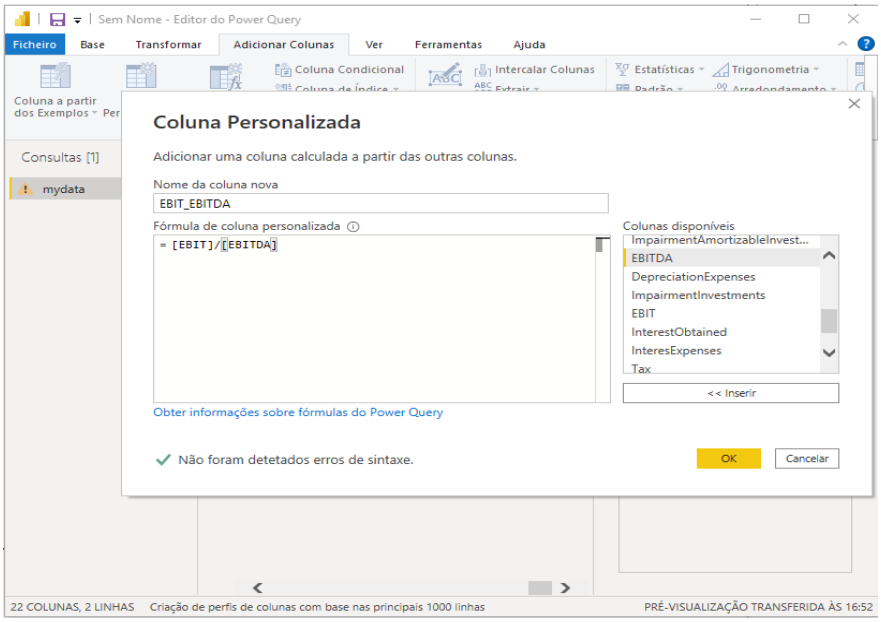
Figure 5 – Creating the table in Power BI



Source: own computation.

After creating the database, which will have a structure similar to a table, the next step is to format the data. This phase is where we check if the data entered is correct and where we may have to change the name of some column, eliminate some row or do some kind of transformation. For example, it is at this stage that we may have to transform text into numbers. This is something that can happen both in Power BI and in R. It is very common when we read from a file the interpreter may not know exactly if what it is reading is plain text or text with numeric context. To shape the data in Power BI, the Power Query editor is used. Step-by-step instructions are provided and the editor will translate into an adapted result making adjustments as it loads. We can calculate the ratios for each of the ones mentioned above and add the result to the data set by creating a new column for each of the new variables. In Power BI, each new column will have a custom formula associated, as shown in Figure 6.

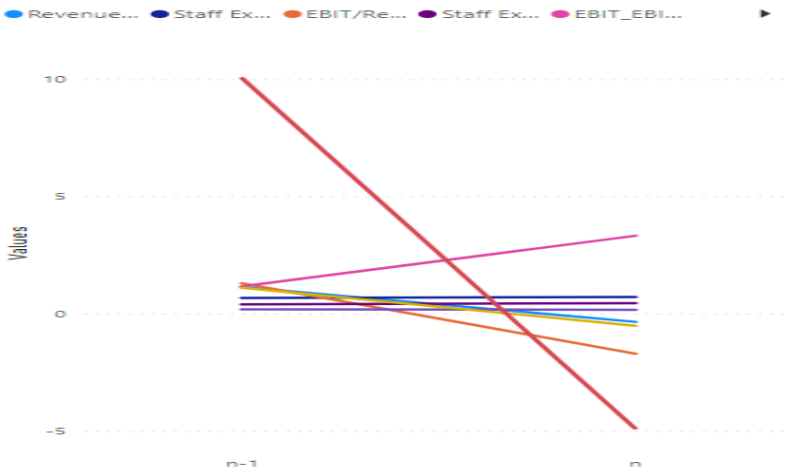
Figure 6 – Custom formula for each ratio in Power BI.



Source: own computation.

The biggest difference between the two platforms is the visual support that platforms like Power BI and Tableau give/provide to the user. To create a graph in Power BI we simply have to drag the data we desire to the respective axis positioning them in the correct place and in the end we will have the graph we wanted. The graph generated by Power BI using the same data as in R is presented in Figure 7.

Figure 7 – Graph created in Power BI



Source: own computation.

By deduction, what is the best option? The answer is simple but depends on the cost that the company is willing to pay, and it also depends on the skills that exist within that same company. If there are no great knowledge or resources available, platforms such as Power Bi and Tableau are designed with this purpose in mind to be able to understand where the company is at, taking into account the data available. Since it has an easy-to-understand platform and where it is possible to graphically visualize the analyses carried out, it is easier for managers to interpret them. More detailed analyses require more knowledge, even though the previous platforms are already very advanced and achieve results with good accuracy when we need to carry out analyses in greater detail or taking into account larger sets of data, these platforms tend not to be as efficient and for this it is necessary to use others more robust such as programming languages or even platforms whose only focus is statistical analysis.

7. Conclusions and Challenges

Data Science allows the use of theoretical, mathematical, computational and other practical methods to study and evaluate business data. The main objective is to extract necessary or valuable information that can be used for various purposes, e.g., decision making, product development, trend analysis and forecasting. Data Science techniques include selective data search, Big Data analysis, data extraction and retrieval. Furthermore, Data Science concepts and processes are derived, e.g., from data engineering, statistics, programming, social behaviour, data storage, machine learning and natural language processing. An organization should be ready for a Data Science platform if it contributes to productivity, if LM models cannot be reproduced, and if the models never make it to the production floor. A Data Science platform can add real business value to the enterprise.

There are some challenges in implementing data projects that institutions face when executing a project based on Data Science. The first question that must be taken into account is to know what the company's need in Data Science is. Although there is the possibility of using Data Science for different sectors, it is important to focus a project on what it should specialize in, prioritizing the capture and organization of information effectively and with market niches that are informative for each sector. It means, then, not reading the data in a broad and automatic way, but understanding the patterns and using them for the company's growth. Here, a qualified data scientist is paramount, as he knows how to determine such patterns and trends critically and logically. Equally important is having the necessary resources for the data scientist to be able to act, from software to teams with the right size for each project, ensuring that everyone has the necessary time to act on the information received. In addition, it is important to align documents, keep systems secure, prioritize cloud storage, prepare reports and facilitate communication between company sectors. In this way, Data Science can be part of different sectors and departments of your business organization and business, making it more technological and based on essential information. Information technology grows mainly due to the need for business innovation, which is why it makes them more present in the digital environment daily, which also leads to the requirement to invest in information security processes and systems. It is necessary to have someone with a high critical sense who always tries to understand how data can be related and how new patterns can be discovered. For this to happen it is necessary to have technology that follows this evolutionary process and there must be communication between departments or a special knowledge of the area under evaluation. Even though a Data scientist always finds another piece of knowledge from the data it is also a good idea to have some specific knowledge about the area in order to understand if the information retrieved after the analysis or during this process of analysis is relevant or not.

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