HISTORICAL EVOLUTION OF THE DASHBOARDS

March 2021
Ariel González Guerrero

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1. Whoever has the Information has the Power:

Apparently it was Hobbes, in **Leviathan**[1] **who put into circulation the idea that "who has the information, has the power."**

Remember that information is not knowledge. If it were, anyone who entered a library would be wise to have as much information as books contain and why speak of the information accessible through the internet. But so much information does not make anyone wise, there is something missing that only wise men, teachers, possess and transmit: organization, structuring, separation of essential information from accessory information, among other aspects.

Hobbes's phrase refers to information, not knowledge. But not just any information, not the one that we can acquire in abundance with a click of a button, through the internet, for example. No, it is already understood that this is the so-called 'inside information'.

2. First findings of numerical records.

In illustration #1 we can see a clay tablet with an administrative text from the city of Uruk, around 3400-3000 BC. C. Apparently the tablet records an amount of 29,086 measures of barley (about 100,000 liters) received over 37 months by Kushim; which can be the generic title of an official, or the name of a specific individual. The ignorance of this can reveal that the first name registered in history belongs to an accountant and not to a prophet, a poet or a great conqueror.

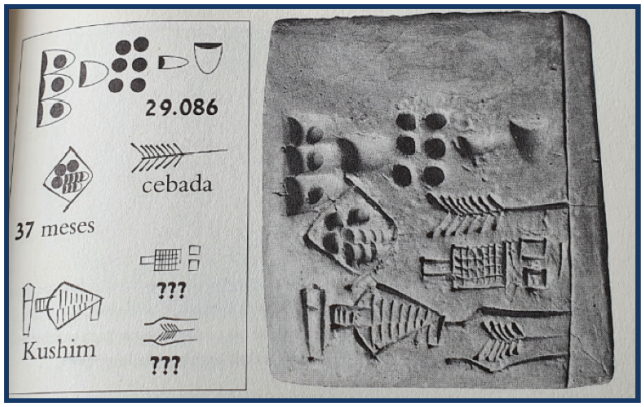


Illustration #1. Clay tablet with an administrative text from the city of Uruk, around 3400-3000 BC. C. Taken from the work 'SAPIENS' from animals to gods by Yubal Noah Harari.

[1] **Leviathan, or The matter, form and power of an ecclesiastical and civil state, commonly called Leviathan,** is the best known book of the English political philosopher Thomas Hobbes. Published in 1651, its title refers to the biblical monster Leviathan, of enormous power.

In Andean zones of dominion of the INCA empire around 2,500 a. C counting tools called QUIPU were identified (see Illustration # 2). These ropes were used for accounting, harvest registration, census and livestock counting. In the same way it was used for linguistic and memory representation (stories, songs and poems). Those long ropes had knots, which represented the units, tens and hundreds; and the lack of knots the zero.

Illustration #2. QUIPU.

As we can observe these first two (2) findings of accounting records, they represent the interest of being able to have data and information beyond those registered in the human mind.

Possibly it represents the interest of being able to share this data with other people and compare them over time to make decisions about it. The means or tools used are those that could be obtained or handled in their circumstances, but clearly demonstrate the importance of measurements.

3. History of the Calendars

Since the first civilizations, the human being has counted the passage of days and has tried to divide time into logical systems. This need to represent the passage of time led to the creation of the first calendars.

Each people adapted the calendar as a reflection of their culture: their religion, the most important festivals, the passing of the seasons and the harvest ... In addition to introducing new observations and calculations that have led to the current calendars.

At present there are different types of calendars: the Chinese calendar, the Hebrew, the Hindu, the Muslim, the Persian, the Buddhist...

The oldest civilizations relied on observing the sky and the stars to tell time, although it was not an exact method. The position of the planets and the phases of the Moon became the reference: when the Moon returned to the initial phase of its orbit, the month was over.

The oldest known calendar is in Aberdeenshire (Scotland) and dates from 8,000 BC. It is a Monolithic monument (illustration #3) made up of 12 stones that mark the position of the moon over the course of a year.

Illustration #3. Monolithic monument (Scotland)

Centuries later, in 45 BC, the famous politician and military man Julius Caesar established a new calendar: the Julian calendar. This consisted of 365 days, since 10 days were added to complete the rotation of the Earth around the Sun.

After the death of Julius Caesar in 44 BC, the Roman Senate decided to dedicate the month of July to him in his honor. His successor, Emperor Caesar Augustus, decided that the following month should be dedicated to him: August.

The most widely used throughout the world is the Gregorian calendar, a solar calendar created in 1582. This was caused by the lag with the solar cycle that led Pope Gregory XIII to commission a new calendar in 1582, which was later named after him. **Although it is the most accurate calendar, used almost everywhere in the world, each year it is off-set by 26 seconds. 3,300 years from now, we will have to add one more day to adjust the calendar.**

4. The origin of time and its measurements

Another aspect that throughout the development of humanity has required having an accounting system is time.

As for the days and their duration, it all starts with the stars. A whole day is the time it takes for a point on the earth to face the sun in the same position twice. This time or period is divided into two 12-hour parts. This division of the day was first adapted by the Romans from the Egyptian culture.

The Egyptians divided the night based on twelve stars that appeared successively throughout the darkness, in this way they began to divide the night into twelve parts. Similar to this star game, the day was also divided into twelve parts.

The term "hours" comes from Greek mythology. The twelve hours represented the "twelve sisters", which were initially three: Talo, Carpo and Auxo. They were daughters of Zeus and Themis, and all three served the gods and guarded the gates of Olympus. They were also in charge of the order of nature and determined the fertility of the Earth.

As for the hours, this is due to the astronomical studies of the Babylonian people, who used the sexagesimal system for their astronomical calculations. In this way, we have hours of sixty minutes and minutes of sixty seconds.

The term minutes comes from the Latin "minutus" which means small, and the term seconds comes from the Latin "secundus", which means "that follows the first" or "second."

5. Censuses and Statistics

The Romans were good administrators, taking censuses (whose name comes from Latin) every five years. Every citizen had to declare his fortune, age, name of wife, son, etc. At the end of the census, a religious ceremony is held, the Lustrim Conditium (where the word luster comes from to indicate a term of five years).

During the Middle Ages, in Europe, the church began to keep civil registers, but the statistics really progressed from the 16th century along with the absolute monarchies and their powerful centralized administrative structure. The first statistical works appear that are rather descriptive; one of the most influential was that of Jean Bodin[2] (France, 1530-1596), who explains the importance of the Censuses.

"… The trade of each one will be known, vagabonds, loafers and thieves may be expelled, as for the registration of goods, it is essential to determine the tax that everyone has to pay; This will prevent riots, popular uprisings and civil wars ".

Statistics took a great qualitative leap in the middle of the seventeenth century. On the one hand, statistical data are beginning to be used by banks and by emerging insurance companies; on the other hand, the concept of "political arithmetic" was invented in England and other disciplines that were, until then, purely descriptive, such as demography, economics and the social sciences, began to "mathematize". They transform upon contact with mathematics.

The following quotes show the enthusiasm of some writers of that time:

- **J.F. Melon:** "Everything can be reduced to numbers, even purely moral things."
- **Mirabeau:** "Mathematics is to the science of economics, what bones are to the human body."
- **Lord Kelvin:** "If the things you talk about can be measured and expressed with numbers, you know something about them; but if you cannot express them with numbers, your knowledge of them is scarce and insufficient."

[2] **Jean Bodin, (Angers, 1529/1533 - Laon, 1596) was a prominent French intellectual who developed his ideas in the fields of philosophy, law, political science and economics. Along with Cardinal Richelieu and his jurists, he is considered one of the founders of French absolutism. Through his work he made notable contributions to the Theory of the State. In this regard, his book The Six Books of the Republic can be mentioned, where he early established the concept of "sovereignty" and the foundations that would later inspire Hobbes and Locke; the theoretical bases of the absolute monarchy (command power, absolute power, indivisible power, perpetual power). Other contributions include monitoring the powers of judges and administration and making fundamental distinctions between state and government.**

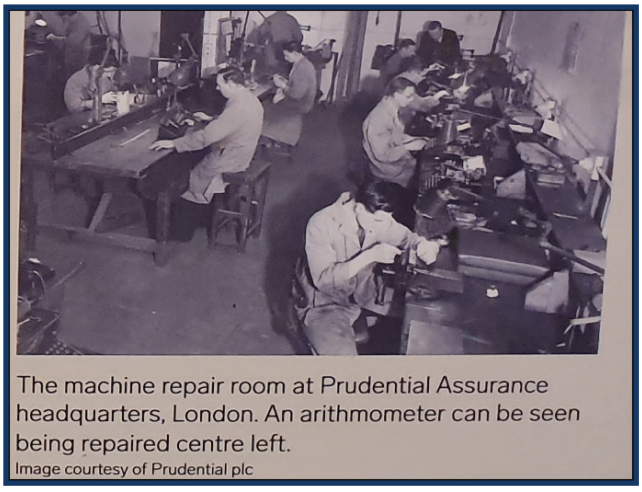
6. Mechanization of data records:

In 1837 the analytical engine of Babbage is presented, British mathematician and computer scientist Charles Babbage. The initial objective was a kind of computer specifically designed to construct tables of logarithms and trigonometric functions evaluating polynomials by approximation.

Although this project did not see the light for economic and personal reasons, Babbage understood that part of his work could be used in the design of a general-purpose computer, so he began the design of the analytical engine.

The analytical engine was to be powered by a steam engine and would have been 30m long by 10m wide. For the entry of data and programs, he had planned to use punched cards, a mechanism already used at the time to control various mechanical equipment. The output was to be produced by a printer, drawing equipment, and a hood. The machine also had to punch cards that could be read later. The analytical machine worked with base 10 fixed point arithmetic and had a memory capable of storing 1,000 numbers of 50 digits each. An arithmetic unit would be in charge of carrying out the arithmetic operations.

Illustration #4. Replica of the analytical engine of Babbage. London Science Museum, England.



The machine repair room at Prudential Assurance headquarters, London. An arithmometer can be seen being repaired centre left.
Image courtesy of Prudential plc

In 1888, the Prudential insurance company was the first to offer insurance products to the mass of the population. To process the enormous amount of data, he developed what is known as an 'Arithmometer', a mechanical calculating machine.

Illustration #5. Repair room of the machine called 'Arithmometer'.

7. Introduction of graphs in statistics.

In 1786, William Playfair, a Scottish engineer and political economist, introduced graphics into statistics. In that year he published The Commercial and Political Atlas where he included 43 time series and a bar graph on various aspects of the British economy, especially on foreign trade.

The idea was transcendent in its day: the visual representation of space had been used for centuries, but until then no one had thought of representing numerical series visually, instead of as mere tables.

Playfair, in his collection of diagrams, offered a more comprehensive view of trade between nations. Another of his great works was The Statistical Breviary, with European economic and demographic data, which among other things contains the first pie chart.

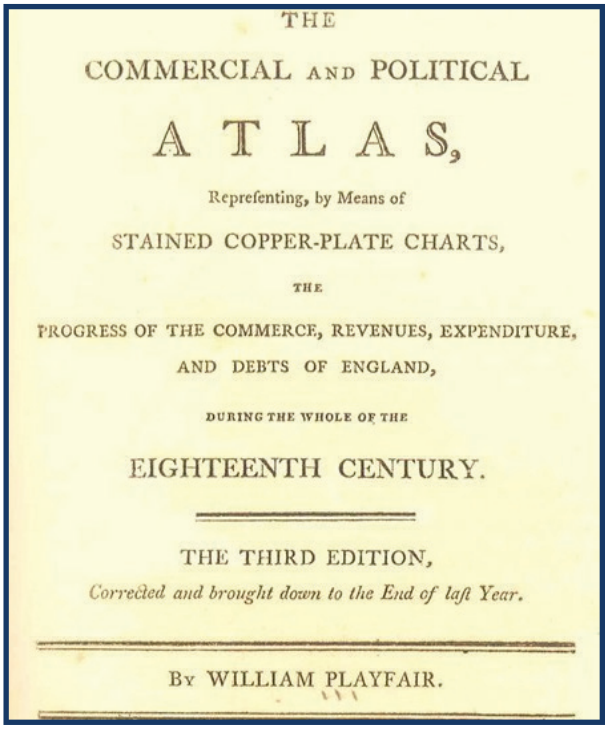
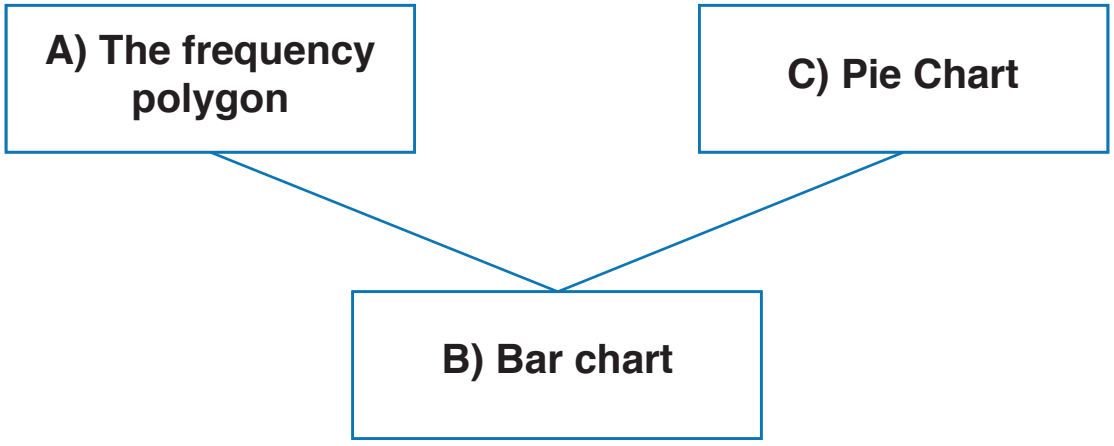

THE
COMMERCIAL AND POLITICAL
ATLAS,
Representing, by Means of
STAINED COPPER-PLATE CHARTS,
THE
PROGRESS OF THE COMMERCE, REVENUES, EXPENDITURE,
AND DEBTS OF ENGLAND,
DURING THE WHOLE OF THE
EIGHTEENTH CENTURY.
THE THIRD EDITION,
Corrected and brought down to the End of last Year.
By WILLIAM PLAYFAIR.

Illustration #6. William Playfair Commercial Atlas.

According to Playfair, a good graph provides a more adequate explanation of the facts than a mere list of data or tables. It serves to simplify the complex, allows the brain greater retention and is a visual aid to busy men. Finally, the graphs allow us to see apparently non-existent relationships between variables, which are often hidden in the multitude of data and figures, difficult to compare otherwise.

He invented three types of schemes:



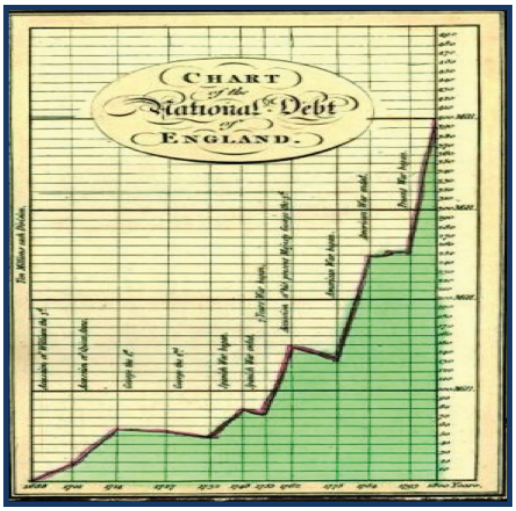


Illustration #7. England Debt Chart

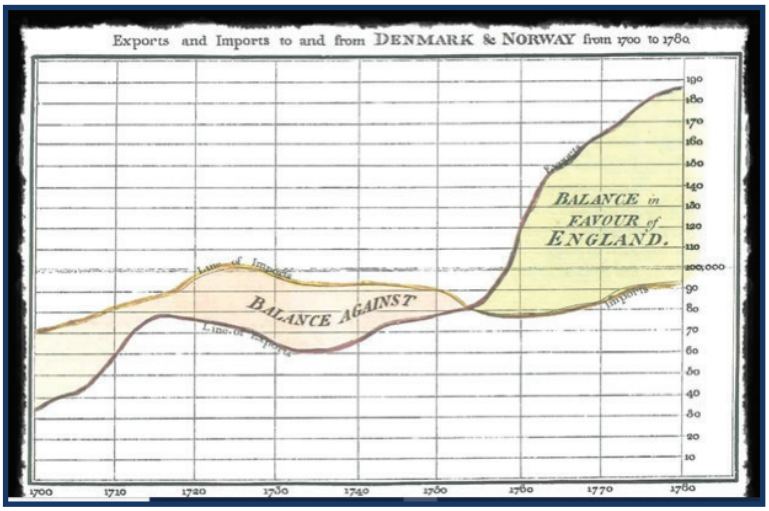


Illustration #8. Exports and Imports from Denmark and Norway

8. Information vs Data

The concepts that we have seen so far have been about data and/or information. Were the INCAS handling data or information?

Although the terms data and information are generally used to describe the same thing, to the IT professional these terms mean different things.

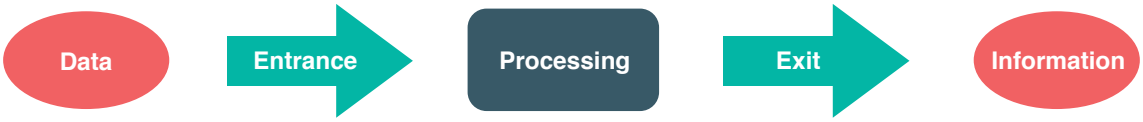


Illustration #9. Flow of data and information.

Data is a term that refers to facts, events, transactions, etc., that have been recorded. It is the raw input from which the information is produced.

Information refers to data that has been processed and communicated in such a way that it can be understood and interpreted by the recipient.

It could be summarized that when obtaining information, knowledge is added to the receiver. According to the consulting firm Gartner Inc[3], the value of information has three (3) degrees:

a) Done: Based on current and execution capabilities.
b) Probable: Based on expectations and planning capabilities.
c) Potential: By applying the data to all relevant processes.

[3] **Gartner Inc. is an information technology research and consulting company based in Stamford, Connecticut, United States. The company focuses on research, executive programs, consultations, and events. It was founded in 1979.**

9. The Information Age:

The information theory, also known as the mathematical theory of communication or the mathematical theory of information, is a theoretical proposal presented by Claude E. Shannon[4] and Warren Weaver in the late 1940s. This theory is related to the mathematical laws that govern the transmission and processing of information and deals with the measurement of information and its representation, as well as the ability of communication systems to transmit and process information. Information theory is a branch of probability theory that studies information and everything related to it: channels, data compression and cryptography, among others.

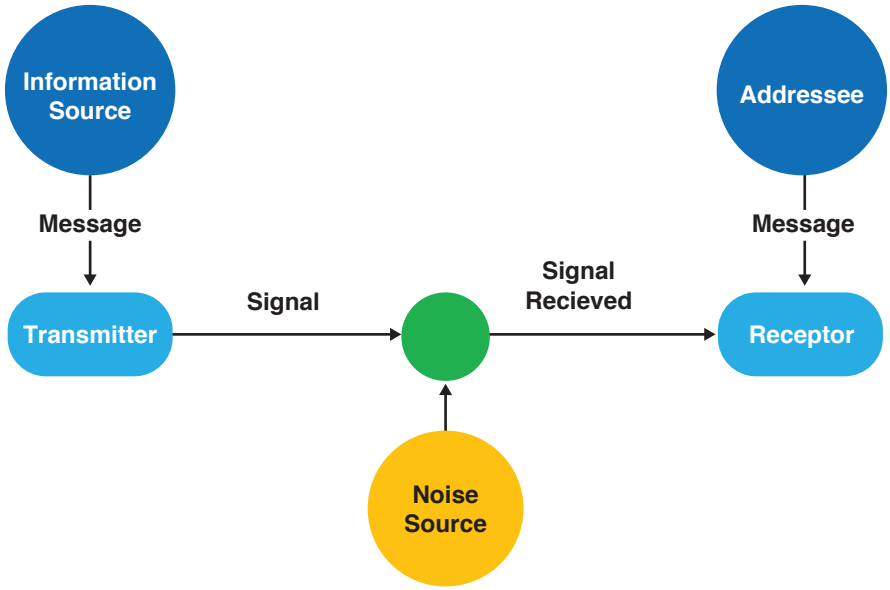


Illustration #10. Communication scheme by Claude Shannon

The Digital Age (also known as the Information Age or Information Age) is the name given to the period in human history that is linked to Information and Communication Technologies (ICT). The beginning of this period is associated with the digital revolution, although it has its antecedents in technologies such as the telephone, radio or television, which made the flow of information become faster than physical movement. The digital era differs, in any case, from the analog by its configuration based on the digit, and not mechanical like the first ICTs.

[4] Claude Elwood Shannon was an American mathematician, electrical engineer, and cryptographer remembered as "the father of information theory." Shannon is recognized for having founded the field of information theory with the publication ‘’A Mathematical Theory of Communication’’, which was a landmark in 1948.

The very development of digital tools, born from analog calculators, through the first data processors with punch cards, the development of transistors, silicon circuits, Alan Turing[5]'s first steps regarding computational algorithms, advances of communications product of the Second World War and the beginning of the Cold War, the achievements at the software level product of the war for the conquest of space by Russia and the United States.

During the 12 years of the Third Reich, IBM facilitated the identification of millions of Jews through punch card technology. First commercial application of the same.

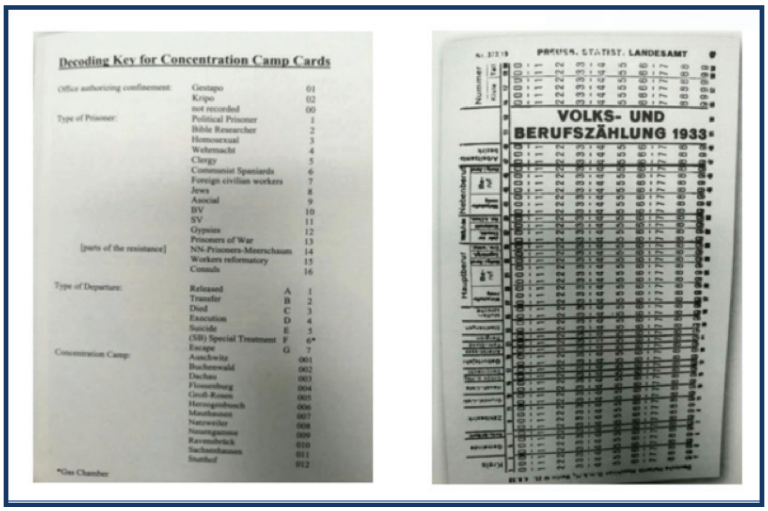


Illustration #11. Jews ID's along with their equivalence table.
Image extracted from the book "IBM and the Holocaust" by the author Edwin Black.

"In mid-1968, 400 people worked on the APOLLO software, because the software was the way in which the United States was going to win the race to the moon," a process with the active participation of Margaret Hamilton[6].

Starting in the 70's, the development of what would become the most powerful and influential industry in the world began: Software

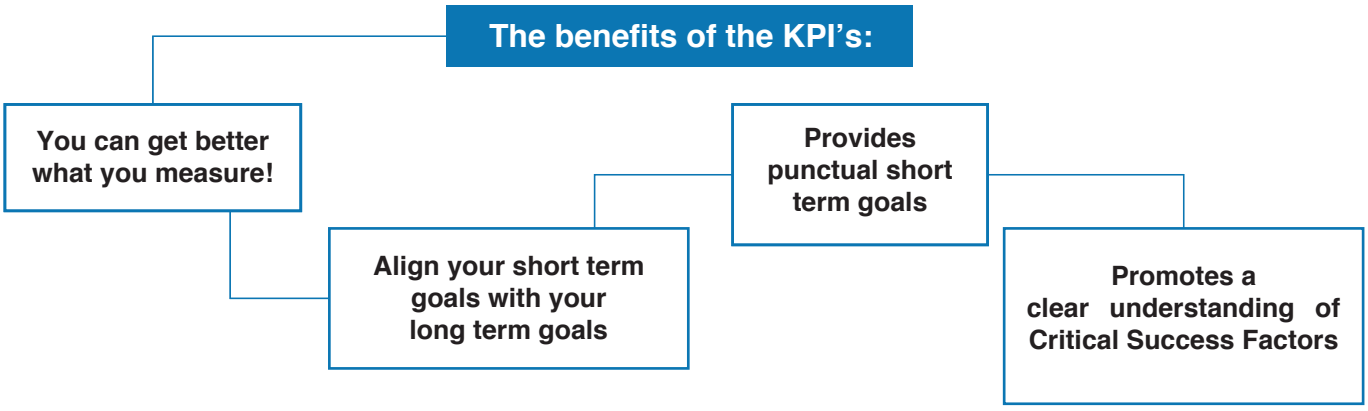
[5] **Alan Turing, British scientist who formalized the concept of "algorithm" and "calculation" with the Turing machine 'Colossus', which can be considered as a general purpose computer model. Turing is considered the father of Computer Science and artificial intelligence.**

[6] **Margaret Hamilton is a Computational, Mathematical, and Software Engineering Scientist. She was director of the Software Engineering Division of the MIT Instrumentation Laboratory, where with her team she developed the "on-board" navigation software for the Apollo Space Program.**

10. The KPI's (Key Performance Indicators)

Before explaining what is related to the Dashboard or Control Panels, we must make known what is called KPI's (it comes from the English Key Performance Indicator).

A Key Management or Performance Indicator is a measure of how well processes are being executed. They can be measured in terms of amounts or quality.



The KPI's are generally represented graphically by means of an analogy with the colors of the traffic lights, where a result of a red KPI indicates that the goal set was not met, a yellow result is that the result is within the established slack and if it is a red result, then it is far from the established goals.

11. The Dashboards or Control Panels

Birth of the Dashboards

For thousands of years we have seen the great interest of all generations in being able to 'measure', classify and quantify different activities. The tools have been different, from clay, stones, string, paper, punch cards, to digital tools.

In all of them there is a common factor and that is the standardization of what the 'data' can say for decision-making purposes.

A dashboard is a type of graphical user interface that provides views of key performance indicators (KPIs) relevant to a particular goal or process. In another use, "dashboard" is another name for "progress report" or "report" and is considered a form of data visualization.

The term dashboard originates from the dashboard of the car, where drivers monitor the main functions at a glance through the dashboard.

Today the "dashboard" is typically accessible via a web browser and is typically linked to up-to-date data sources.

12. Evolution of Dashboards

Dashboards have also evolved. Its terminology is supported from the moment the statistical graphs are developed.

We can see a special representation of the Dashboards in the MAP ROOM[7] that Winston Churchill had during the Second World War. As we can see in the following graphs, in said table of maps there were Dashboards that represented the results of the war processes themselves.

Illustration #12. Access door to the Map Room inside the Churchill War Rooms museum.

Illustration #13. Map Room. You can see the world map with information at various points.

[7] The Churchill War Rooms (literally, Churchill's war rooms) became a museum in London and one of the five branches of the Imperial War Museum. The Museum comprises the Cabinet War Rooms, an underground historical complex that housed a British government command center during World War II, and the Churchill Museum, a biographical museum that explores the life of British statesman Winston Churchill.

In the MAP ROOM there were different areas. One of the areas was where they received the data, this through the different telephones that were there. These data were tabulated and placed on the maps.

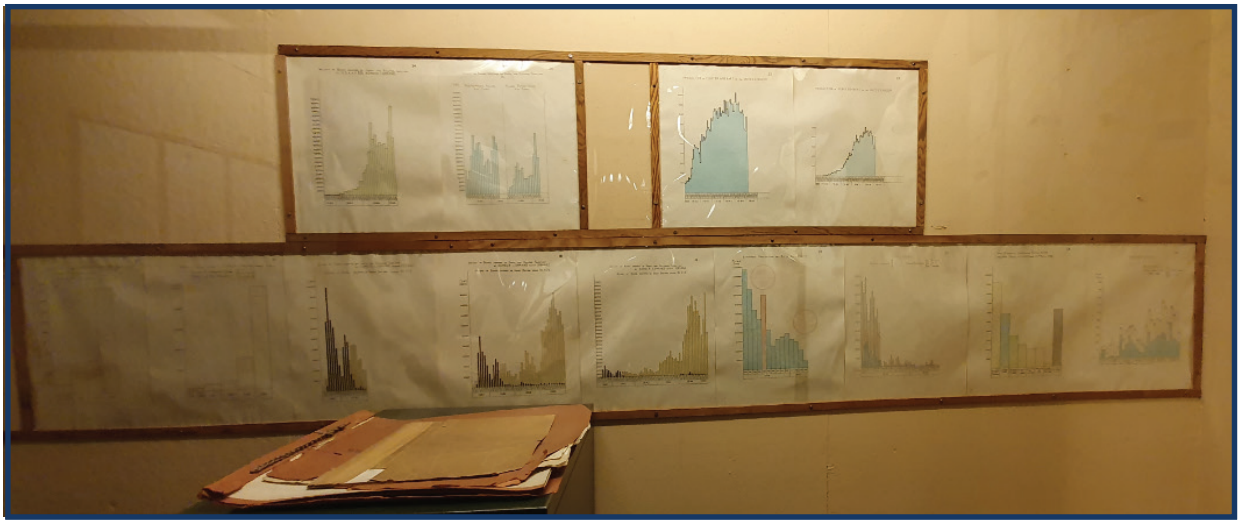


Illustration #14. Map Room. You can see different tables with graphs regarding the war processes at that time. Inventory of weapons, ammunition, numbers of deceased soldiers, advances, among other points.

Data analysts at the time, took this data relative to the war processes and drew the newly developed bar, line and area graphs. They were placed on the walls of the MAP ROOM.

13. Massification of the Data

‘‘The software is eating the world’’, expressed Marc Andreessen in the Wall Street Journal in 2011. What Marc Andreessen has meant is that from the accelerated development of the Software Industry, starting in 1970, there has been an accelerated digitization and systematization of business processes and the daily chore. This has caused an overcrowding of data storage.

Illustration #15. 5 MB disk (IBM) along with a 128GB USB stick.

In Winston Churchill's Map Room, data on warfare were physically and visually captured on the battlefield, recorded on forms, and transmitted via phone calls. The recipients of the calls completed forms which were consolidated by the analysts and designers of the Dashboards who drew them manually and placed them on a wall.

Today that would be a mostly digitized process and the data would be captured online, via sensors, GPS, drones, radars and structured storage of servers. From there you would have the Dashboards with information in real time.

14. Dashboards today

The original concept of measuring data and information is maintained and evolves as the digitization of processes and dataification advances[8]. The exponential systematization of both business processes and our daily lives has led to large volumes of data and information.

This has led to the development of tools and techniques to enhance and expand the use of Dashboards. Each string of a Quipu or each set of stones or each graph on paper or the walls of Winston Churchill's War Room have the same meaning as the screens of today's software tools to display Dashboard.

We have notable differences in terms of the volume of data and information that we can handle, the speed with which we can obtain the data and the diversity of their presentations. In the same way, we can distribute the Dashboards in real time to anyone who has a digital device with internet access.

Illustration #16. Evolution of Data Storage.

[8]"Dataification" is the process by which a phenomenon (even a state of mind) is captured in a quantified format for tabulation and analysis. At present this process is incessant, and its consequences will imply a paradigm shift as important as that of the invention of the printing press.

15. Dashboard features:

ID	ELEMENT	DASHBOARD
1	Is used for...	Measurement / Monitoring performance
2	As a tool measurement is...	Metric
3	The measure is linked to defined objectives...	Does not bind
4	Measure...	Performance
5	It updates...	In real time
6	It focuses on...	Operational objectives (short term)
7	Your goal is...	Give a high-level idea of what what is happening in a process
8	Your help...	Visualize performance for understand the current state
9	In the car it's...	Dashboard of the car (Sample of how your car is running)

16. Dashboard presentation tools:

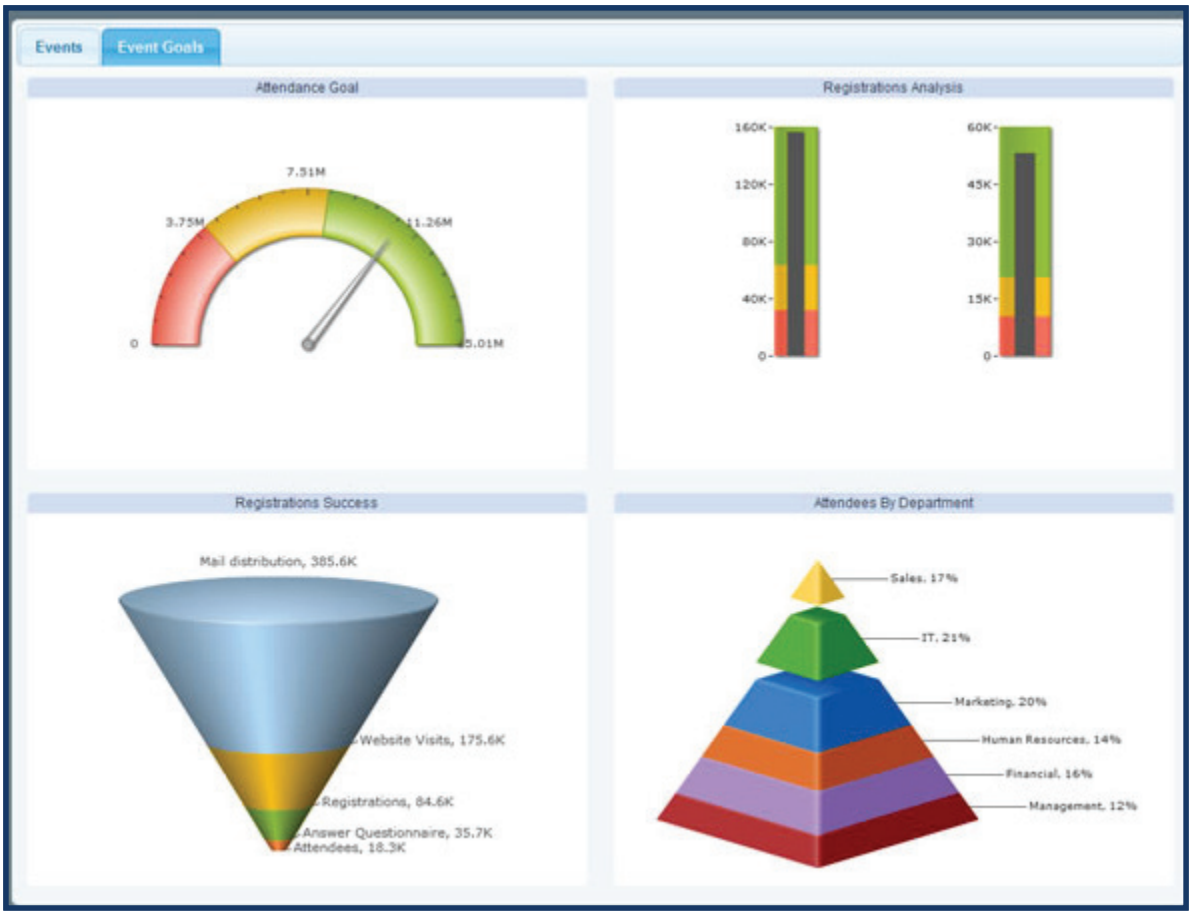


Illustration #1. Example of a Digital Dashboard. Various graphic representations are placed.

According to (Su Tzu[9]) indecision is always reckless, if you wait until absolutely everything is ready, of course and there is no risk of uncertainty, you will never make a decision and experience shows that the worst decision is "Not knowing to decide". Information is KNOWING and that is why before making a decision collect as much information as possible, this, combined with the appropriate tool, will help you in making decisions.

Today most software platforms have a Dashboard to probably summarize the key management indicators (KPI), operational and analytical results aspects.

[9]Sun Tzu was an ancient Chinese general, military strategist, and philosopher. The name by which we know him is actually an honorific meaning "Master Sun". His birth name was Sun Wu and outside his family he was known by his courtesy name.

Illustration #18. Example of a Digital Dashboard. Various graphic representations are placed.

These tools are fed by the data that is stored through information systems, sensors or other means of digital data collection. We find Dashboards in Finance ERP software, in social media management software, in our applications that we use on smartphones, on vehicle screens, to name a few.

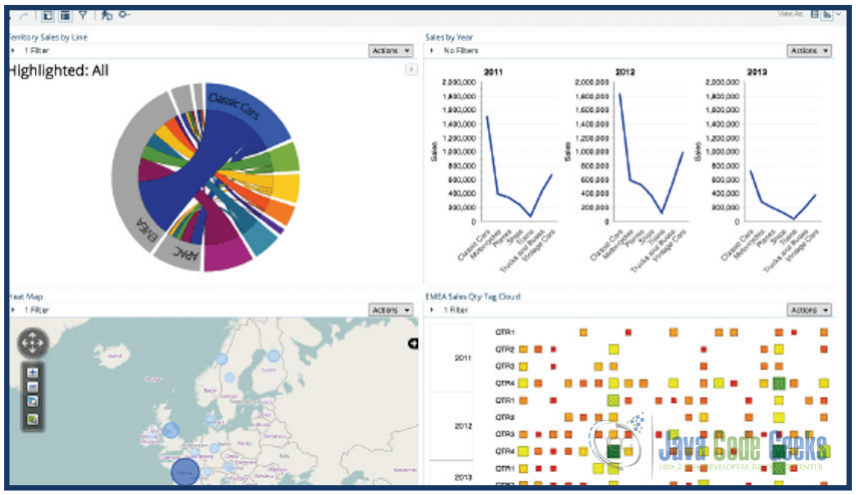


Illustration #19. Example of a Digital Dashboard. Various graphic representations are placed.

Dashboards come as a blank canvas, ready to put visuals there. The graphs, tables, indicators, maps, etc. that are available are placed. The update of the same can be instant or with the frequency that we indicate.

Illustration #20. Mercedes Benz GLS technology 2021. Dashboard.

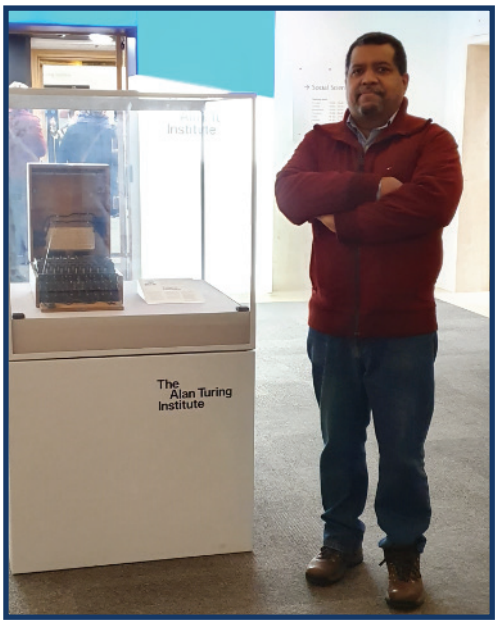


Illustration #21. Copy of the 'Colossus' by Alain Turing located at the Alan Turing Institute in London, England.

Dashboards have incorporated a concept that Alain Turing expressed in 1938 when he indicated that generalist machines (computers) were to be developed, that is, the same device could perform different functions and not just one as it was conceived at that time. A phenomenal screening and he was right.

That is why we see in the following table how the control panels of these spaceships have varied from having an instrument for each indicator to having a digital Dashboard that presents the indicators that we need to know.

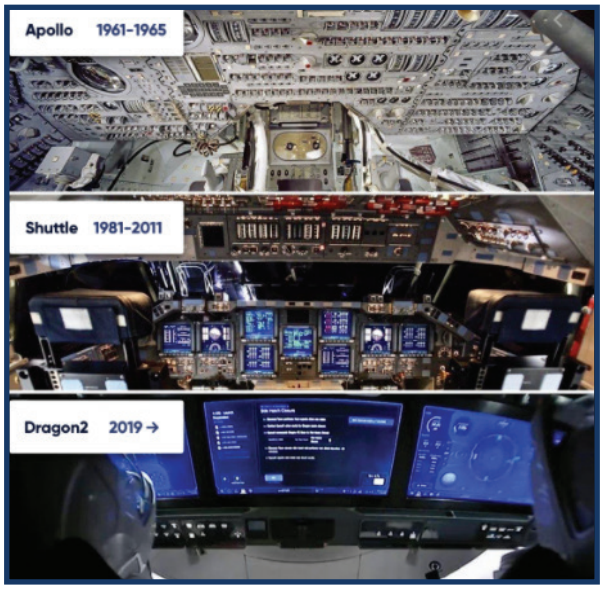


Illustration #22. Evolution of the Dashboards of North American spacecraft.

17. Dashboards and their consistent evolution:

The first findings on the quantification of events are expressed with tools according to the environment of each era. That is why we see the use of stones, clays, ropes, among other elements throughout the history of mankind. To this quantification process, aspects related to time were added and hence the importance of the appearance and sophistication of the Calendar. It was important not only to know information at the moment but its change over time.

As society became politically and socially organized, it was important to include demographic data on citizens and hence the appearance of censuses as a tool for collecting these data. At that time, there was already the quantification of activities or processes, their behavior over time and data on citizens.

Illustration #23. Evolution of the graphic representations of the quantifications.

The population was growing in quantity and in its activities and improvements in the data recording process that were produced were imminent. Analogous machines were developed for data recording and together with them the graphical representation of the data and the statistics appear.
This combination of statistical tools plus analog data recording leads to what is called Measurement or Information Theory, a step prior to the appearance of the digitization of processes and with it the massification of data collection and processing.

In all these stages it was necessary to have a tool to represent said quantification. Today we call it the Dashboard or Control Boards. They are overcrowded, have design schemes and good practices and are for the daily use of the population.

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