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NAAMÃ MENDES JUNIOR

INVESTIGATE THE PAST, PRESENT AND FUTURE, AND HOW TECHNOLOGY AFFECTED THE KM CYCLE

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Dissertação apresentada como requisito parcial à obtenção do grau de Mestre, no Curso de Pós-Graduação Stricto Sensu em Gestão do Conhecimento nas Organizações, do Centro Universitário de Maringá-UniCesumar.

Orientador: Prof. Dr. Flávio Bortolozzi
Coorientadora: Profª.Dra. Cláudia Herrero Martins Menegassi

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Monografia apresentada como requisito parcial à para obtenção do grau de Mestre no Curso de Gestão do Conhecimento nas Organizações, Centro Universitário de Maringá- UniCesumar.

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Maringá, maio de 2019.

Dedico este trabalho à minha família,
que me apoiou em todos os momentos da
minha vida. Te amo Pai e Mãe

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“Ensinar não é transferir conhecimento, mas criar as possibilidades para a sua própria produção e construção”.

(PAULO FREIRE, ano, p.).

RESUMO

A Ciência da Gestão do Conhecimento é reconhecida academicamente a apenas algumas décadas. Durante estas décadas tem permeado em diversos setores da economia, e criado um catálogo enorme de publicações e artigos científicos. A gestão do conhecimento é jovem em seu reconhecimento na Academia, e com esta nomenclatura, porém, já atua no mundo real, desde o advento do acúmulo do conhecimento. Nessa perspectiva o objetivo do trabalho foi fazer um resumo histórico da Gestão do Conhecimento, como ele evoluiu durante a história humana, especificamente em reação a avanços tecnológicos, e seu impacto no ciclo da Gestão Conhecimento. A pesquisa é de natureza teórica e qualitativa, portanto será utilizado a metodologia de uma revisão bibliográfica e documental, nas publicações mais influentes no meio acadêmico pela perspectiva de Gestão do Conhecimento. A revisão bibliográfica irá explorar os tópicos de história da Gestão do Conhecimento, Ciclo da Gestão do Conhecimento, e Tecnologia na Gestão do Conhecimento. Por meio disso será possível, trabalhar dentro de um escopo histórico, do início da sociedade até 2019, com uma perspectiva futurista, com o que pode ocorrer no futuro com a implementação de novas tecnologias como Big Data e Inteligência Artificial. Nossos resultados acusam a necessidade de aumentar o fluxo de pesquisa sobre o passado do Ciclo da Gestão do Conhecimento, uma dedicação maior a implementação e estudo sobre o futuro da Gestão do Conhecimento.

Palavras-chave: Gestão do Conhecimento, História da Gestão do Conhecimento, Ciclo da Gestão do Conhecimento.

ABSTRACT

The Science of Knowledge Management has been recognized academically for only a few decades. During these decades it has permeated in several sector of the economic, and created an enormous accumulation of knowledge through publications and scientific articles. Knowledge Management is a young science, and only recently been academically recognized for its importance, however in the real world, it has been in action since the beginning of the accumulation of knowledge. From that perspective the objective of this paper was to do a historical analysis of Knowledge Management how it evolved throughout human history, specifically its reactions and changes due to technological advancements, and its impact in the Knowledge Management Cycle. The research method is theoretical and qualitative, therefore we utilized a documental and bibliographical review, looking at the most influential publications in the academic field. The bibliographical review will focus on the following topics: History of Knowledge Management, Knowledge Management Cycle, Technology and Knowledge management. Through that approach, it was possible to work within a historical scope, surveying the initial of human accumulation of knowledge, to 2019, with a futuristic perspective, specifically due to the insertion of technologies such as big data and artificial intelligence. Our results showed a necessity to increase the focus on the past perspective of Knowledge Management Cycle, and a need to increase the study of the future of knowledge management cycle, with a focus on emerging technologies.

Key-words: Knowledge Management Cycle, History of Knowledge Management, Knowledge Management Cycle.

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KMC - Knowledge Management Cycle

KM - Knowledge Management

AI - Artificial Intelligence

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Chapter 1: Introduction

1.1 Background

Thousands of years ago, one human being, taught another human being how to make fire. Those human beings discovered, identified, and created the knowledge necessary to make fire. This Knowledge was stored in the memory of the human beings that came in contact. Through that process people utilized that knowledge and made improvements upon it (DALKIR, 2005). As we can observe, even prior to oral language, without books, computers, Knowledge Management existed thousands of years prior to its academic existence in 1980's. The objective of this research is to look to the past, observer how technology helped the process of knowledge creation, storage, sharing, utilizing, learning, and improving, throughout different times in human history, and which are the new technologies which will impact the knowledge management cycle (SOUZA, 2014).

Knowledge Management is something intrinsic within societies. Wherever there is data, there is information, and therefore knowledge that must be managed. The process of how Knowledge is created, how cycles evolve, and how its management is perfected by new technologies. The Knowledge Management cycle is the exact description of that process, in which there are various research and models. (SPANHOL, 2015) During this research project we analyze different models, however work primarily with Dalkir's model which has the following steps; Create, Store, Share, Utilize, Learn, (DALKIR, 2005).

The context in which we will be studying in ample, vast and wide, therefore it is necessary to define the basic aspects of knowledge. Understanding the definition of it, will help to identify it throughout history. It is widely accepted that the construction of knowledge within Knowledge Management, is built upon data, information and thereafter knowledge.

For Klincon (1999), data are only facts without any particular organization, or analysis. Data can come in many forms, mostly in numbers and text, however it can also be memories and oral stories (BROOKING, 1999). Data points without analysis are completely useless, however it

is the essential building block for knowledge. Throughout history data evolved, from what you could observe and tell, then what you could read and write, and now what you can type and share. A more elegant way to define data is that data is representations of our reality without any process of analysis (FAUCHER; EVERETT; LAWSON, 2008).

Never in the world have we collected more data points. What we eat, what we buy, whom we talk to, where we go. Our watches contain biometrics, our cars keep our location, our phones keep our interest. **With the understanding that Data is the basic unit of knowledge** (FAUCHER; EVERETT; LAWSON, 2008). With that understanding it is easy to connect the dots, the more data, the more opportunity for information the more possibility for Knowledge. Each and every step of the technological evolutions we will follow, we will see that more data was collected, and stored, which would effectively create more opportunities for knowledge creation.

Information was not given its importance until the industrial revolution, (LEONARDI, 2014). While many often reproduce that idea, very few people actually understand what information actually is (NONAKA, 1995). Information goes a step beyond data, a stepping to stone to knowledge. Information is a natural evolution of data, and absolutely necessary to understand how knowledge is created, the very premise for knowledge creation is having enough information. There are various definitions for information, however Nonaka (1995) mentions that there is a loose academic consensus, that says, **information is data within the appropriate context to help with decision making for organizations** (THIERAUF; HOCTOR, 2006). Context is valuable because it directly impacts the type of decision that is being made. Think about the example of a t shirt bought at a store. For the store, this generates income, data of the buyer, what was bought, and where to ship it. For the Bank it gives information of how much money should travel between which accounts. Both types of information are valid within their context (KLINCON, 1999). In the 1980's Nonaka called an organization a machine for processing information, showing that in the beginning of Knowledge Management, information, was the greatest star. There was a tremendous focus on the accumulation of information, which has reigned from the 1980's until present time, however, there has been a difficulty turning that information into knowledge. (EVANGELISTA, 2006) The advent of Knowledge Management

showed that information by itself was not an effective to help decision making within organizations. Information became the fuel to the process of knowledge creation within organizations. (LEONARDI, 2014)

Knowledge has been defined with a broad stroke throughout history and different academic perspectives. Within the academic context of KM there are many definitions for knowledge, however there are few principles that are present in most definitions. First, its outmost importance within the decision-making process of organizations, secondly that information and data are the building blocks of knowledge (NONAKA, 1995). Wigg for instance, defines Knowledge as facts, data, know how, mental maps, references and experts' opinions after the analysis of information (WIGG, 2004). Davenport and Prusak (1998) definition can be resumed as a group of information within context applied through a concise process by experts in order to create the knowledge necessary. For Poersch (2004), from the 1990's knowledge began to be the largest focus or organizations, specifically the process to create and manage knowledge. A definition by Faucher, Everett and Lawson (2008), nicely resumes the link between information and knowledge, "**Knowledge is the information that was processed and applied in an effective manner".** Figure 1, shows the process in which data transforms itself into information, knowledge, and to his definition wisdom. It is a construction, in which the more data, the more potential for information and the more potential for knowledge. We will see that throughout history, new technologies, which help to release bottlenecks throughout this process.

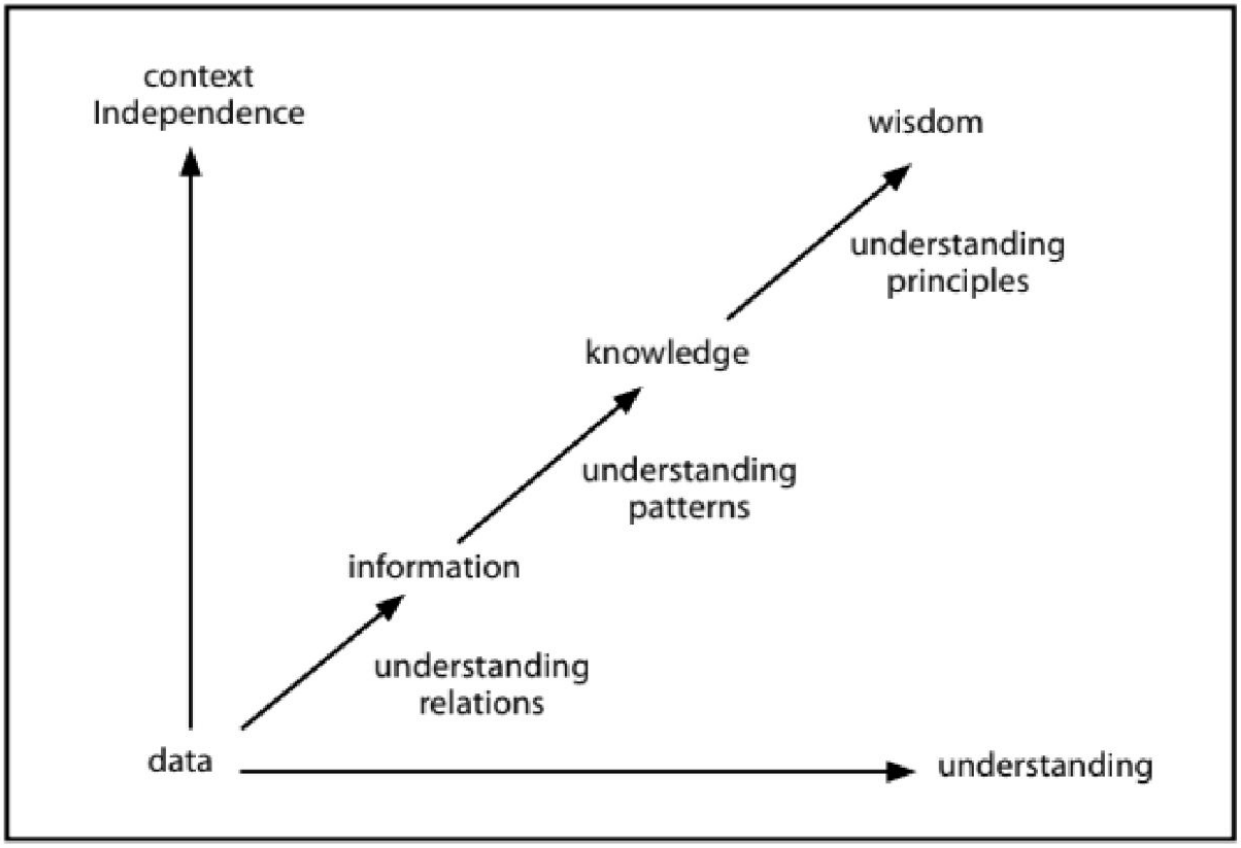


Figure 01 – Conceptual Progression from Data to Knowledge. Filemon A. Uriarte Jr. (2008)

Figure 01, helps to frame what we will understand as data, information and knowledge within this research paper.

Table 01 – Author

Data:	Data is the representation of facts and reality without process.
Information:	Information can be considered data that was processed to place it within its appropriate context.
Knowledge:	Knowledge is information that was processed in a significant way in order help organization make assertive decisions.

Now that we have defined data, information and knowledge, we can look to its disruptor within the context of this research paper, what is technology. When we speak about technology there is a natural tendency to look at computers, tablets, smartphones and things of that sort, however technology could be something far simples. Technology is indeed any tool or system that aids the human being, (BAIN, 1937), or a way to solve for a human desire or need (ARTHUR, 2002). That ample definition and vision allow us to walk through history and identify techniques and tools that are often ignored when the discussion is tech. Through this research paper we considered everything from oral language, to paper, to artificial intelligence all within the wide lens of what is technology.

The importance for technology in KM is apparent within literature. In reality KM is closely related to Knowledge Engineering and Information Systems. Technology and systems that were created in the 1980's paved the way for the prominence of KM within organizations, showing that technology was essential in the creation, storage, sharing and utilization of knowledge (DAVENPORT; PRUSAK, 1998). Technology opens possibilities to acquire data, understand its context, and create knowledge, that without it would be impossible to do so, however technology is not considered an end in itself, but rather a way in order to create knowledge (O'DELL; GRAYSON JR, 1999). We examined how each different type of technology affected different aspects of the knowledge management cycle in its own way.

The genesis of knowledge management is often attributed to one author in the U.S and another across the pacific in Japan. Wigg in the U.S in 1986 and Nonaka in 1987 in Japan began formalizing the topic, and saw it consolidated within the 1990's (SOUSA; NAKATA;

CALADÃO, 2014). Information Technology was the greatest potentialize to the discipline, and within the 1990's it became clear that Knowledge became the biggest competitive advantage for companies and organizations (PORTER, 2001). The Genesis of the discipline and its adoption happened quickly, and its accelerated growth to meet the needs of society at present time did not allow for the discipline to look back to see how KM was present prior to its academic discovery (WIGG, 1997). Within the discipline of there are theories about how knowledge is actually created, stored, and shared, it is referred to as Knowledge Management Cycle. A deeper understanding of this cycles will be given in chapter three, for now, I will simply state that we will utilize Dalkir Cycle, which is constituted by creation/identification, Storage, Sharing, Utilizing, Learn and improvement. To finish this introduction, I will attempt to organize the cycle which we will be replace ting, and the technologies which we believe it has impacted.

Table 02 – Technology that impacted the cycle of knowledge. Source: Author

Cycle of Knowledge	**Technology that will be studied**
Create/Identify	Oral Language
Store	Agriculture/Cities
Sharing	Writing
Utilize	Parchment/Paper
Learn	Printing Press
	Industrial Revolution
	Information Revolution
	Big Data/Artificial Intelligence

Table 03 – Impact of Technology per cycle Source: Author

	Create	Store	Sharing	Utilize	Learn
Oral Language		X	X		
Agriculture/Cities	X		X	X	
Writing		X	X		
Parchment/Paper		X	X	X	
Printing Press/		X	X	X	
Scientific Method	X			X	X
Industrial Revolution		X	X	X	
Information Revolution		X	X		
Big Data		X	X		
Artificial Intelligence	X	X	X	X	X

Table 3 shows where the technology impacts the cycle of knowledge management. As we can see most of the disruptions impact storage and sharing, and only indirectly affect utilization, learning and most importantly creation. The three big shifts in creation of knowledge are Agriculture and Cities, Scientific Method, and lastly Artificial Intelligence. The first two shifts are about a change in paradigm in thinking, and in living, by humans. Humanity started to think different and created techniques that changed the way we found truth, fact, or knowledge. Artificial Intelligence is the change of the primary creator of knowledge, from human, to machine.

1.2 Objectives

1.2.1 General Objective

Investigate the past, present and future how technologies affect the Knowledge Management cycle.

In other words, to work within a historical scope since the beginning of human society, to 2019 with an eye to what may occur in the future, in particular due to the further development of technologies such as Big Data and Artificial Intelligence. The research will attempt to look at how technologies impacted the knowledge management cycle.

1.2.2 Specific Objectives

In order to achieve the goal of answering the General Objective the following Specific Objectives were outlined:

- investigate the accumulation of knowledge throughout history;
- identify technologies that have changed the process of the Knowledge Management Cycle;
- understand and Analyze how technologies such as Artificial Intelligence, Big Data and Biometrics can help with Knowledge Management;
- analyze perspectives about the evolution of Knowledge Management; and
- show how Knowledge Management with absorb technologies such as big data and artificial intelligence.

1.3 Justification

The world is changing rapidly, and the increase in data, the basic unit of KM, is at the forefront of that change (FAUCHER; EVERETT; LAWSON, 2008). In the last two years, the world created more data, then in the previous rest of human history. Today 73% of organizations invest in big data, yet only half of a percentage point of all the data created is actually analyzed. (Gartner, 2014) The area of Knowledge Management finds itself in its adolescence, having gone through a rapid growth of practices techniques tool and process of how to manage knowledge, and coming to an inflection point. An explosion of data in an exponential rate, makes us reflect about its past, think about its future, and try to understand its present.

The explosive growth of Knowledge Management within the last few decades can be explained simply by need. Organizations and companies needed to have a framework for understanding how to manage knowledge, once knowledge became the primary factor for market competitiveness (PORTER, 1994). With the growth of service-based industry, that has that particular focus, Universities became involved in the process of creating an academic framework to understand the process and create best practices (FREIRE, 2014). The necessity to comprehend and develop de discipline, meant that there were few articles looking at the past, and trying to comprehend how knowledge management was applied prior to the develop of the academic discipline. To look at our past and look at how different people utilizing different technologies were already utilizing knowledge management cycle without even knowing it.

With that insight we can gain about how past technologies impacted Knowledge Management, we may be able to more accurately infer how new technologies such as Big Data and Artificial Intelligence (AI) might impact our future. The historical mapping of these technologies and their impacts, and evaluation of knowledge management and its evolution, and the future of knowledge management is the justification for this thesis.

1.4 Thesis Structure

The mechanism for this research paper will be a literary review. Based on a revision of literature existing in Knowledge Management, specifically knowledge management cycles. The hope is to understand and show how Knowledge Management has progressed to its current

model, more precisely the popular model utilized by Evans, Dalkir and Bidian (2014), that can be shortened to include, knowledge creation, storage, sharing, utilization and learning therefore restarting the initial cycle.

We will also present a historical study of the greatest advancements in technology that most contributed to the Knowledge Management cycle, from the advent of language, through the era of information. The desire is to map out, how vast were these technological impacts, and how it changes the cycle for knowledge management. We will analyze how incipient technologies, such as Big Data and Artificial Intelligence will affect the knowledge management cycle. Which parts of the KMC will be affected by these new technologies, how will it change the very nature of knowledge, and how it is applied in organizations? At last, we will look at the evolution of knowledge, throughout human history.

Chapter 2: Literary Review

2.1 A historic overview of technologies that impacted Knowledge Management.

The technologies with largest impact in Knowledge Management, in general have impacted the KMC, and its process. According to Dalkir and Evans (2014), KMC can be reduced to the process of creating or identifying knowledge, adequately storing knowledge, sharing knowledge, utilizing knowledge, and lastly, learning. As we have already defined, the goal is to see how technology has contributed to the evolution of KMC directly or indirectly. For technology we utilized Read´s definition, with is vast, and open, as it states that technology is any instrument of process that helps a human being acquire something or reach an objective. This vision about technology allowed us to better understand how diverse technologies help with the development of KM, specifically how Information Technologies had the largest effect on the academic discipline. As we have seen earlier, we will work with the following definition for Knowledge Management Technologies, as any technology that helps the process of communication and dissemination of information (ZHANG; SHELLEY; HESHAN, 2008).

2.1.1 Oral Language, Myths and Religion.

It is rare for us to consider language as innovation. It is so crucial, and such a part of our day to day lives, essential for basic communication, however it is the very thing that makes us the most advanced creatures in this world. About 200 thousand years ago, our ancestors appeared on earth, and had very little impact in its ecosystem, and surroundings, simply another mammal in the hemisphere. After 170 thousand mediocrities in the global scale, our ancestors developed and advanced methodology to communicate through a combination of sounds. This change allowed human to thrive and increase its superiority over other animals (PINKER; BLOOM, 1990).

Knowledge Cycle now had a different start point, voice, made it easier to share and store knowledge. Prior to organized language, much of information was stored through DNA, like all other animals, through natural selection. The animals that had the best instincts copied in their DNA were able to survive and thrive, therefore reproducing the DNA makeup. Humans began utilizing myths, stories and tales to begin memorizing important information. Language increased the potential for humans to both share and store knowledge. This allowed for communities to gain communal knowledge as each individual shared their wisdom. With that development humanity began to accumulate knowledge across generations.

Think about a simple mouse that passes his days in the NY subway. The mouse, throughout his life has learned about the best spots to eat, where he must be careful crossing the street, and how to run away from those pesky humans. When he dies, maybe those that saw could carry out that knowledge, however no one could communicate it, tell a story, spread it and store it through language, nothing is left for the next generation to build upon. About 30,000 years ago we began to see the first oral histories being told, through tradition, rituals, and myths information began being passed down from generation to generation. This idea is described by David Christian as Collective Memory, in more than 4 billion years nobody else had the privilege to build upon previous generations. We are where we are because of Collective Memory (CHRISTIAN, 2011).

"Our language in incredibly versatile. We can connect and unlimited series of sounds and signals

> to produce a number of infinite phrases, each one of them with a completely different meaning. Therefore, we can consume, store and communicate an extraordinary amount of information about the world around us (HARARI, p. 31/2015)."”

As described in the text above, our language unlocks the potential for the full knowledge cycle to be completed, that is, storage, sharing, utilizing and learning is made possible, better and easier due to our communication through oral language. The oral language was the structure, while myths, folklore, and even religious texts, were used as the highways to transmit information. (MALINOWSKI, 1976). Tales, myths and religious texts are often dismissed by

science and academia as worthless, as non-valid information, as something that does not pass through the scientific method, all of this information was deemed the most essential to share from generation to generation was now deemed completely invalid. These myths were and still are a way to share information, particularly information about culture and history of communities.

Religious text is also packed with information and knowledge. A constant within Judaism, Christianity and Islam, is a general disdain for predatory lenders (SAUER, 1999). In the Judaic-Christian customs, we have passages in Deuteronomy which gives detailed instructions for plot rotation for crops, as well as some integration of pasture and plantation. All of which is information that is currently still applied in the best agricultural schools in the World. Religious text can be analyzed as a means of transferring information to a large group of people through storytelling, therefore an effective way of teaching. Traditional myths, such as homer's epic poems, initially transferred orally also carried information that was useful to the productivity of that society. An example are the strategies of war, that would later be reused by Alexander the great. The poem also lays the foundation delineating the moral ethics of early Greek society, by reaffirming a focus on glory, courage and paternal society (BELL, 2014).

As stated below

> So he [Achilles] triumphed and now bent on outrage, on shaming noble Hector Piercing the tendons, ankle to heel behind both feet, he knotted the straps of rawhide through them both, lashed them to his chariot, left the head to drop (HOMER, 22: p. 466).

This exemplifies how violence, war is seen as heroic acts filled with honor, the glory of a male, and his power. The poem is effectively transmitting information, and therefore the potential for knowledge.

In Academia this communication process is called oral tradition. Oral tradition is when knowledge, is passed through stories, or myths, from generation to generation. Preliterate societies utilized this oral tradition to pass on rules and other useful information that would ensure the proliferation of a particular society (HAASE, 2011). The greatest difficulty with oral

communication is to keep data uniform. In reality, many traditions, incentivized the great poets to change information and renew these myths (OLSON, 1976). In general, this made the type of information that was shared dealt with big ideas and principles rather than highly technical and exact information. Culture norms, great events, ethics, health and security concerns. Specificity, dates, accountability, and data were not of importance or relevant to the type of knowledge being generated, and store through oral language techniques.

2.1.2 Agriculture, Cities and the necessity for precise information.

Language has allowed for stories and myths transferred important information about general aspects of society through the generations. A series of unassimilated technological advances ended up pushing for the need for more precise and accurate information. The first was the development of agriculture and domestication of animals. These two things together allowed for humanity to move from a nomadic group of 50 to 100 people, to a fully developed society living and developing in a specific space with thousands of people (WEISDORF, 2005). The ability to place themselves within in one place, meant a population boom that was unlike that had been seen before in history (DIAMOND, 1997; GALOR; MOAV, 2002). There are many consider agriculture the largest innovation in history, creating new possibilities and therefore new necessities. It was the first time that a significant of the population was freed from the process of finding food. This allowed for the human species to create new knowledge at unprecedented rates, creating a new class in society, of bureaucrats, artist, innovators, and others. This new class created a domino effect for others, which meant that new ways to transfer and keep data were necessary. Including the next method of communication, writing. The necessity to organize this large society meant that humanity needed a new way to store, share, and communicate knowledge. Since there were more people free to think, humanity was able to evolve into something new, writing.

2.1.3 Writing

Writing was created 2 to 4 times in human history at different times and different places. All of which carried similar traits in the development of each specific society. Let us understand how this happened within the middle east. According to Davies and Davies (1998), about 5,600 years ago in ancient Sumerian as the first cities in that region were establishing themselves. For thousands of years lived at the mercy of what it could hunt and forage. It was completely dependent on what nature was able to offer. The human race walked through the earth without a home, without placing their roots anywhere, always in search of the next source of food. Human being moved in small groups of mostly 10, 50 at most 100 individuals at most. Agriculture changed all of this, making it possible to provide food for thousands of people, year after year, from one central location. The structure of how these groups interacted and behaved completely changed in every area and meant there were new needs to control these high concentrations of people and a system for taxation. Writing was essential to initiate the process of cataloging and controlling items (BAXENDALE; FAIRCLOTH, 2004). Figure two shows an example of an early method of writing, that was used specifically in accounting.

(MET 2004)

Figure 02 – An example of an early method of writing, that was used specifically in accounting. Museum of Modern Art

At first, the concern was to create a system of accountability, so they developed symbols, that were etched into stones to help understand what is stored. As societies became more complex, we have been able to develop more symbols with a variety of meaning, to be able to aid with the organization of this new type of societies. Writing became the basic system for Knowledge Management, the tool for human communication, and continued to be so, even after all the technological advancements we have seen through these thousands of years (SCHMANDT-BESSARAT, 1986). Writing unlocked the potential for the wealthiest to aggregate knowledge and to organize society at first, as the mode of communication of writing evolved, it become more democratized and available to a larger number of people. From the invention of writing the process for communication was simplified, and easier to transfer, from clay tablets, to animal skins, to the developed of paper, it gradually grew to become more efficient.

Writing was the operational system for Knowledge Management (KM) and continues to be the basis for human communication, even after all of the technological disruptions we have seen so far. The changes within human communication is not in its operational system, but rather dealing with the speed of transfer of information, portability of information and conservation of information. According to Kargbo (2016) from clay tablets, to animal skin, to the development of paper were the essential steps to the next great technological jump.

2.1.4 The Gutenberg Press

The Gutenberg press has been called by many as the most impactful invention in humankind (TIME, 1997). The technological advancement as a result to the invention of the Gutenberg Press was drastic, raising literally by millions the production of knowledge, and therefore the advancement of different academies. The Press was invented by Johaness Gutenberg, in 1493, and saw is more efficient printing press spread quickly through the European Continent. Due to this spread of a more effective way of printing there was a surge in both the creation of newspapers and small publications as well as higher literacy rates throughout Europe. This climate was essential to the political and economic changes of the 17th, 18th and

19th century (MAN, 2002). In Figure 03 we show the number of books published in between 1450 and 1800.

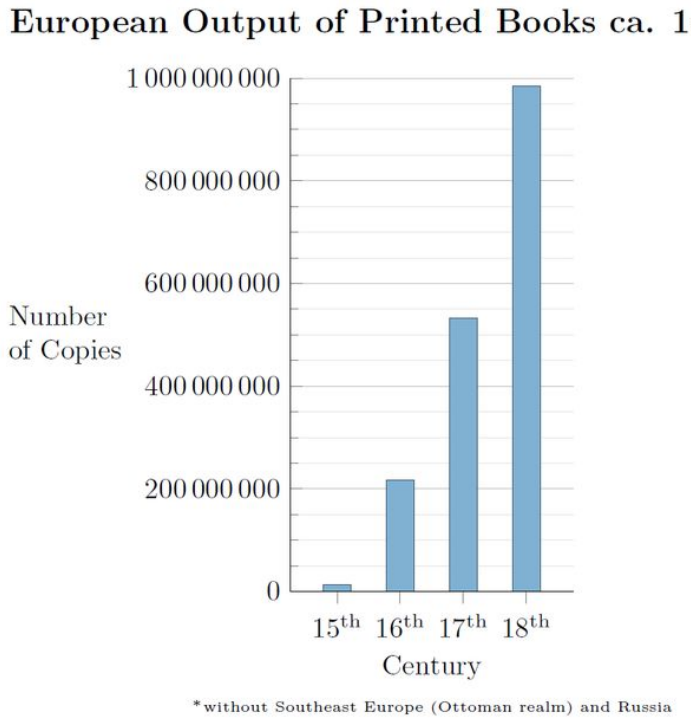


Figure 03 – Number of books published in between 1450 and 1800. (MAN, 2002)

The innovation within the Gutenberg press was the ease in which one could reconfigure the letters in order to print something completely new. Essentially, the form letters were made of metal, arranged in rows per page. The mechanism would insert ink and press those letters on the pages. This allowed from a tremendous amount of production in a reduced amount of time. The effect of this simple process would be felt for centuries to come (WEBER, 2006). Through the Gutenberg press the scientific method was created and introduced to the world at a rapid pace, and completely changed the way in which the process of knowledge creation was done. The scientific method introduced for the first time a ordered and measured way to the knowledge creation cycle.

2.1.5 The era of Revolutions

In the next centuries, according to Grey (1984) human civilization produced a boom of inventions, restorations and revolutions in all sectors of society. The first was the Protestant revolution, in religion. Although it seems unrelated, the protestant revolution opened the door for further literacy, since more people were allowed to read the bible. Literacy allowed for a further development of knowledge creation, and the spread of ideas.

One of these ideas was capitalism, and a rejection of the monarchy and feudal economic system. The upheaval of the existing economic system in favor of capitalism, and a murmur of political activity in most major countries, all of which were propelled forward through increased flow of information and knowledge creation. This political and economic change gave further incentives for knowledge creation, since inventors became the popstars, and the rich men of that society. One's ability to create now defined their wealth, not their last name. These new inventions meant that it was now possible for even more people to live in a smaller space. Alongside with these revolutions that was a tremendous advancement of transportation, which contributed for the increased flow of information, as train and boats made it possible for further trade and travel. Furthermore, the urbanization movement made necessary by the Industrial Revolution meant that ideas and knowledge were being shared with a greater number of people (GREY, 1984).

The new capitalist economy, which revolved around large factories produced a large exodus from agricultural societies to a more concentrated urban centers, and where skills such as literacy are further encouraged. With these ingredients the flow of information became far more effective, and a ease knowledge creation. At the end of the Industrial Revolution, the world lived in large concentrated Urban cities, with democratic governments, with advanced capitalist systems, and a large and effective communication sector that was free and highly influential. Therefore, opening the door to the age of information (FITZSIMMONS, 1994).

2.1.6 Era of Information.

In the 20th century, there was a revolution in the way in which we communicated, both peer to peer as well as mass communication. In 1912, radio began being transmitted in the United States and Europe. That marked the first time that information could be transferred in close to real time to masses of the population. The creation of a common narrative between nations, with vital information being transferred, and there became a leveling of certain knowledge. The magic of communication with people thousands of miles away, to millions of people at the same time, was had for the first time via radio. A few decades later, that would be possible with the television, which not only transferred audio, but images for the first time. The doors were open to transmit knowledge and information to the general population ina completely different and impactful manner (BENNINGER, 2009).

The next game changing technology was the computer. The computer was able to amplify humanities ability to create data, information and knowledge. Imagine at the time, the jump in the creation and transferring of data now made possible by something as simple as a word document on a disc. In this manner there was a democratization of knowledge creators, and the ability for more people to make their implicit knowledge explicit. As many know, the greatest catalyst was the internet (ENG, 2004). At this point anyone, anywhere in the world, data, information and knowledge could be transferred in any medium (text, images, videos) through the internet. The internet made it possible to create knowledge not only from established entities, but from individuals and small communities to other individuals. The internet made it possible for there to be an avalanche of information, for all corners of the world, unlike any other previous technology in the history of the world (BÜCHNER, 1999).

2.2 History of data and information

The search for knowledge is the biggest difference between human species and other species. The desire for knowledge is what moves human progress through all of society. Building

knowledge can be seen in the first cave paintings, was stored through the Greek dialogues, and arrives today, as an academic discipline, Knowledge Management (ANAND; WALSH, 2016).

In the next few pages we will present the most important advancements in information and knowledge management throughout history. It will be implicit the desire for humanity to grow its knowledge base, has always been present and only intensified throughout our own history. For millennia, human beings create, catalog, and record some type of information. A history of a society is a history of information, because our stories, are stories of a desire to create, to store and to utilize knowledge to reach the top of the pyramid (WELLER, 2007). The way in which we treat, utilize, and deploy information is directly related with the state of the society in which you are situated. At this point we will attempt to understand how information and knowledge evolved throughout time. What was the nature of information and knowledge, what was its definition, and what does it do in society?

The first concept of information and knowledge were made when humans began depicting their experiences on cave walls. These walls were plastered, mostly with acts of war or hunting were recorded. What you choose to record show quite a bit about the value of a culture, basic information about its surroundings, and its best practices. The most impressive aspect is the constancy of the information that was relayed by different in each corner of the world (WHITLEY, 2009).

The human being began transmitting information orally, probably through sounds and grunts, afterwards through language, which became stories and histories. From that evolution came the first creation stories, religion and traditions. These stories or myths have as a characteristic and attempt to explain human phenomena, how the Universe and the world works, transmits cultural and societal values (MALINOWSKI, 1976) An example of this necessity is that almost every society has its own creation motif. This show not only the necessity of human beings to make sense of the world, but also what it moves a particular society. Who created what, who was considered a God, and the focus on certain geographical or nature elements show what is of greater importance to that culture? While its scientific veracity may be dismissed there is tremendous value to what these myths tell us about the culture of that particular culture. An example is that a lot of Judeo-Christian stories place God in the center of the Universe, who

created the earth in 7 days, and after that, due to human error, allowed pain to become a reality. This created a culture that was filled with rules and normative all designed to make its people be able to find redemption with their God. In contrast, many North American Indian myths place their motifs around the sun, water, wind and mountains, in order to highlight their dependency and importance of nature. These stories often had important information, sometimes camouflaged as religious rituals. An example of this is the practice of circumcision within the Judaic people, or the lack of pork within their diet, both of which were extremely beneficial to health of the Israeli people.

According to Daniels (2007), the next great movement in which information and knowledge changed character was in the ancient middle east, most likely in the city of Uruk, modern day Iraq. At this moment societies and cities began to have a need; that is to document and account their products and better manage their agricultural production. It was the first moment in which the veracity and accuracy of information became absolutely vital in order to be effective. It was the first time that knowledge, or information, was recorded as data, and was directly correlated with economy, math, and wealth. At this point, there context for information, which became knowledge, which now as actionable and dynamic.

Humanity continue to evolve, mostly within cities, creating tools, building organizations, organizing tax collection, laws, and knowledge became evermore essential. In Greek society knowledge itself, its genesis, how it acted, and how to obtain started to be discussed, we can come to think of the Greek temples as the firsts "BA's" the world ever saw. A space specific for knowledge creation, and the first discussions by communities of practice, that being communities of similar knowledge base, that debate possibilities for betterment. Aristotle, Plato and Socrates did not agree on the definition of knowledge, or what was its essence, but certainly agreed on its importance. Plato believed that it was impossible to have knowledge, that it was something outside of the human being, something divine. For the Greeks, knowledge had to be shared, because there was no possibility for knowledge without dialogue, or debate (SENGE, 1992). These dialogues were written down, showing the first cases where knowledge, or the debate of knowledge was valuable enough to be written down and something to be preserved and archived. At the same time these discussions were happening, the Library at Alexandria was being erected,

to conserve all of the world knowledge till that point. To build something that great, in order to preserve and archive knowledge showed the importance knowledge already had at that point. During a long time, knowledge and information stagnated, for centuries there was no major advancement of knowledge or of mankind.

The next great change was the Gutenberg Press. Prior to its existence 30,000 manuscripts existed in the world, 150 years after its creation, there were more than 1.25 million books (BAWDEN; ROBINSON, 2000). This evolution created a gigantic number of books, specifically bibles that spread throughout Europe. This raised significantly the number of people that were able to read and write, which lead directly to the protestant revolution. Knowledge was now accessible to a much large parcel of the population, and great thinkers were accessed by a great part of the population. The topics of most interest at the time were a temporal knowledge such as art, philosophy, religion and economics. Knowledge was now something to be cultivated, it would inform values, decisions, however it was not yet time sensitive. The Gutenberg Press made it possible for the masses to educate themselves (TUSZYINSKI, 2014).

In the 17th century the first newspapers began to be printed in large cities in Europe, and in many North American cities (WEBER, 2006). At this moment information became a daily occurrence, it became dynamic and transitory, and ever changing just like we are accustomed to now. Knowledge was not only something that was found in the classics or in the bible, but rather it was a daily occurrence, focused on the realities of that particular day, dealing with the necessities of that specific city. At first papers were largely controlled and issued by the government, and dealt with mostly financial, and commercial news.

In the 19th century there was a flexibilization of censure by government, which meant the beginning of political newspapers with diverse information and perspectives, most times working to provoke or check government and the elite people of the time (TUSZYNKI, 2014). Due to this new understanding of knowledge, and an acceleration of the information that was being propagated became possible. The creation of newspapers such as the *"The National Inteligencer"* in the United States, a newspaper specifically for republican electorate (CAMPBELL; WITCHER, 2015) or the *Federalist Journal*, specific for American Federalist. Knowledge is now not only reserved for a few areas, but rather permeated all areas of society and began

moving the very fabric of what society was built upon. In the 18th century the era of exploration meant that technical knowledge became extremely important, such as sailing, physics, cataloging, geography and much more. In the great wars of the 18th and 18th century information, or the lack there of was decisive. A simple example is the American Revolution, which was sparked by an increase in taxes. The negative sentiment by the Americans did not get back to the British until it was too late for there to be any further action (DESMARAIS, 2009).

In the 20th century most technological advancements impacted information directly, including but not limited to the radio, television and the internet. Information became, instant, numerous and extremely cheap (HILBERT, 2011). Information and knowledge became irrelevant outside of KM, difficult to sort out, and too complex for any human being to truly comprehend. In a vast perspective, a combination of postmodern theory, complexity, diversity, made it far less probable for anyone to claim an objective truth or certainty in absolute terms. There is no more truth, and therefore a question about what knowledge is truly.

In pragmatic and objective terms, never has information and knowledge been used less effectively on decision making by individuals in particular. In contrast companies are hoarding information, due to its perceived value. They are doing the same to protect and mine they're on information, with a boom in business analyst, and highly skilled data scientists. The most puzzling development of this era of information if the concept of fake news, where inaccurate information is communicated to the masses, to further murky the waters of an already complicated and flooded market. We currently suffer to diagnose what is real news, and what is fabricated inaccurate news more than at any other time of our society (CORNER, 2017).

The next wave of technologies will impact directly how information and knowledge will be processed, assimilated. The next wave is composed of three major fields, Big Data, Biometrics, and Artificial Intelligence. Biometrics include but are not limited to information directly tied to our bodies, through a series of sensors, wearable's and others, that will create a rich amount of data, that are not only large, but highly specific and personal. Big Data will make it possible to assimilate and offer the possibilities for companies and organization to apply that large amount of data in an efficient manner. Lastly, Artificial Intelligence has the potential to unlock an incredible amount of hidden knowledge, making information that is previously

impossible to be processed and understood by human beings, to highly important information, at a speed and rate faster than any organic intelligence might be able to generate.

Figure 04 shows the evolution of knowledge sharing and information throughout history. As we can see, the intensity of new technologies has been intensified since the 1800's while prior to that, we might see centuries before any change in the way in which we created and build information and knowledge. The process of evolution has always been focused on the manner in which information is either stored or communicated. The time which we are reaching now changes that paradigm, and places a focus on the ability, specifically due to artificial intelligence as a manner of creating information and knowledge in a completely different manner.

Table I The evolution of information and knowledge sharing

Year	*Emergence of knowledge*
15000 BC	Lascaux cave drawings use imagery to capture and depict hunting knowledge
3400 BC	Hieroglyphics emerged as a new way to document spoken language
300 BC	Library of Alexandria, significant library of ancient world to explore knowledge of past
77 AD	Romans wrote first encyclopaedia setting a model for organizing and archiving knowledge
1100s	Monks transcribing books called scriptorium are tasked with replicating and copying the knowledge of the era
1440	Johannes Gutenberg printing press allows for widespread production of print material. Thus, knowledge sharing was revolutionized.
1600	Newspaper started circulating and people accessed knowledge and events
1835	Morse code allows for knowledge transfer across large distance
1800s	Public libraries emerge as system of knowledge sharing
1912	Radio broadcasting started spreading knowledge and knowledge to public
1946	Television broadcast started spreading mass knowledge and knowledge
1960	Databases are introduced as repositories for large amount of structured data
1965	Invention of hyperlink
1971	Floppy disk allows portable data storage and transfer of knowledge documents
1985	America online company emerged as a leading internet company for the world
1993	Siebel system introduced CRM system to combine customer knowledge
1995	Altavista and Yahoo emerged leading search engine for searching knowledge and sharing
2001	Wikipedia emerged as an internet platform for a new generation collective knowledge
2003	Facebook becomes part of social networking thus sharing knowledge
2005	YouTube becomes a free platform to use knowledge through video observation
2011	Bigdata emerges as a technology platform to analyse contents in massive data and present in intelligent way for knowledge workers

Figure 04 – Table of evolution of information and knowledge sharing. Bhatt (2008)

2.3 Management as an area of knowledge

The field of KM began as an academic discipline in the 1980's and is today one of the most prominent areas of knowledge. Knowledge management is often seen as a type of process that seeks to better knowledge in all spheres. The largest push was an economic push post industrial revolution, and into a service-based economy meant that knowledge and organization memory became crucial for the development of companies and organizations. According to Wigg (1999) the phenomena below were the biggest push for the further development of knowledge management as a discipline.

- ✓ **Globalization:** With an increase of competition of a global scale, this forced companies to create complicated processes that were well organized and added a level of sophistication and efficiency.

- ✓ **Sophisticated Consumers:** Consumer are ever more demanding. This not only creates a need for better products, but also personalized products. Therefore, an ever so refined understanding of products is necessary in order to achieve a higher level of quality.

- ✓ **Sophisticated Competitors:** In the same manner, competitors are investing far more on quality and innovation, which places knowledge at a premium.

- ✓ **Sophisticated Providers:** In the same manner as the previous two factors, the level the necessary level of knowledge.

- ✓ **Internal inefficiencies:** The necessity to become more efficient, to reduce bottlenecks in organizations. When one bottlenecks if found, that allows for a new speed of process, which will certainly unlock new bottlenecks. This process is continual, in order to achieve the fastest speed possible.

- ✓ **New abilities and technologies:** The boom of new technologies in the last 100 years mean that there is a push for further knowledge applied throughout our systems, organization. We as a society now are able to consume and create information faster, and with higher efficiency.

- ✓ **Understanding cognitive abilities of human beings:** The increased focus on the human mind, and in companies, human capital becomes the most important factor of growth in any organization.

With these pressures made evident, and the increase in speed of all human processes means that knowledge has become more essential, yet more transitional and difficult to retain, it is the key for the future of any organization (DRUCKER, 1998). The future of KM is also being designed, through the addition of new technologies, such as Artificial Intelligence, Big Data and Biometrics. With this need for immediate change, authors and researchers focused in solving real problems and needs of society. That meant that there has been less done studying the history of KM.

During our analysis of KM we will use as the base model Evans, Dalkir and Bidian (2014) titled *A Hollistic View of the Knowledge Life Cycle,* complemented by other authors found in literature. The article chosen was able to create a simple's system, that is logical and rich with understanding, about the process of creating knowledge.

2.3.1 Process of creating knowledge

According to Dorow (2015), the cycle of knowledge creation, is necessary for the understanding of an organization. Through and understanding of this dynamic process we can understand how KM continues and pushes growth. To better understand the maturation process of the discipline, we will walk through the most relevant and impactful papers by the most influential authors.

One the first authors to organize a system of knowledge creation was Wigg (1999), the objective was to create a coherent model, and establish a simple but workable system. In Wigg's system it was necessary to create the following 4 phases.

- ✓ **Built***:* In this first step Wigg describe how each organization add knowledge through personal experience, training or education.

- ✓ **Hold***:* This phase is tied specifically to the accumulation of knowledge. How to archive all knowledge that has been acquired, while maintaining access to it fairly easy.

- ✓ **Pool***:* This phase is all about creating systems, in order to organize information and be able to have it be easy to find.

- ✓ **Apply***:* The last phase, is how to turn all of the knowledge gathered into action. How to make that knowledge work for the decision-making process of the organization or company.

Wigg's model also see the creation of knowledge is something that is mutable and applied within its own context. As an example, we can consider how the hold phase will look extremely different for groups and organizations of different types. Wigg works to understand knowledge in three levels, the individual, small groups, and institution or large organizations.

Other authors brought a refinement of knowledge creation cycle, as an example he utilized Zack (1999), that works with the following steps.

- ✓ **Acquisition** *(Acquisition)*: As for knowledge creation, Myers and Zack, placed a premium in finding information that was considered high quality. In order to achieve that, it is necessary to have experts validate the information brought forward by people or

- ✓ **Refinement**: The process of bringing data, cleaning it, checking it and making it available for easy access and use.

- ✓ **Storage/Retrival***:* The process of storage, and a system of access to essential information. This step is essential in order to allow for information to be quickly and efficiently accessed.

- ✓ **Distribution***:* How to bring information to the right people at the right time, with the correct frequency.

- ✓ **Presentation/Use***:* How to establish the value of knowledge, how to utilize it within the necessities of that organization.

The biggest innovation was utilized in refinement and acquisition. To place the focus on the refinement stage meant that there was better more accurate information. The desire is that any information is deemed irrelevant or unworthy might be thrown away prior to utilization, that way making the organization more effective.

A model that breaks most thinking throughout the academic literature in Knowledge Management up until this time is McElroy (2003) system that placed the emphasis in the process of evaluation of the information. The model follows the phases below.

- ✓ **Knowledge Claim Evaluation:** Before any action, it is necessary to debate the information acquired in diverse groups, and in a variety of different ways to validade knowledge. This process may occur might happen within an organization, within a society, or until it becomes common sense.

- ✓ **Knowledge Integration:** After a great debate in the previous step, this step focusses of disseminating new knowledge with everyone in the organization that might to have that new knowledge.

- ✓ **Adopting**: After that the organization adopts that knowledge in their organizational memory and began to work with that constantly, always recycling that knowledge throughout the organization.

The biggest advancement made by Mcelroy was to understand the necessity to establish a framework to accept any type of knowledge. For Mcelroy the knowledge has to be valid, pertinent, and interesting to each particular organization. The ability of human beings as individuals, as well as for organizations, their ability to assess and decide what information is valid is essential for the implementation of knowledge in an efficient manner.

An essential work of literature in KM is Heisig (2009) who did the arduous work of research over 450 different systems of Knowledge Management described throughout literature from 1995 to 2003. During his study, he was able to conclude that 73% articles followed the

following flow for Knowledge Management creation: Identify, create, acquire, sharing and storage. This show a consensus among most academics in the Knowledge Management space, throughout time and geographic space. One of the most cited authors of these systems are Evans, Dalkir and Bidian (2014). Before we dive into the chosen model, we will see a summary of various researchers. (Table 04):

Table 04 – Process of Knowledge Creation. Dalkir (2005)

Authors	**Knowledge Creation Cycle**
Wigg	Construct, Hold, Pool, Apply.
Meyer e Zack (1996)	Acquisition, Refinement, Storage, Distribute, Utilize.
Davenport e Prusak (1998)	Generate, Codify, Transfer.
Nickols (1999)	Acquire, Organize, Specialize, Store, Access, Recover, Distribute, Talk, Disponibility.
McElroy (2003)	Evaluation, Integration of Knowledge, Adoption.
Hoffman (2001)	Create, Store, Distribute, Apply.
Bukowitz e Williams (2003)	Acquire, use, learn, contribute, access, build, support, discard.
Becerra-Fernandez (2004)	Discover, Capture, Share, Apply.
Jashapara (2004)	Organize, Capture, Evaluate, Share, Store, Update.
Maier (2004)	Discover, Publish, Collaborate, Learn.
Rao (2005)	Create, Codify, Recover, Apply, Distribute, Validate, Locate, Personalize.
Wong e Ahmed (2005)	Acquire, Organize, Share, Apply.
Dalkir (2005)	Identify/Create, Store, Share, Utilize.

This conceptual base for this project that was chosen is Dalkir, in "*A Holistic View of the knowledge Life Cycle: The knowledge Management Cycle (KMC) Model*. This Knowledge Management Cycle by Dalkir was chosen after studying and analyzing various different KM cycles in current academic literature. The KMC by Darkir is made of the following seven phases: identify or Create, Store, Share, Utilize, Learn and Improve.

2.3.2 Knowledge Management by Dalkir

The first step is to identify and create. TO identify the process, we can utilize specific tools that explain knowledge, such as brainstorming sessions, data analysis, and search for methods in different companies. An example would be an economic study, or information offered by systems that organize knowledge such as google and others.

The creation and identification of knowledge is the most sustainable manner to keep a competitive advantage in the current economy (TEECE, 2000; BARNEY;2008) and is essential to be able to maintain growth during turbulent moment in the economy (NONAKA; KONNO, 1998). The process of creation happens in environments where there is an existing context to exchange information between different actors. In this process it is absolutely essential to have active human capital (WENGER; SNYDER, 2000).

In the manual of tools of KM, written by Ronald Young, talks about different practices and tools utilized during KMC. We will summarize them in Table 5.

Table 05 - Knowledge Management Tool or Practice for knowledge creation or identification. Adapted from Ronald Young Knowledge Management Tools and Techniques Manual (2010)

Tool for KM practice for the creation or identification of KNOWLEDGE	**Description**

Knowledge Cafe	A Knowledge Café is a way to have a group discussion, to reflect, and to develop and share any thoughts and insights that will emerge, in a very non-confrontational way. A Knowledge Café suspends all judgment and normally leads to developing deeper insights and sharing than usual.
Communities of practice	COPs are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly. In the context of KM, COPs are formed—intentionally or spontaneously—to share and create common skills, knowledge, and expertise among employees.
Advanced search	Almost everyone who has used the World Wide Web will, at some point, have used a search engine. However, very few users take advantage of the advanced search tools that are offered by most of the search engines. Understanding these tools can result in a significant improvement in the quality of search results.
Clusters of Knowledge	The term 'Knowledge Cluster' is a term given to a group that—as a result of coming together in this new way—create, innovate, and disseminate new knowledge. In other words, different individuals, teams, and organizations can now come together, virtually, on the Internet, to better communicate, collaborate, learn, and share knowledge through the cluster.
Specialist Locator	Expertise Locator (Expert Locator, Who's Who) is an information technology (IT) tool to enable effective and efficient use and/or share of existing knowledge by connecting people who need particular knowledge and people who own the knowledge. Sometimes, the system helps building new teams/projects by finding various expertise needed.
Mapping and auditing of knowledge	Knowledge Mapping is a process by which organizations can identify and categorize knowledge assets within their organization—people, processes, content, and technology. It allows an organization to leverage the existing expertise resident in the organization, as well as identify barriers and constraints to fulfilling strategic goals and objectives. It is constructing a road map to locate the information

	needed to make the best use of resources, independent of source or form.
KM Maturity Model	A Knowledge Management (KM) Maturity Model helps an organization assess its relative progress in KM implementation at a more detailed level. It can be described as a structured collection of elements that describes the different levels of KM maturity in an organization.
Mentor / *Mentoring*	Mentoring is a form of knowledge sharing. It builds a caring, trusting culture. In terms of the knowledge-creation cycle, it creates a space for people where they can internalize explicit knowledge through reflection on their experiences, throw ideas around in a safe socialization space, and work to verbally express what they know (to externalize). The self-reflection that can result from a mentoring relationship can be a powerful growth experience and can give you new insights about yourself. This applies both for the mentor and the mentee.
Brainstorming	Brainstorming is a simple way of helping a group of people to generate new and unusual ideas. The process is actually split into two phrases: divergence and convergence. During the divergent phase, everyone agrees to delay their judgment. In other words, all ideas will be treated as valid. During the convergent phrase, the participants use their judgment but do so in a 'positive' manner—that is, they look for what they like about the ideas before finding flaws.
Learning and Idea Capture	It is a manner of systematically organizing and taking note of ideas and creativity by a variety of tools, including but not limited to digital means
Learning Review	It is a technique used by a project team to aid team and individual learning during the work process. A Learning Review is different from an Active Action Review (AAR). An AAR is usually conducted at the end of a formal project. It can be conducted after any identifiable event. An event can be either an entire small action or a discrete part of a larger action, e.g., a project-planning meeting.

Collaborative Physical Spaces	When we share or create knowledge, we usually interact with other people through face-to-face communication—we discuss, dialogue, or simply just ask a question. The physical workspace is where such human interactions take place—and it can support knowledge sharing/creation if it is well-designed. You may think, “We have desks for everyone, meeting rooms for internal meetings, and space for business talk. What else do we need?” Actually, physical workspace works much more than that. How would you describe the atmosphere of the meeting room above? Dynamic or static? Creative or ritual? Do you think you can have creative discussions in the room?
Knowledge Basis	In the context of organizational knowledge management (KM), we should externalize the important or critical knowledge that needs to be accessed, shared, applied, and developed by others. But KM should certainly not be about externalizing and codifying as much knowledge as possible. That would simply be impossible and ineffective. We should consider codifying the knowledge that is considered 'critical' to develop and apply in the organization and that would make 'a big difference' to the organization’s performance. This is where we can effectively create explicit knowledge bases
Blogs	A Blog is a very simple 'journal style' website that contains a list of entries, usually in reverse chronological order. The entries are typically short articles or stories, often relating to current events. However, the entries do not have to be just plain text. They could also be photographs, videos, audio recordings, or a mixture of all the types.
Voice and voice-over-internet protocol (Voip)	In very simple terms, the internet is now capable of sending both audio and video signals between computers, using nothing more than a broadband connection and some low-cost equipment, such as a webcam and a headset. This capability is often referred to as Voice-over Internet Protocol (VOIP). The adoption of broadband has led to the creation of a number of companies that offer various VOIP services. In general, they all offer instant messaging and voice transmission; many of them provide video calls as well. The cost of the service varies from company to company. However, almost all of the providers offer free computer-to-computer audio; many of them provide free one-to-one video calls.

Video Sharing	In its simplest form, video sharing is the ability to publish video content, either to a specific audience or the entire world. In addition to sharing the content, most of the hosting sites also allow some level of discussion.

All of the tools in table 5 are tools that aid in the process of creation and identifying knowledge (DAVENPORT; PRUSAK, 1998). The creation of knowledge is dynamic, relational, and based on human interaction (NONAKA; TAKEUCHI, 1995). In the first moment ideas come to individuals, however during the process of sharing, talking, and commenting these ideas are refined, organized, validated and become knowledge (NONAKA, 1995). The organization becomes a great incubator and should work to have spaces that allow for that type of knowledge creation, by providing opportunities for constant interaction (LEVINTHAL; MYATT, 1994). In order to better explain the importance of spaces in creation the concept of "BA" was created. This concept was first created centuries ago by a philosopher named Kitaro Nishida, however adapted to the purposes of Knowledge creation by Nonaka, and Konno em 1998 (NONAKA, 1998).

“Ba” could be translated as space, which was designed specifically to advance the creation of knowledge of an individual or organization. There are different ways or strategies to Design a BA, however the objective is always the same, to bring context in order to make information become knowledge. “Ba” inserts information within a context, it gives that information meaning, and makes that information into knowledge (NONAKA, 1998). While it is often a physical it is important to cite that knowledge is dynamic, as Bohm describes " It is important to mention that although it is a space, often physical, knowledge is always dynamic, in the words of Bohm, "ba is a phenomenological time and space in which knowledge, as "stream of meaning", emerges. New knowledge is created from existing knowledge through the change of meanings and contexts"(BOHM, 1996). BA points to the necessity of a process, design, a space, specific, with the best conditions for the creation of knowledge. Bohm points out that knowledge and these spaces must become more dynamic, fast, and in constant evolution.

The next step is the need for Storage. A mistake often made is to discard storage as an important phase, however storage is essential for KM, and the places most impacted by technological advancement. The storing of knowledge is essential to the organization itself, to the speed and proliferation of knowledge throughout the organization. Later, we will understand the technological effect on this particular step. Table 06, shows the tools in KM for knowledge storage.

Table 06 – Tools in KM for knowledge storage. Adapted from Ronald Young Knowledge Management Tools and Techniques Manual (2010)

KM tools for the storage of knowledge	**Description**
Learning Review	é uma técnica usada por equipes de projeto para promover a aprendizagem durante o processo de trabalho. A revisão de aprendizagem é diferente da revisão pós-ação *(after action review – AAR)*. A revisão pós-ação é realizada no final do projeto. Já a revisão de aprendizagem pode ocorrer após qualquer evento. Um evento pode ser uma atividade curta, ou parte de uma atividade mais longa – por exemplo, uma reunião de planejamento de projeto.
After Action Review	It is a technique for evaluating and capturing lessons learned when a project end. It allows project team members to discover what happened, why it happened, and how to maintain strengths and eliminate opportunities for improvement. The review takes place through an informal discussion with key project members. The review can be done at the end of the project or at the end of a key point during the project. It's not a gathering for criticisms and complaints. The review maximizes learning by enabling an environment where leaders and members can talk honestly about the project. This is not a full evaluation report.
Knowledge Cafe	It is a way to conduct a group discussion to reflect and share thoughts and insights in a friendly way. The goal of the knowledge café is not to criticize. It usually leads to deeper insights and more intense sharing than the ordinary.

Communities of Practice	They are informal and interdisciplinary groups of people united around a common interest. Communities are self-organized in order to allow the collaboration of internal or external persons to the organization; provide the vehicle and the context to facilitate the transfer of best practices and access to specialists, as well as the reuse of models, knowledge and lessons learned.
Taxonomy	It is a technique that enables structural organization: i) information; (ii) documents; and iii) libraries in a consistent manner. The structure, or architecture, helps people navigate, store, and retrieve necessary data and information across the organization. Taxonomy allows you to organize the necessary information and knowledge in an intuitive way. It can be considered a classification system for the intellectual capital of the organization, besides indicating the experience and knowledge of the people. The taxonomy may also include metadata that allows the systematic management of data or information.
Library of Documents	A system of organization, storage of all company information.
Knowledge Bases	refers to the externalization of knowledge considered "critical" due to its impact on organizational performance. Knowledge Bases serve to preserve, manage and leverage organizational memory. Knowledge Bases may be tacit or explicit. A database such as Wikipedia is an explicit form of database. A tacit database is knowledge in processes or people that need to be stored in some kind of knowledge base.
Blogs	it is a type of website on the world wide web in the form of a newspaper. Contains a list of entries in chronological order. Inputs can be texts, photographs, videos, audio recordings or a mix of all of this. The content of the blog can be produced by a single author or by a team of authors.
Voice and voice-over-internet protocol (VoIP)	The worldwide computer network allows the transmission of audio and video signals between computers using broadband connection and low-cost equipment such as webcam and headset. This is known as voice over-internet protocol (VoIP).
Clusters	refers to the externalization of knowledge considered "critical" due to its impact on organizational performance. The bases or repositories of

	knowledge serve to preserve, manage and leverage organizational memory. There are several different types of knowledge repositories used today. They can be classified in different ways. In general, a knowledge repository will contain more than documents (document management system), data (database), or records (records management system). A repository of knowledge will contain valuable knowledge, which is a mixture of tacit and explicit knowledge based on the unique experiences of individuals who are or were part of that company, as well as the know-how that has been tested and approved in work situations.
Specialist Localizer	Expert locator. Usually by Google or Linkedin.
Collaborative Spaces	They allow people to work together regardless of where they are physically. This means the combined ability to share documents, edit collaboratively and conduct audio / video conferencing. The main benefits are: i) it allows access to the best experts anywhere in the world; ii) reduce travel expenses; and iii) allows people to work at their preferred time and place to achieve better results, as well as providing the information they need. Online space to better work as a team. An example would be Trello, Slack among other software programs.
Tools for Collaboration such as Intranets	are computerized systems that capture and disseminate knowledge and experience among workers / departments. A portal is a web space for integrating corporate systems, with data security and privacy. The portal can be a real working environment and a repository of knowledge for the organization and its employees, providing access to all relevant information and applications, and as a platform for communities of practice, knowledge networks and best practices. In the more advanced stages allows customization and customization of the interface for each of the servers / employees.
Video Sharing	It refers to the publication of content in the form of video, or to a specific audience or to everyone. In addition to sharing content, the sites allow some level of debate as well.

From the perspective of KM, not only documents should be stored, but rather any process that might become knowledge, including internal communication within

organizations(REFERENCE). The next step is understanding how to utilize all that data in a way that it might become readily available for people as information and eventually knowledge.

With the growth of transnational organizations and their complexity and makes it necessary to have physical and virtual spaces to store all of that knowledge (GARTNER, 2002). Today, organizations' activities are complex, diverse, and constantly changing, which forces each organization to have its information in a way that is easily accessible (COAKES, 2006). Mobile technologies, and the way we communicate today, have made more information available. Many organizations today, to improve their internal communication, reducing the need to exchange endless e-mails and participate in various meetings to make a decision are using slack software and other tools of mobile communication, for their day to day activities. With this advancement, many of the personal conversations, and therefore lost, are automatically recorded for use by the organization (MAKINNEN, 2006).

Traditionally, when we think of storage, we think only of ways to keep physical and digital recordings in a variety of ways. Knowledge of an organization is also stored and communicated through its culture, tradition, and structure. This type of internalization is a most effective and long-lasting storage method, and it is often referred to as organizational memory (ACKERMANN, 1994).

Knowledge **sharing** is essential for any kind of social system (MERGEL, 2008). Companies today, according to Anand and Walsh (2016) are the largest social systems in the world, and within them, there is a gigantic need to have knowledge, as it is the most critical factor for the development of companies. In the academy according to Alhalhouli, Hassan and Der (2014) there is no definition for sharing information, but for this research we will adopt the definition that it is an action in which: knowledge, information, skills or expertise is shared between people, communities or organizations (JIACHENGE; LU; FRANCESCO, 2010). Knowledge sharing in this way has the ability to reduce costs, accelerate the innovation process, improve sales, increase income, and improve organizational performance overall (LIN, 2007).

The great difficulty according to Davenport and Prusak (1998) is that sharing knowledge is not natural. Sharing knowledge involves human beings, emotions, attitudes, consequences, actions, all of which can help or hinder the process of knowledge sharing (KROK, 2013). For

Sondergaard (2007) people may have resistance to sharing their knowledge by three major factors, geography, individual motivation, and trust. With the greatest complexity in the geographical aspect, certain information is not shared simply by the difficulty of putting the right people in the same environment. This difficulty can be overcome with tools, techniques and virtual "Ba" and face-to-face. The second and third reasons are social problems, not technical problems. According to Webster et al. (2008) people can retain information simply because they are afraid that if sharing their knowledge can be easily replaced. This is culturally embedded in society, with mantras as knowledge and power. Along the same lines, Brooks (2014) corroborates that it is important to trust the company and that its employment is safe as it is one of the most effective ways to increase sharing rates.

Gephart (1996) comments that when these difficulties are overcome, the organization begins to share information in an organic and unpretentious way. This is confirmed by Van Den Brink (2001), who affirms that with the time and sophistication of this trust, this becomes collective, integrated into the organization's day-to-day life, and thus making it more effective. In this situation, Dalkir (2005) completes that the organization manages to change the perspective, of knowledge and power, to share and power. In Table 07, we can see effective and systematic KM practices and tools for knowledge sharing.

Table 07 - Effective and systematic knowledge management practices and tools for knowledge sharing. Adopted from Ronald Young Knowledge Management Tools and Techniques Manual (2010)

KM tools for sharing Knowledge	Description
Learning Review	It is a technique used by project teams to promote learning during the work process. The learning review is different from the post-action review (AAR). The post-action review is carried out at the end of the project. Already the learning review can occur after any event. An event can be a short activity, or part of a longer activity - for example, a project planning meeting.
After Action Review – AAR	It is a technique for evaluating and capturing lessons learned when a project end. It allows project team members to discover what

	happened, why it happened, and how to maintain strengths and eliminate opportunities for improvement. The review takes place through an informal discussion with key project members. The review can be done at the end of the project or at the end of a key point during the project. It's not a gathering for criticisms and complaints. The review maximizes learning by enabling an environment where leaders and members can talk honestly about the project. This is not a full evaluation report.
Storytelling	They are techniques used in knowledge management environments to describe complicated issues, expose situations and / or communicate lessons learned, or interpret cultural changes. They are retrospective reports of personnel involved in the events that occurred.
Communities of Practice	They are informal and interdisciplinary groups of people united around a common interest. Communities are self-organized in order to allow the collaboration of internal or external persons to the organization; provide the vehicle and the context to facilitate the transfer of best practices and access to specialists, as well as the reuse of models, knowledge and lessons learned.
Collaborative Physical Spaces	When people share or create knowledge, they usually interact with others through face-to-face communication. They discuss, dialogue, or simply ask questions. Physical space is where this kind of human interaction occurs. If this space is well planned, it can promote knowledge sharing and creation. Many physical spaces are not suitable for promoting collaborative work. On the other hand, there are spaces that facilitate interaction between people and promote the creation and sharing of knowledge.
Knowledge Cafe	It is a way to conduct a group discussion to reflect and share thoughts and insights in a friendly way. The goal of the knowledge café is not to criticize. It usually leads to deeper insights and more intense sharing than the ordinary.
Taxonomy	It is a technique that enables structural organization: i) information; (ii) documents; and iii) libraries in a consistent manner. The structure, or architecture, helps people navigate, store, and retrieve necessary

	data and information across the organization. Taxonomy allows you to organize the necessary information and knowledge in an intuitive way. It can be considered a classification system for the intellectual capital of the organization, besides indicating the experience and knowledge of the people. The taxonomy may also include metadata that allows the systematic management of data or information.
Library of Documents	A system of organization, storage of all company information.
Knowledge Bases	It refers to the externalization of knowledge considered "critical" due to its impact on organizational performance. Knowledge Bases serve to preserve, manage and leverage organizational memory. Knowledge Bases may be tacit or explicit. A database such as Wikipedia is an explicit form of database. A tacit database is knowledge in processes or people that need to be stored in some kind of knowledge base.
Blogs	It is a type of website on the world wide web in the form of a newspaper. Contains a list of entries in chronological order. Inputs can be texts, photographs, videos, audio recordings or a mix of all of this. The content of the blog can be produced by a single author or by a team of authors.
Online Social Network	Social networking is a group of people who share a common area of interest. Online social networking services, or "digital social networks," support social networking on the world wide web. Services, among others, include mechanisms to: i) find people with similar interests and needs; (ii) organizing groups or subgroups of persons to facilitate communication between them; iii) share content (documents, links to relevant sites and videos).
Voice and voice-over-internet protocol (Voip)	The worldwide computer network allows the transmission of audio and video signals between computers using broadband connection and low-cost equipment such as webcam and headset. This is known as voice over-internet protocol (VoIP).
Clusters of Knowledge	It refers to the externalization of knowledge considered "critical" due to its impact on organizational performance. The bases or repositories of knowledge serve to preserve, manage and leverage organizational

	memory. There are several different types of knowledge repositories used today. They can be classified in different ways. In general, a knowledge repository will contain more than documents (document management system), data (database), or records (records management system). A repository of knowledge will contain valuable knowledge, which is a mixture of tacit and explicit knowledge based on the unique experiences of individuals who are or were part of that company, as well as the know-how that has been tested and approved in work situations.
Video Sharing	It refers to the publication of content in the form of video, or to a specific audience or to everyone. In addition to sharing content, the sites allow some level of debate as well.
Mentoring	It is a performance management modality in which a participant expert (mentor) models the competencies of an individual or group, observes and analyzes the performance, and feeds the performance of the activities of the individual or group.

From this stage, organizations are ready to use knowledge. Previously knowledge was pointed out as the most sustainable way of maintaining a competitive advantage. A new knowledge demands to be used. For Dove (1999) a new knowledge has no value if it is not applied, however, after being applied it must create a change in the ecosystem, create innovation, create a competitive advantage. Similarly, King (2016) states that knowledge must already be in the right place and easily accessible for use by the organization. In addition, the same author in King (2005) emphasizes that the use of new information generally opens up new opportunities to digest information in a different environment, and with-it new insights and innovations are created.

Knowledge according to Ganzaroli et al. (2016) should be used to make decisions more efficiently. For Yang (2010), knowledge regenerates the operation, and this interaction ends up innovating the organization's system, making it better. In short, all other steps would be useless if the use of knowledge was not done effectively. Oliver and Kandadi (2006) argue that the use of knowledge is what makes organizations successful and longevity.

To use knowledge, we need to understand that there are two effective ways of doing the same. Firstly, for Zaim et al. (2018), through technologies that helps explicit knowledge to be available to all who need it. An explicit knowledge is knowledge that is somehow codified, that is, translated in writing, with numbers, or data, and therefore easier to be transmitted (ANAND, 2011). For Renata (2016) this kind of knowledge tends to be less important to the organization, evidencing that the greater value lies in the implicit knowledge that is in the minds of the people who make up the human capital of the organization. On the other hand, for Zaim et al. (2018), to extract this kind of knowledge it is necessary to create actions, activities and tasks related to how the human capital management is practiced, in order to extract the most valuable knowledge to create value, innovation and assist in the decision-making process of organizations. Ronald Young highlights situations that are shown in Table 08 of practices and tools to apply knowledge.

Table 08. Effective and systematic KM practices and tools for applying knowledge. Adopted from Ronald Young Knowledge Management Tools and Techniques Manual (2010)

KM for tools for applying knowledge	Description
Collaborative Physical Spaces	When people share or create knowledge, they usually interact with others through face-to-face communication. They discuss, dialogue, or simply ask questions. Physical space is where this kind of human interaction occurs. If this space is well planned, it can promote knowledge sharing and creation. Many physical spaces are not suitable for promoting collaborative work. On the other hand, there are spaces that facilitate interaction between people and promote the creation and sharing of knowledge. This is the BA concept. Create spaces that naturally help people create knowledge. Whether it is for the technology available, the way space is organized, or even for food, coffee or something similar available in these spaces.
Knowledge Cafe	It is a way to conduct a group discussion to reflect and share thoughts and insights in a friendly way. The goal of the knowledge café is not to criticize. It usually leads to deeper insights and more intense sharing than the ordinary.

Communities of Practice	They are informal and interdisciplinary groups of people united around a common interest. Communities are self-organized in order to allow the collaboration of internal or external persons to the organization; provide the vehicle and the context to facilitate the transfer of best practices and access to specialists, as well as the reuse of models, knowledge and lessons learned.
Taxonomy	It is a technique that enables structural organization: i) information; (ii) documents; and iii) libraries in a consistent manner. The structure, or architecture, helps people navigate, store, and retrieve necessary data and information across the organization. Taxonomy allows you to organize the necessary information and knowledge in an intuitive way. It can be considered a classification system for the intellectual capital of the organization, besides indicating the experience and knowledge of the people. The taxonomy may also include metadata that allows the systematic management of data or information.
Library of Documents	A system of organization, storage of all company information.
Knowledge Bases	It refers to the externalization of knowledge considered "critical" due to its impact on organizational performance. Knowledge Bases serve to preserve, manage and leverage organizational memory. Knowledge Bases may be tacit or explicit. A database such as Wikipedia is an explicit form of database. A tacit database is knowledge in processes or people that need to be stored in some kind of knowledge base.
Blogs	It is a type of website on the world wide web in the form of a newspaper. Contains a list of entries in chronological order. Inputs can be texts, photographs, videos, audio recordings or a mix of all of this. The content of the blog can be produced by a single author or by a team of authors.
Tools for Advanced Search	Many people use search engines available on the world wide web. However, few uses Tools for Advanced Search available from most search engines, such as Google. Understanding these tools greatly improves the quality of search results.

Clusters of Knowledge	It refers to the externalization of knowledge considered "critical" due to its impact on organizational performance. The bases or repositories of knowledge serve to preserve, manage and leverage organizational memory. There are several different types of knowledge repositories used today. They can be classified in different ways. In general, a knowledge repository will contain more than documents (document management system), data (database), or records (records management system). A repository of knowledge will contain valuable knowledge, which is a mixture of tacit and explicit knowledge based on the unique experiences of individuals who are or were part of that company, as well as the know-how that has been tested and approved in work situations.
Specialist Locators	Specialist Locators.
Collaborative Virtual Spaces	They allow people to work together regardless of where they are physically. This means the combined ability to share documents, edit collaboratively and conduct audio / video conferencing. The main benefits are: i) it allows access to the best experts anywhere in the world; ii) reduce travel expenses; and iii) allows people to work at their preferred time and place to achieve better results, as well as providing the information they need.
Mentoring	It is a performance management modality in which a participant expert (mentor) models the competencies of an individual or group, observes and analyzes the performance, and feeds the performance of the activities of the individual or group.
Portals for collaboration	These are computerized systems that capture and disseminate knowledge and experience among workers / departments. A portal is a web space for integrating corporate systems, with data security and privacy. The portal can be a real working environment and a repository of knowledge for the organization and its employees, providing access to all relevant information and applications, and as a platform for communities of practice, knowledge networks and best practices. In the more advanced stages allows customization and customization of the interface for each of the servers / employees.

The next two steps are linked, and the largest differential of the model being discussed. Dalkir (2005) presented learning and refinement as the next two steps. For Evans and Ali (2013) knowledge when applied gains a context specific to the organization, and generates new insights, so the organization continues to learn. Already for McElroy (2003) knowledge is deconstructed, recycled, gains depth and so can again go through the cycle. For the refinement step, this new value brings by the knowledge become organizational memory and within the context of the organization. Refinement is the decision point to again put knowledge through the cycle.

In table 09, we present a summary of the works that highlight the actions in the knowledge cycle.

See the table on page 95 of the article Evans, Dalkir and Bidian (2014) "A Holistic View of the Knowledge Life Cycle: The Knowledge Management Cycle (KMC) Model."

Table 09 - Works that highlight actions in the knowledge cycle. Evans (2014)

Actions	Authors
Identify / Create	Build (WIGG, 1993); Acquisition (MEYER; ZACK, 1999); Get (BUKOWITZ; WILLIANS, 1999); Claim (MCELROY, 2003); Identify (EVANS; ALI, 2013).
Storage	Hold (WIGG, 1993); Storage (MEYER; ZACK, 1999); Build (BUKOWITZ; WILLIANS, 1999); Organizer e Storage (EVANS; ALI, 2013).
Share	Pool (WIGG, 1993); Distribution (MEYER; ZACK, 1999); Contribute (BUKOWITZ; WILLIANS, 1999); Integration (MCELROY, 2003); Share (EVANS; ALI, 2013).
Use	Apply (WIGG, 1993); Use (MEYER; ZACK, 1999); Contribute (BUKOWITZ; WILLIANS, 1999); Integration (MCELROY, 2003); Apply (EVANS; ALI, 2013).
Improve	Apply (WIGG, 1993); Integration (MCELROY, 2003); Learn (EVANS; ALI, 2013).

Learn	Refinement (MEYER; ZACK, 1999); Access (BUKOWITZ; WILLIANS, 1999).

From this Evans knowledge cycle model (2014), which works with the phases of: identify / create; store; to share; use; improve; and learn, we can check some technologies of the past and the future that have had or will have significant impact on some of the phases in the Dalkir model. The goal is not necessarily to demonstrate scientifically what technologies in the past have had the greatest effect on the knowledge cycle, but rather to analyze qualitatively how each technology affected the knowledge cycle.

2.4 – New Disruptive Technologies to the Knowledge Management Cycle

As we can see throughout history, technological advancements were able to change, mutate, and refine the knowledge management cycle. The oral language made it possible for information to be shared in a more effective manner. Writing revolutionized the way we archived and stored knowledge, in a far more effective way. The Gutenberg Press, democratized knowledge, therefore increasing the speed of the actual cycle of knowledge creation. The internet, telecommunications, and other technologies in the 20th and start of the 21st century, there was a boom in knowledge, which was able to make knowledge the most important asset of any organization (DRUCKER, 1998). Which will be the effects of new technologies? What part of the cycle will be most impacted by big data and artificial intelligence?

2.4.1 – Big Data

"You can not manage, what you cannot measure" (McFEE, 2010).

Big Data has become a vogue subject in the past few years, however the groundwork for such projects started when the internet became real. From the beginning of the internet, that meant that information is no longer stored individually, but rather shared within a broader network. This also meant that more information had to be organized and created in order to make millions

of people being able to access the internet. With the speed of growth of data, search engines and databases began to form the base for what would be big data. Companies such as Microsoft, oracle, Google and IBM began investing millions of dollars to buy up startups that dealt with big data (CHEN, 2014). Big data requires specific technology that is capable to deal with large sets of data instantly. The technology that is most common cited with Big Data is Hadoop which allows for fast query's to be processed through the open source platform (DE MAURO; GRECO; GRIMALDI, 2016).

Big data opens opportunities for companies to measure knowledge, processes, knowledge creation, in such a way that it can directly affect the decision-making process of companies and organizations. There are various definitions for what is Big Data, De Mauro, Grecco and Grimaldi (2016) worked through the literature in order to come to a definition that might be close to a consensus within the academy. "Big Data is an active of information, characterized by Volume, Velocity and Variety that is so large that there is a need for technology and analytical methods to transform that into something of discernible value"

To best understand the scope of what big data is, allow us to work with number. First, let us understand **Volume**, today more new information is stored every second, then all the information that was created between 1970 and 1990. Each hour, Walmart collects enough data about their clients, that would be enough to fill 20 million standard sized lockers. Second, let us understand the **Velocity** which this information is happening. Think about the speed in which a driver from a ride sharing app receives your request. That speed is essential for the business to run correctly. Lastly, **Variety**, the different type of information which we receive, and the different ways in which we receive it. A Formula one car is a perfect example, since each car has 150 different points of information, coming from sensors, velocimeters, GPS and other different sources (McFEE, 2012). All of these allow for the highly optimized efficient operation.

Big data opens up the opportunity for new information, for a change in the process of knowledge creation, and mostly a large step on the efficiency of the management of organizations, since organization will make data-based decisions, while then intuition (MCFEE, 2012).

The **Figure 05** demonstrates how the process of knowledge generation can be shortened and be more direct by utilizing Big Data. Increasing access to information, and transforming information into something more direct and predictive, than the knowledge usually generated in organizations. As we can see below, the process for knowledge creation has been reduced to Big Data, Knowledge to Wisdom, to Accurate Business prediction. This means that information is more accurate, more numerous, therefore, information becomes more complete, and wisdom, is not general, but rather direct, which helps companies make more assertive decisions.

In an innovative study, Sumbal, Tsui and Eric (2017), studies the relationship between Big Data and KM specifically within the Oil and Gas industries. The sector is known to be knowledge intensive, something necessary for this analysis (NONAKA; TAKEUCHI, 1995). In their analysis, they analyzed companies located in the Middle East and Europe through several internal reports for a period of 12 months. Companies that already worked with data correctly implemented big data within their projects, with well-designed projects that generated relevant knowledge for the Company. Big data generates important, predictive information (COWLEY-DURST, 1999), but a human intervention is required to see if that information should be evaluated or discarded. Knowledge is created through machine learning, or a method of data analysis that can automatically show patterns, which exempts the need for interaction between members of the organization.

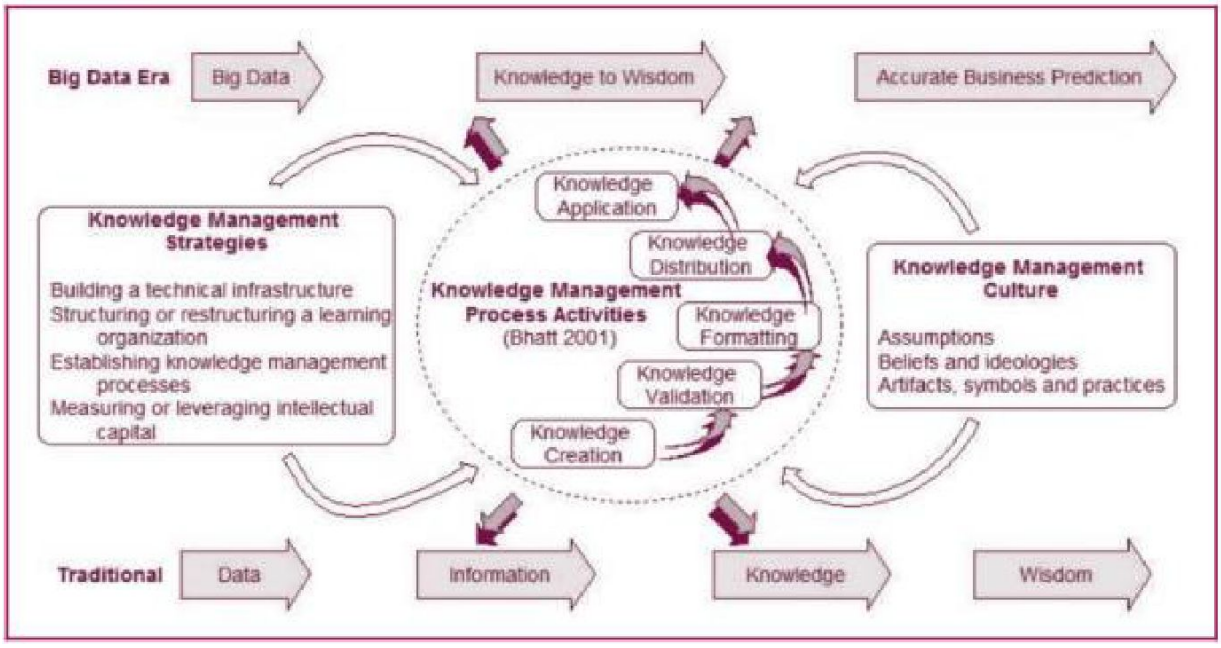


Figure 06 – How the process of knowledge generation can be shortened and be more direct by utilizing Big Data. (TIAN, 2017)

After this, tacit knowledge of the companies, is applied based on the SECI model (NONAKA; TAKEUCHI, 1995) as described in the Figure 07.

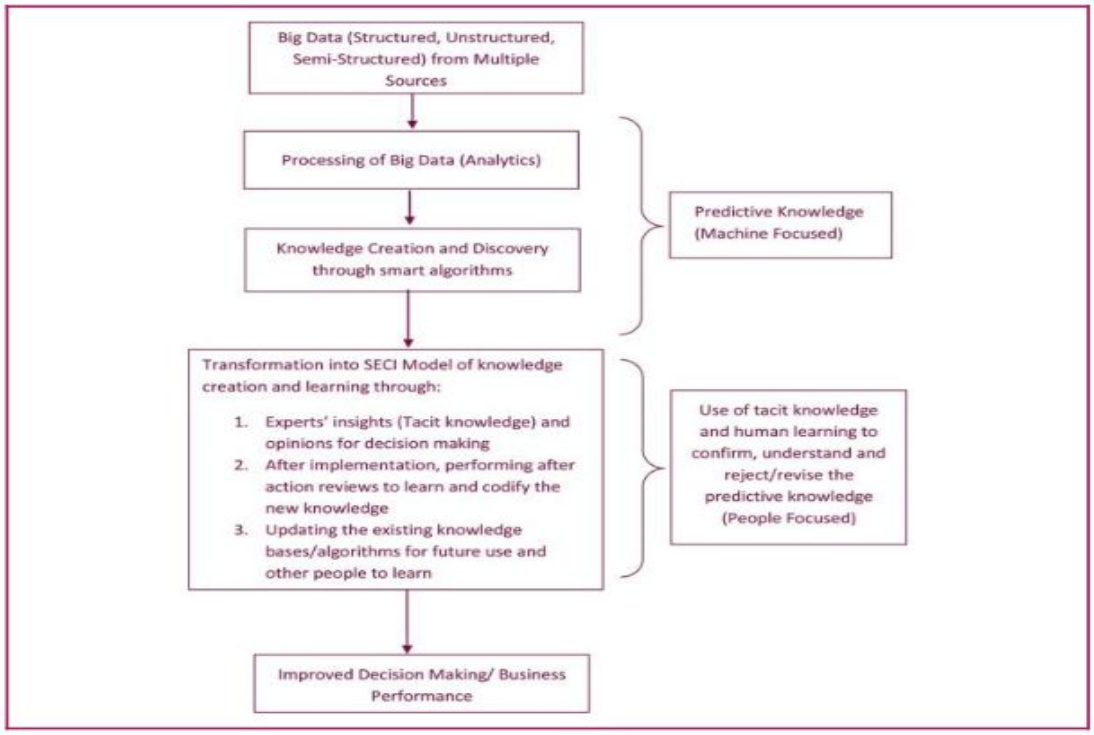


Figure 07 – Tacit knowledge of the companies, is applied based on the SECI model (NONAKA; TAKEUCHI**, 1995).** Sumbal, Tsui and Eric **(2017).**

In summary, Sumbal study show a clear link between Big Data and KM, and the ability of Big Data to make KM a more powerful and effective tool for any organizations.

2.4.2 – Artificial Intelligence

The artificial intelligence field is vast, but a succinct and simple explanation for AI was mentioned by Bellman as "The automation of activities associated with human thinking, such as decision making, problem solving, and learning" (BELLMAN, 1978) . Artificial Intelligence

started as a project backed by the American government in 1950, and has since had gigantic advances (BOSTROM, 2018).

Volume, Speed and Variety of Big Data created the need for new technologies such as Artificial Intelligence to be able to process all of the incoming data (HOESCHL, 2006). Possibilities to mine data, create knowledge repositories, create new knowledge and identify trends to aid decision making. A more advanced version of Artificial Intelligence with so-called intelligent agents that work independently to store, search, and even create new knowledge without human intervention (BRADSHAW, et al., 1998).

In his study, "Decision support through knowledge management: the role of artificial intelligence" (Metaxiotis, 2003), defined three areas within Artificial Intelligence essential for KM. Firstly, Expert systems, which is an area that tries to simulate the reasoning of a human being with vast knowledge in a specific area. The creation of Expert Systems, powered by fuzzy ontologies, can create more efficient systems, goals, and empower a human expert. Second is Artificial Neural Networks, it is a technique based on our nervous system, which is used to process information. The big difference is that the system learns, by itself, with existing information, but not necessarily all available information (HAYKEN, 1994). This type of system is used within KM to decide how to distribute and share information. Finally, Intelligent Agents is a computer system that is autonomous in the decision-making process (JENNINGS; WOOLRIDGE, 1998). An example is a Startup in Maringá, Multibot, which sells and buys stocks in a fraction of a second. In KM smart agents are especially important in the search for

information, information dissemination, and information analysis, and it works powered by Big Data.

Narrow A.I

We can currently separate A.I into two large groups, Narrow A.I and General A.I. The first is the one where we are in touch with the most, Narrow A.I. Narrow Artificial Intelligence has to do with any type of technology that has been automated and given instruction to how to act, in a responsive and accurate manner. Narow A.I, after it understands you are asking, it directly enters that text onto a search engine, and returns an answer based on those parameters. That is why when your question is vague, the answer might not be satisfactory, however when you ask, what the weather's like today, it will give you an adequate answer. Another example of this are bots utilized by telecommunications companies in support centers. While highly applicable in business these type of approach, when most think of artificial intelligence.

General A.I

The idea behind general A.I is something that would be able to have general knowledge. Be able to be flexible and able to think essentially thinking the same way a human would. The ability to intelligently make real time decisions (KURZWEIL, 2005, p. 260). General A.I also brings into focus the possibility of consciousness for machines, however progress in research for General A.I has been far slower than Narrow A.I. A recent example of general A.I is depicted in the movie "Her"and many other science fiction movies. While largely irrelevant in applicability, general A.I is topic of discussion for literature, philosophy, and other genres, that find the problem of consciousness by machines an interesting topic.

Artificial Intelligence Techniques

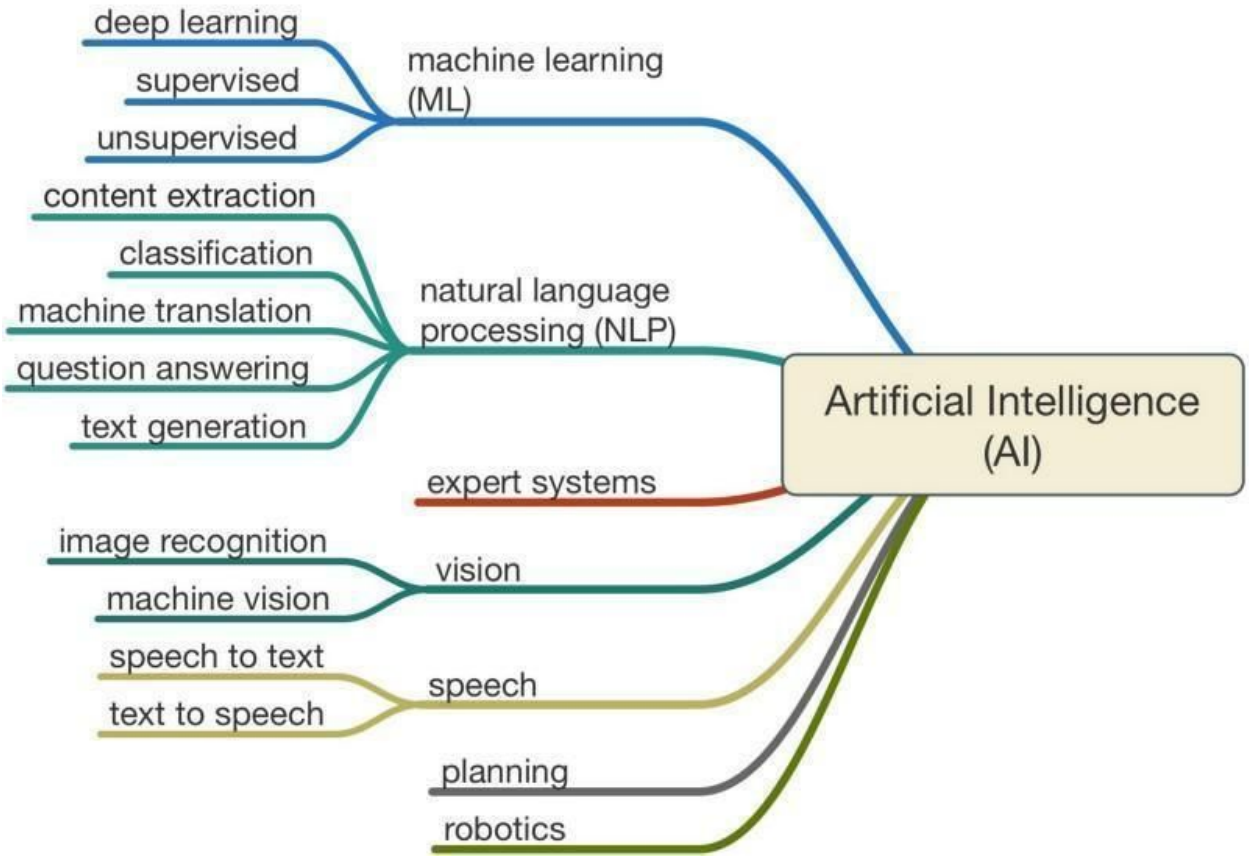


Figure 07. Source: Author

The field of artificial intelligence is extremely broad, the graph above shows some of the fields that are currently being researched. All of which are extremely important, we will attempt to give brief summary of each field that are related to knowledge management.

Natural Language Processing (NPL)

Natural Language Processing was one of the first areas of Artificial Intelligence to be research. It was the basis for the Turing test. For most of its history it was based on hand written coding

language, that through a rule based approach. This meant that most of the research was focused on translation, until the late 1980's 1990's, when NPL started to utilize statistical models based on machine learning (Resnik., 2011.). This new approach was able to take into consideration context, and therefore better understand and communicate through human language. We use this technology everytime we ask Siri something. These types of technologies used to be able to answer direct pointed questions. Currently even non sophisticated NPL techniques already take into account context answer more ambiguous questions. Mariani, Joseph; Francopoulo, Gil; Paroubek, Patrick; Vernier, Frédéric (2019), "The NLP4NLP Corpus (I): 50 Years of Research in Speech and Language Processing", Frontiers in Research Metrics and Analytics

Machine Learning

In 1959, the concept of machine learning was created, with the influence of an experienced based approach to learning. As statistical models, computational power, and big data evolved, the opportunity for experience to create knowledge was further emphasized Samuel e Arthur (1959).

Machine Learning is a technique that uses statistical models to help machines make decisions without specific instructions. Machine learning utilizes large datasets, in order to understand the statistical probability of something happening, and through that it makes inferences and decisions. A simple example is when your inbox marks something as spam. If the data shows that people are not opening that email, or deleting it quickly, it will look to understand why, label words on the title, or the sender, and start automatically labeling it as

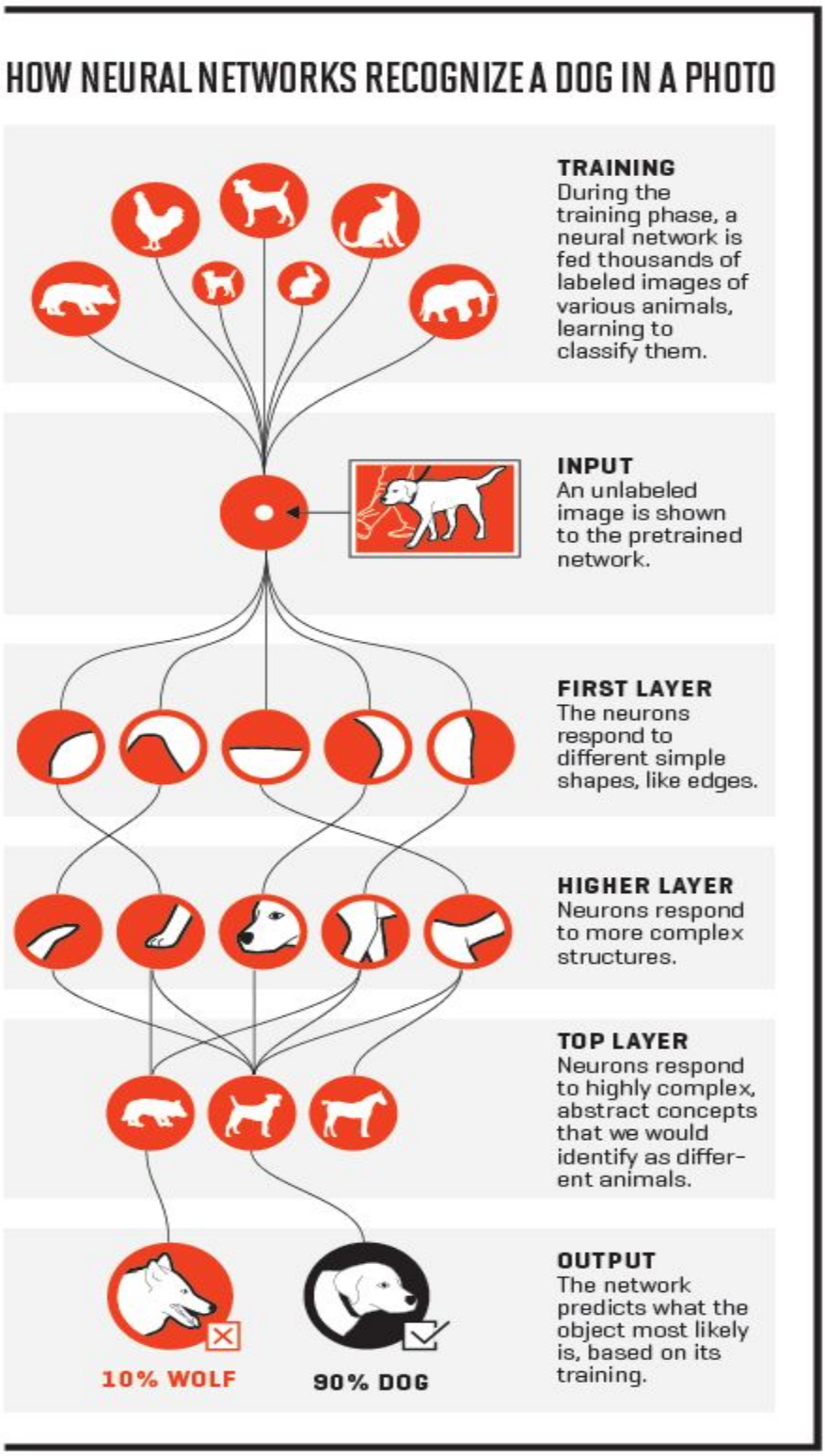
spam. When that process is done, the statistic becomes more accurate and therefore a better system throughout time.

Machine Learning is also broken down into supervised and unsupervised and also opened the door to Deep Learning. In supervised model, the algorithm is given both inputs, as training data, as well as desired outcomes. This limits the range of learning and analysis that is possible with machine learning, however it is highly effective for defined results. Unsupervised Machine Learning setups an initial data supply set, however it allows for the algorithm to find statistically relevant clusters and learn through that pattern. Knowledge creation is becoming farther and farther from the input of a human being. The next step in machine learning is deep learning.

Deep Learning:

Deep learning was introduced in the latter years of the 1980's, however saw its popularity blossom in the 21st century. The most utilized approach in deep learning is neural networks, which attempt to mimic the process of a biological human brain. Similar to a human brain it looks at a picture, and it identifies a general concept, afterwards it defines things in more details as time goes one. First we understand there is something moving towards us, after we decide what it is, and lastly we decide whether it is a danger.

Figure 09. Artificial Intelligence Journal



These Neural Networks A These systems work similar to a biological nervous system, and essentially having the ability to learn on its own. This idea is what has most closely resemble the second category of Artificial Intelligence.

The second Category for Artificial Intelligence, is General Intelligence, or Strong A.I. This type of A.I is similar to the human brain. The human brain has the ability to think, strategize, create myths, and think about things abstractly. We do this through our experiences, both read, and felt, and constantly updated. We only see examples of true general A.I in Sci-Fi movies such as "Her", however the closest techniques to find General A.I is machine learning, and later deep learning.

The graph above shows the main ways in which artificial intelligence is applied and utilized.

Artificial Intelligence is necessary to be able to understand all the data generated by Big Data, it is informing KM, and improving some processes, but it is not replacing the need for human beings with tacit knowledge.

General A.I

The idea behind general A.I is something that would be able to have general knowledge. Be able to be flexible and able to think essentially thinking the same way a human would. The ability to intelligently make real time decisions (KURZWEIL, 2005, p. 260).

2.4.3 - Biometrics, Sensors, Social Media and IoT's

Where does the data come from for Big Data? Why do we produce so much data today? How are they produced, and by whom? There are several ways to generate data, let's focus on some trends, to try to predict the future of Big Data.

The biggest generator of data is the internet, and of the 7 billion things connected to the internet, 5 billion are not computers. They are automobiles, telephones, automation systems, sensors, meters, industrial controls, and even medical devices (VESSER, 2012). This data is digital, therefore easy to store, and analyze, with time, time, and location related to all of them. Internet of Things are objects of our daily life that are connected to the internet that receive and send data over the internet. A common example is our phones, another is our smart watches, and so on (ASKITAS, 2015). Data generated by the Internet of things can extend to data on human health communication between security systems, thus creating a gigantic amount of Data (NOLIN; OLSON, 2016).

Today, social media is the largest producer of consumer data in the world. Constantly generated information, which passes preferences, feelings, and perceptions of human beings on products, organizations, and topics. Social media has the ability to demonstrate a direct link between social media metrics and organizational performance. Social media has the ability to help companies understand, sentiment and desires of their consumers, whether to take more innovative, and refine processes within the organization (WANG; AKULA, 2017).

As we can see in the figure below, all these new ways of receiving data end up feeding Big Data. They are essential to it, and each one has a niche of data that they are collecting.

Chapter 3: Methodology

3.1 Introduction

The research is by nature theoretical, because it aims to create knowledge and understanding, not a solution applicable to some specific problem. The research beyond the theoretical framework will have a bibliographical section. It will be done through a survey of theoretical references in three major topics: Knowledge management, Technology and History of Knowledge. Methodologically it will provide a way to build a new understanding based on the accumulation of knowledge already written and researched in the past. This enables new information and knowledge to be generated (FONSECA, 2002).

The use of documents in research should be appreciated and valued and according to Sá-Silva, Almeida and Guindani (2009), the wealth of information that can be extracted and rescued justifies its use in several areas of Human and Social Sciences because it allows to broaden the understanding of objects whose understanding requires historical and sociocultural contextualization.

For example, in the reconstruction of a lived history, [...] the written document is an extremely precious source for every researcher in the social sciences. It is, of course, irreplaceable in any reconstitution concerning a relatively distant past, for it is not uncommon for it to represent almost all traces of human activity at certain times. Moreover, very often, it remains the only testimony of particular activities that have occurred in the recent past (CELLARD, 2008, p. 295).

Also, according to Sá-Silva, Almeida and Guindan (2009), another justification for the use of documents in research is that it allows adding the dimension of time to the understanding of the social phenomena. Documentary analysis favors the observation of the process of maturation or evolution of individuals, groups, concepts, knowledge, behaviors, mentalities, practices, among others. (CELLARD, 2008).

That said, our documentary research seeks to rescue the use of knowledge, technologies and people throughout history, in order to understand how knowledge was managed throughout this evolution. Once understood as the evolution of knowledge occurred in this context, we will parallel the knowledge cycles defined in Knowledge Management.

In addition, this explanatory and qualitative study, aiming to build a deep understanding of Knowledge Management and its evolution during the evolution of humanity. The intention is to explain, not define, or prove, but rather to show: the evolution of knowledge and in parallel as occurred the management of knowledge; as well as which technologies help in this evolutionary process. Qualitative research, according to Manayo (2001), works with aspects that cannot be quantified, so it is necessary to work in an environment that has a level of subjectivity.

Therefore, according to Cellard (2008, p. 298), a person who wishes to undertake documentary research must, in order to constitute a satisfactory corpus, exhaust all clues capable of providing him with interesting information.

3.2 Research Design

In order to meet the general objective of this research, it is "to make a redemption of the evolution of cycles of knowledge in order to understand the effects of these evolutions in societies", that is, to work in a historical scope, from the beginning of human society, try to see what may happen in the future with the use of artificial intelligence, big data, and data receivers. The research aims to understand how the cycles of knowledge have changed, spread and transformed as the technologies and needs of society changed.

We will divide this goal into five research questions.

Q1 – How to investigate the accumulation of knowledge?

Q2 – How to identify Technologies that changes the process of knowledge management cycle?

Q3 - How to understand and analyze how technologies such as Artificial Intelligence, Big Data can collaborate to the development of KM?

Q4 - How to analyze the evolution of KMC?

Q5 - How to show that KM can absorb the technologies of big data and artificial intelligence?

3.2.1 - Bibliographic Research Protocol.

To answer the questions will be developed a bibliographical research following a protocol adapted from Thirty (2009).

- ✓ The main concepts of following research 3.1
- ✓ Define research strategy for 3.2.
- ✓ Show how research will be shown in 3.3.
- ✓ The formation of a database 3.4.
- ✓ How articles are refined 3.5.

3.2.2 Definition of the main concepts of the research

The first step consists of determining the basic concepts that should be explored by the research. Specifically, for the search strategy and for the accomplishment of the bibliographic search it is necessary to define the contextualized environment, the research problem and the general objective of the research, whose purpose is to enable the definition of the main key concepts.

According to Tasca et al. (2010), the analysis of the context, the definition of a problem and the guiding questions initiate the process of scientific research, thus motivating researchers to search for information on a certain subject on a bibliographic basis.

The aim is to fully exploit the potential of existing and available bibliographic databases and information technology tools for the treatment of such data. Table 10, taken from Gabriele (2011), shows the necessary linkages between the items described above, which will make the concepts of research clear.

The present context is a evolution of knowledge, constantly pushed by technologies, and at present with the advent of two extremely important technologies, Artificial Intelligence, and Big Data. The goal of the research is to try to understand the phenomenon of how technology changes Knowledge Management, to better understand how the merger of the new technologies

of AI and Big Data, will affect KM. Figure 2. Problem, main purpose, specific objectives and research questions.

Table 10 - The necessary linkages between the items described above, which will make the concepts of research clear. Adopted from Gabriele (2011)

Context:	**Problem:**	**General Objective**	**Specific Objectives**
Exponential Growth like we have never seen.	A lack of historical analysis of the history of Knowledge Management	Rescuing of the evolution of the cycles of knowledge creation and understand the effects of these in society.	Investigate the agglomeration of knowledge.
Exponential growth in companies that are based on knowledge.	*A lack of understanding of how technologies changed the KMC		Show how KM can absorb new technologies such as big data, artificial intelligence, and biometrics
The birth of new potent technologies such as Artificial Intelligence, Big Data and Biometrics.	Lack of understanding between the connection of Artificial Intelligence, Big data and Biometrics		Analyze perspective about the evolution of KM
Focused on the current problems that KM is trying to solve, therefore a lack of material about the historical development of KM.			*Understand and analyze how new technologies such as artificial intelligence, big data and biometrics can impact KM

Scalability, Volume, and Velocity of the process of KMC like never seen before.			Identify how technologies changed the KMC.

3.3 Definition of the Research Strategy

We will be utilizing a strategy based on bibliographical research, with keywords and definitions, derived from our specific objectives to create the database necessary for our research (LACERDA, 2012). In order to visualize and decide the appropriate keywords we will adapt the building of a word tree as described by Farias Filho (2009) (See Table 11). In this manner we will be able to organize our material in a methodical way, with the specificity necessary for it be an effective bibliographical research paper. This tree can demonstrate the connections between terms, objectives, and themes, and therefore the keywords being searched.

Table 11 - The building of a word tree. Adopted from Farias Filho (2009).

Objective	Theme	Sub-Theme
* A rescue of the evolution of KMC in order to understand the effect of this on the evolution in societies.	History	History + Knowledge
	KM	History + KM
	Artificial Intelligence	History + Technology
	Data Gatherers	KM+ Artificial Intelligence
	Information	KM+ Big Data
		Knowledge+ IA
		Knowledge+ Big Data

		Information+ AI
		Information + Big Data

As we were able to visualize with the tree, we were able to give depth and efficiency to a robust, detailed, and organized search. The main goal derivations provide a clear, assertive path for a bibliographical research that is fair and complete.

Furthermore, in order to deem the source of these papers, we choose to limit ourselves to the papers written in the top 5 journals as ranked by Bontis Serenko, in his article "Global ranking of knowledge management and intellectual capital". We then applied the research tree of table 11, and tallied our results, by relevant, or irrelevant, to all the articles written in these publications since their starts. This makes up over 2650+ articles, across over 20+ years.

Serenko graded journals based on the following criteria: first an expert survey, with renowned authors in the area. Secondly the harzing publishing tool, which is a tool that measure the impact of each publication, by number of citations and other parameters. Serenko's ranking also excludes any publication that requires payment, as well as citations that have been considered unworthy of academic credit (SERENKO, 2017).

3.4 Conducting the research

It is necessary to create standards for bibliographic research. As described in the previous section, the language and terms will be defined by the process of creating a keyword tree (FARIAS FILHO, 2009). The definition of how these keywords will be researched and analyzed need to be standardized, and previously defined (TASCA, 2010). In this sense it is necessary to define softwares, databases, and types of articles admissible in the research process.

After defining the key words, and the places where the research will be done, it is necessary to define what we are looking for from each of these articles. How to digest all this information? For this we will determine some rules of inclusion and exclusion.

Inclusion:

- Be in Portuguese, Spanish or English
- Results must be available in full for download or consumption
- Published in Journal, Books, or Recurring publications considered credible.
- Title or Summary directly related to any of the specific issues.
- Be related to the general areas of Information Technology, History or and Knowledge Management.

Exclusion:

- Result is not in the appropriate language.
- Result is not available.
- Outcome is not within the scope of the research questions.
- Result is not published in scientific journals, or publishers of credibility.
- Result are not within the pre-established ranking.

This research process is successive and progressive, in order to allow each round of research to obtain articles that are more applicable to the interests of the researcher and aligned with the objectives of the research. The keyword tree must be dynamic and inclusive and must adapt to the research process, reflecting in the results this dynamism. The researcher must catalog and save the entire process in order to always guarantee the traceability of the research.

3.4 Formation of the initial database

At that moment the scientific documents are cataloged, and the formation of the initial database is sought to extract all the articles that do not have adherence to the research. To do the bibliographic search we will be researching important journals in the knowledge management, big data, and artificial intelligence. Searches will be done methodically with the combined keywords shown in Table 12.

Table 12 - Searches will be done methodically with the combined keywords

Combined keywords
“History + Information”
“History + Knowledge”
“History + Technology”
“History + Knowledge Management”
“Knowledge+ Technology”
“Information + Technology”
“Knowledge Management + History”
“Biometrics + Knowledge Management”
“Big Data + Information”
“Big Data + Knowledge”
“Big Data + Knowledge Management”
“Artificial Intelligence + Information”
“Artificial Intelligence + Knowledge”

"Artificial Intelligence + Knowledge Management"

3.6 Refining the sample and forming the portfolio of articles

In this stage the final portfolio of articles is formed, seeking to select those most adherent to the research. For this, it will be cataloged all the articles available and verified one by one if it meets the criteria quoted above. This will be done in a methodical and cataloged way for review and publication. All of this information will be included in an appendix, and after that, the remaining articles will be reviewed for further study of the current research.

After these pre-selections, each article will be analyzed in a methodical manner, to fill a form with all the relevant data, and answers so that we may proceed with the research. If articles are fully answer, or partly answer any of the questions formed within the main and secondary objectives it will be deemed relevant. If not, they will be deemed irrelevant. The table 13 shows the final portfolio of articles is formed, seeking to select those most adherent to the research.

Table 13 - The final portfolio of articles is formed, seeking to select those most adherent to the research

Journal	Volume + Issue	Name	Topic Addressed
Journal of Knowledge Management	Volume 1 issue 1	"Knowledge Management: An Introduction and Perspective"	History
Journal of Knowledge Management	Volume 1 issue 3	"What Lies Beyond Knowledge Management:	History

		Wisdom Creation and Versatility"	
Journal of Knowledge of Management	Volume 1 issue 3	"At the Core of a Knowledge Base"	History
Journal of Knowledge of Management	Volume 1 Issue 4	"Knowledge Management: An Emerging Discipline with a Long History"	History
Journal of Knowledge of Management	Volume 1 Issue 4	"The Human Organization"	History
Journal of Knowledge of Management	Volume 21 Issue 5	"Does big data mean big knowledge? KM perspectives on big data and analytics"	Big Data
Journal of Knowledge Management	Volume 2 Issue 2	"Natural technologies for knowledge work: information visualization and knowledge extraction"	Big Data
Journal of Knowledge Management	Volume 12 issue 1	"The linkage between knowledge accumulation	Artificial Intelligence

		capability and organizational innovation",	
Journal of Knowledge Management	Volume 12 issue 3	"An evolutionary and interpretive perspective to knowledge management"	History
Journal of Knowledge Management	Volume 13 issue 1	"A follow-up ranking of academic journals"	History
Journal of Knowledge Management	Volume 14 issue 1	"Research paradigms of contemporary knowledge management studies: 1998-2007"	History
Journal of Knowledge Management	Volume 14 issue 1	"A scientometric analysis of knowledge management and intellectual capital academic literature (1994-2008)"	History
The Journal of Intellectual Capital	Volume 17 Issue 3	"A history of intellectual capital measurements: from	History

		production to consumption",	
VINE	Volume 26 Issue 2	"Decision support systems: an overview",	Artificial Intelligence
VINE	Volume 37 Issue 4	"Data-driven decision making for the enterprise: an overview of business intelligence applications"	Artificial Intelligence/Big Data
VINE	Volume 38 Issue 4	Welcome to the intelligence age as a complex venture emergent behavior	Artificial Intelligence
VINE	Volume 31 Issue 3	How it all began: A brief history of the internet	Big Data, Artificial Intelligence
VINE	Volume 37 Issue 4	Effective Educational Process: Data Mining Process	Big Data
VINE	Volume 38 Issue 2	Intelligible Knowledge: The conjugality of business Intelligence	Artificial Intelligence

		and business operational data	
Knowledge Management Research and Practice	Volume 10 Issue 3	"Patterns as objects to manage knowledge in software development organizations"	Artificial Intelligence
Knowledge Management Research and Practice	Volume 7 Issue 3	The world wide web of research and knowledge	Big Data
Knowledge Management Research and Practice	Volume 8 Issue 1	Software and Human Agents in Knowledge Codification	Big Data, Artificial Intelligence
Knowledge Management Research and Practice	Volume 12 Issue 3	Intelligence Capital: a capability maturity model for a software development center	Artificial Intelligence
Journal of Intellectual Capital	Volume 17 Issue 3	A history of intellectual capital measurements	History
Journal of Intellectual Capital	Volume 9 Issue 2	Patents and Academic Research: A state of the art	History
Journal of Intellectual Capital	Volume 6 Issue 4	Knowledge valuation analysis: Applications	History

		for organizational intellectual capital	
Journal of Intellectual Capital	Volume 18 Issue 2	Intellectual Capital in the age of big data	Big Data
Journal of Intellectual Capital	Volume 16 Issue 2	Smart City Intellectual Capital	Big Data
Journal of Intellectual Capital	Volume 6 Issue 4	Data Envelopment Analysis	Big Data
Journal of Intellectual Capital	Volume 18 Issue 3	Increasing Smart Cities Competiveness and sustainability	Big Data
Journal of Intellectual Capital	Volume 15 Issue 1	15 years of the journal intellectual Capital Research and counting	History
Journal of Intellectual Capital	Volume 15 Issue 2	Metrics of the elements of intellectual Capital in an economy driven by knowledge	Big Data
Journal of Intellectual Capital	Volume 19 Issue 1	Identifying Future Directions for IC research in education: a literature review	Big Data, History

Journal of Intellectual Capital	Volume 6 Issue 2	Exploration for the relationship between innovation, IT and performance	Big Data, Artificial Intelligence
International Journal of Knowledge Management	Volume 14 Issue 1	Our knowledge management hubble may need glasses: Real-Time big data systems faults	Big Data
International Journal of Knowledge Management	Volume 14 Issue 4	The Iot and Big data driven Data Analysis Services: KM implications and Business services	Big Data
International Journal of Knowledge Management	Volume 15 Issue 2	The Evolution of Data Science	Big Data
International Journal of Knowledge Management	Volume 13 Issue 1	The Past-Present-Future Conundrum	History
International Journal of Knowledge Management	Volume 7 issue 2	A dynamic ability based view of the organization	Artificial Intelligence

Chapter 4: Analysis and Results

While working with the samples described above, it became evident, that the discipline as a whole has failed to look backwards or forwards, but rather is too involved with matters of current affairs. In the sections below you will understand a little bit of the breakdown of what has happened.

The Journal of Knowledge Management: 23 volumes: 13/660

"The *Journal of Knowledge Management* is a peer-reviewed publication dedicated to the exchange of the latest academic research and practical information on all aspects of managing knowledge in organizations. The journal publishes original research and case studies by academic, business and government contributors on strategies, tools, techniques and technologies for Knowledge Management. The focus of this journal is on the identification of innovative Knowledge Management strategies and the application of theoretical concepts to real-world situations."

Journal of Intellectual Capital: 15 Volumes: 11/300

"The *Journal of Knowledge Management* is a peer-reviewed publication dedicated to the exchange of the latest academic research and practical information on all aspects of managing knowledge in organizations. The journal publishes original research and case studies by academic, business and government contributors on strategies, tools, techniques and technologies for Knowledge Management. The focus of this journal is on the identification of innovative Knowledge Management strategies and the application of theoretical concepts to real-world situations."

Knowledge Management and research practice: 15 Volumes: 4/726

Knowledge Management Research and Practice offers articles that embody a multidisciplinary approach and conceptual integration greater than those found in other publications. This cross-disciplinary focus helps the journal address other important tensions in the field of knowledge management, such as those between strategy and operations, people and technology, and short- versus long-term needs.

The contents feature empirical research papers, theoretical papers, conceptual papers, case studies and surveys.

The range of coverage is broad, from organizing for sustained innovation to discussion of know-how transfer mechanisms in franchise networks, to business model innovation from the perspective of intellectual capital, to the functions of human capital, renewal capital and entrepreneurial capital in high- and low-tech companies.

Vine: 49 volumes: 6/624

VINE Journal of Information and Knowledge Management Systems is an international, peer-reviewed journal that publishes articles, opinions and case studies which consider information and knowledge from a content management/library science perspective.

It recognizes the reality and need of organizations, both governmental and private, to operate in a highly interdependent world, where collaboration and knowledge/information are the predominant assets for getting things done; and, in many cases, critical for achieving competitive advantage.

VINE Journal of Information and Knowledge Management Systems provides a combination of topical themed issues, well-researched, timely, unbiased articles, and practical overviews which

can be applied in the workplace ensure that the journal offers lively and topical coverage of developments in the field.

International Journal of Knowledge Management: Volume 5/300

The **International Journal of Knowledge Management (IJKM)** covers all aspects of knowledge regulation and order including organizational issues, technology support, and knowledge representation. IJKM provides a forum for global aspects of this significant field of study differing cultural perspectives on its use of knowledge and knowledge management. This journal also focuses on the technical issues associated with the creation and implementation of knowledge management systems.

While most of the abstracts that describe these papers mentioned innovation, and history, as we will see, they fail to address the areas of innovation that we mention throughout this thesis. Furthermore, the number of papers that deal with Knowledge Management from a historical perspective is also few and far between. None of the journals show a higher than 1% of articles included the topics of big data, artificial intelligence, or the history of Knowledge Management. The return almost negligible, which strengths the need for further research in this area, to complete the picture of Knowledge Management throughout history.

4.1 The accumulation of knowledge

When we take into consideration our first questions of our research questions, "the accumulation of knowledge" it becomes clear that the amount of knowledge created and accumulated around the area of Knowledge Management is huge. In total 2.5 quintillion gigabytes were created each day, that is, 90% of all the data ever created in the world was done so in the last two years (MARR, 2018). The academic area has exploded, due to a high demand and thirst of the market for Knowledge Management techniques. The focus of the discipline has been just that, to apply knowledge management to different industries, organizations and systems. With that established we can move forward, with the understanding that Knowledge Management has a solid academic

base, with defined principles, and obvious applicability. For Serenko and Dumay (2015), the academic discipline is still in a pre-science stage, more specifically still not mature. The discipline is extremely young, with only a few decades, however extremely prolific, with journals and publications permeating most business schools, and applied in extremely diverse industries. Organization such as the American Productivity and Quality center have shown that Knowledge Management have been applied to industries such as Defense, Chemical, Construction, Engineering, Finance, Insurance, Military, Government, Non-Profit, Manufacturing, Energy, Services, Pharmaceuticals, and many more.

When we survey the discipline in 2019 we understand first, we have never created or accumulated so much knowledge. Secondly this creates a tremendous need for Knowledge Management, to be applied in a wide range of industries. Third, this means an immense amount of production of knowledge management that is focused on the present needs of society rather then looking backwards of forward.

4.2 Technologies that disrupted the accumulation of knowledge

Our second question "technologies that disrupted the accumulation of knowledge" offers an interesting dichotomy. While the answer to our first question, offers a huge number of articles and research, while the answers to the second question were mostly vacant. When talk of technology was spoken of, it was mostly speaking of best techniques to existing technologies such as management systems, rather than looking forwards and backwards into "how" technologies impacted the knowledge creation cycle. When we consider the journal's that we picked less then 1% of the articles mentioned tangentially technology, and none of them dealt with the technologies prior to the 21st century.

When knowledge management cycle theory is applied to the technology it further enforces the effects and explains why such an advancement was able to produce a boom in progress in the accumulation of knowledge and therefore changes in human society. Due to the high applicability and speed of innovation within areas that directly impact the interest in doing a

historical evaluation of how knowledge management, and specifically knowledge management cycle was being utilized throughout different eras of history, without even realizing.

The lack of knowledge management historical analysis also leaves a significant gap for the development of the research area. An example is that storytelling is a technique utilized by knowledge management, however there is no study that looks at creation myths, greek or roman mythology or any other similar type of mythology within the discipline.

A more longitudinal look at technology and its effect on knowledge management would give a larger weight to the discipline, with a perspective that would be able to show how technology and its effects permeate through the Knowledge Management Cycle. That approach would give better practices and context to absorbing new and emerging technologies that will always be present in this particular discipline.

4.3 Artificial intelligence, Big data can collaborate to the development of KM

Our third question and its need its further highlighted with the previous answers. Question three asks whether Artificial intelligence, Big data can collaborate to the development of KM. There are few articles that tackle big data, in a response, as an addition to existing system that aids knowledge management. We found no articles that deal directly with how Artificial Intelligence will impact Knowledge Management, or the Knowledge Management cycle, however, that might the biggest impact of any technology that came before (KURZWEIL, 2005, p. 260).

All prior technologies explored within this text, speaks about technologies that aided every area of the knowledge management cycle, expect the actor creating knowledge itself. The human brain has always been the originator of knowledge; however with the advent of neural networks we are currently seeing examples of computer-generated knowledge that is completely exempt and independent from human interference. Neural Networks have already created designs for aircrafts that look completely different than anything man made, neural networks that are able to identify people and offer security at speeds far faster than the human brain, and even languages

that are unable to be understood by human beings (HASSAN, 2017). The question that arises is that if the creation of knowledge can be made my a machine, will that have a similar effect of knowledge creation as the internet, or video had with the sharing of knowledge? If we can have the same exponential type of growth to knowledge creation as we did to other areas, what will that create in terms of progress and scientific advancement? How can Knowledge Management aid that process?

Without a doubt big data and artificial intelligence can aid the Knowledge Management Cycle and should be furthered research in invested in, in order to create mechanisms that will optimize KM. Absorbing these new technologies will open frontiers of knowledge creation, storage and sharing unlike anything we have seen in history. Allow me to highlight once more, how different these technologies are then prior technologies, since it opens the possibility of a new agent of knowledge creation, while other moments only further enhanced knowledge created by human beings. The cap of human knowledge, used to be humanity and its ability to disseminate and store information, with artificial intelligence, the cap to knowledge is unknown.

4.4 Evolution of Knowledge Management cycle

The fourth question has as a goal to attempt to see the evolution of Knowledge Management cycle. During our research we found that most of the focus was on the development of the discipline, from 1980's till present day, while most reflections of our past were only mentioned in brief introductory texts, rather than a true analysis of the Knowledge Management of prior times. Our analysis shows that the Knowledge Management cycle was used unknowingly throughout human history, and its steps and processes were constant. As we analyze the advancement of Knowledge throughout history, we can see how KMC has been aided by technology. The advancement of technology was able to create better processes for KMC. It can be seen that technology has been essential for KMC, since all of its processes have been aided by the advancement of the technologies spoken about throughout this paper. Academically we have been far too reactive to technology, whether then pushing technology forward with the intent, in order to create and absorb new technologies faster and more assertively (IVES, 1997).

The evolution of KMC is not dependent on technology. Different processes and further reinforcement can also create positive results on KMC, however nothing has as dramatic effect on KMC as a new technology that dramatically changes how knowledge is shared, or even created. While the method of in which we store, share, and utilize Knowledge changes with incoming technology, the process has remained unchallenged (DALKIR, 2005).

4.5 Big data and artificial intelligence can be absorbed

For question five we can try to understand how big data and artificial intelligence can be absorbed. Big Data obviously changed the way we store information. It allows for far more data and information to be stored than ever before in human history. Below I will give a few examples in order to show how it can be used (STOCKLEBEN, 2017).

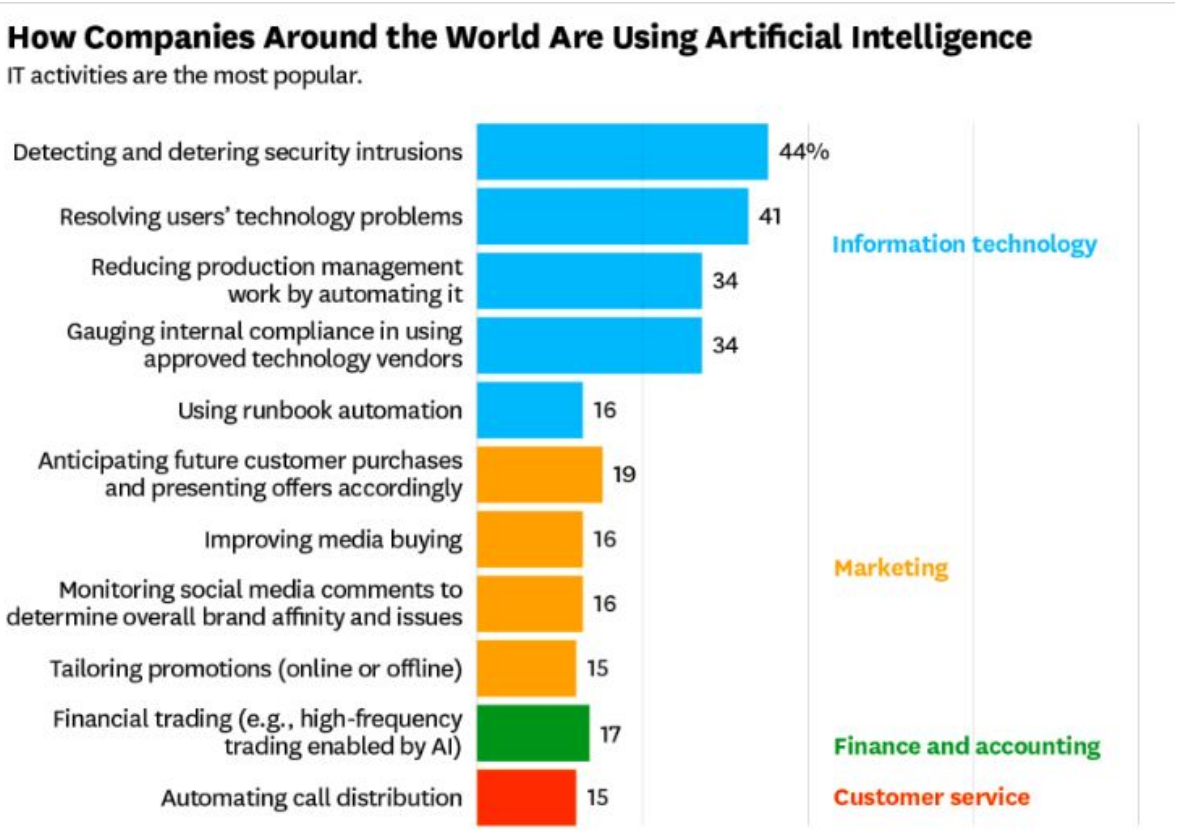
Mclaren, one of the winningest Formula 1 teams utilize 250 data sensors, to help their team bring top notch performance to the car. Those sensors generate 2 gigabytes of data per lap, in a race 3 terabytes. With that data engineers and workers make critical decisions to perfect its race car (SURMACZ, 2017). What is interesting is that big data allows them to track information from today, to information from years ago, while at the same time, giving the best immediate information about what is happening in the racetrack now. It has changed the way the race team stores, and disseminates knowledge, and impacted the overall performance of the team. Netflix utilizes Big Data in order to understand how its users watch and what they prefer. Based on their customers behavior and their ability to store and process that data in real time and continuously in order to create, showcase, and personalize the customer's experience (MARR, 2018). It seems odd, but big data, holding a huge amount information about everyone, is able to create a personalized and intimate experience.

As we can see with both examples, not only is the way they store data different, but also the way it is made available to them, and therefore the way they use data. The knowledge created is also

changed, because the type of information that is now being fed into the system. The change in structure and decision making is tremendous, however highly specific. Big data can be processed for specific examples such as these since there are set parameters, and an objective goal. The challenge is when what is the desired parameters, or even ideal outcome is yet unknown, therefore the necessity for the next complementary technology.

Artificial Intelligence allows for big data to be the incoming input, with innumerable variable, and an infinite number of outcomes. Recently Mckinsey and Company research shows that 30% of all activities can be automated. The alarming fact however is that few companies are engaging with Artificial Intelligence, which further enhances our initial findings, that Knowledge Management itself does not investigate the area (SINGH, 2017). To further our concerns, those companies that area adopting Artificial Intelligence are using mostly for Information Technology, one of the disciplines most tightly related to Knowledge Management, as shown in the table below.

Figure 10. (2017)
Source:Harvard Business Review



A few companies have taken the lead in implemented this type of technology. In the financial sector most banks, specifically American Express, artificial intelligence is able to run through a series of data points that help a particular transaction be approved. It looks at consumer behavior in a variety of different ways in order to understand whether to approve a certain transaction, or a loan to a business. It sees the way a person's phone is angled, whether the purchase has history of making similar purchases, whether the location is within the day to day activities of that individual, all that in real time, only made possible by artificial intelligence. Proctor and Gamble chose to gamble on building expert systems, that is utilizing both for price setting and production totals. This has estimated an increase in profits of about 20% for the company specifically in coffee brands (DAVENPORT, 2017).

Initiatives such as the ones mentioned above have shown how the usefulness of artificial intelligence in the Knowledge Management Cycle. It is absolutely necessary for academia jump

straight into the study of how these technologies could change the landscape of knowledge management cycle, and therefore the way modern organizations act.

Chapter 5: Final Considerations

We began understanding the context of KMC, how it was built through the development of the discipline, and finally settled on Dalkir's model, which utilizes the following steps, create, identify /store/sharing/utilize/learning. With that as the base for analysis we looked at different technologies and how they affected the process of creation of the knowledge management cycle. While there were many technologies that had a deep impact within the Knowledge Management Cycle, we choose to focus on a few. We spanned from oral language, to the invention of writing, to the adoption of paper, the printing press, industrial revolution, the communication revolution, all the way to artificial intelligence and big data. To cap our findings and research, we did an overview of how prevalent these topics are within the academic field.

The research showed an absolute need to both maps out or past in relation to KMC and prior disruption in the Knowledge Management Cycle and future disruptions to come. Such an understanding will allow us to better prepare the next few steps of Knowledge Management Cycle in order to lead in the advancement of technology rather than a reactionary and descriptive science. We saw that there was little to no research on each technological advancement pointed out throughout the research currently present, however the research shows that each and every advancement in technology was able to change and bring potential to the knowledge management cycle. Each and every technology adopted impacted directly the way we stored and shared knowledge, and therefore indirectly impacted other areas of the Knowledge Management cycle. As we observed these prior technologies, we see their importance, however it became clear the potential and unique ability of artificial intelligence to change the knowledge management cycle. Artificial Intelligence does not only have power to speed up the knowledge management cycle, but rather it changes dramatically who has the power over Knowledge Management. When a machine is able to create knowledge, it might become invalid the full process, since for a computer, the process of storage, sharing, and utilization is simultaneous.

Furthermore, the implicit knowledge that a machine might hold, may never be unlocked, and therefore, might never be truly understand by the human mind. Furthermore, the speed of knowledge creation by an effective artificial intelligence might be too fast for human comprehension, therefore making human knowledge creation completely useless.

Further research should be applied to each technology mentioned, in order to understand the order of magnitude that each technology changed the cycle. This could be done through a quantitative experiment, that measures the amount of learning utilizing each technology, and running it through the full Knowledge Management Cycle. This research will allow us to further inquire about the effect of the knowledge management cycle on human political, social, and economic progress. We should also apply further experimentation with the potential of artificial intelligence, and understand its philosophical implications to the discipline, in order to create a framework that will prepare companies to deal with knowledge that is created by machines. There is also the possibility to suggest and direct where Artificial Intelligence and its research should go in order to better serve Knowledge Management.

In sum, we have been able to identify a lack of research of specific technologies and there advancements in Knowledge Management Cycle. There is a historical gap, where researchers have refused to look backwards to watch how the Knowledge Management Cycle was utilized throughout human history. As we have seen we need to take a more open approach, that analyzes new technologies in a proactive manner in order to be more efficient as an academic area. In particular Artificial Intelligence and its potential to revolutionize should be studied further. What will happen to the world, once the creation of the most advanced knowledge is no longer created by human beings, but rather by a machine?

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