

A historical perspective on the dynamics of knowledge creation and application

*Jean-Pierre Bouchez

* PhD in Management Sciences. Research Fellow Professor, University of Versailles-Saint-Quentin, Guyancourt, France. **E-mail:** bouchez@club-internet.fr

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Abstract:

Introduction: This paper aims to demonstrate the hypothesis that the process of creation, distribution and application of knowledge, as well as its potential result in an innovation, is as old as human history itself. Hence, the paper will show that the current trend of the knowledge economy is merely a phase in the overall evolution of the process. **Methodology:** To support this hypothesis we demonstrate that this trend unfolds within the context of a combined dual dynamic: a so-called *longitudinal* dynamic which describes the evolution of structural innovations and a *transversal* dynamic that highlight the interaction and interconnection of the various interactive components that specifically arise within a favourable historical context and environment. This dual dynamic is examined through a series of historical examples. **Results:** This exemplified double dynamic thus lets us show how the knowledge economy fits into a long-lasting context with a historical perspective extending over several millennia right down to our times. In this way it emphasises that the contemporary knowledge economy is actually no more than a phase – albeit a considerable one. **Conclusions:** Over and above these results it should be highlighted finally that this contemporary phase of the knowledge economy offers perspectives that are contrasting at the very least. On the one hand, it opens the way potentially towards a new collaborative sharing world. But, on the other, it helps increase the risks of an excessive privatisation of knowledge.

Key words: knowledge economy, knowledge technologies, dynamic of knowledge creation, spaces, agents.

On the evolution of the creation and application of knowledge based on a combined dual dynamic

We will put forward the two dynamics in succession while highlighting how they are linked and how they combine.

The succession of “knowledge technologies” (k.t.) as an initial, longitudinal, dynamic.

The term “*knowledge technologies*” (K.T.) is borrowed from the anthropologist Goody (2000), who successfully applied it more specifically to writing “*stemming from the interaction between the human brain and the written word, which is external to the agent in a way that is different to the spoken word*”. He implies “*a reflexive process, a way to bounce thoughts between self and paper*”. Goody thus refers to “*cognitive processes*” mobilised in an interactive way. By extensive use of the term we intend to highlight that this creates an expansion of our cognitive abilities and significantly impacts the evolution of these K.T.

An expansion of our cognitive abilities.

By using this terminology, we hope, in effect, to increase acceptance of the concept formulated by Goody by applying it to all tools and devices used, whether they are connected to the increase, expansion, acceleration or application of all our cognitive abilities. Expressed differently, the “knowledge technologies” that result from basic human activity, play a part in increasing our knowledge¹ for compiling and classifying data, as well as for processing and transmitting information, developing knowledge, supporting an argument, manipulating concepts and ideas, etc. Presented in the order of their emergence and in the successive evolution of the most representative examples, they are: script, the alphabet, the codex, printing, counting, writing and calculating machines, the Internet and the Web. It would be easy to amplify the list with elements that follow on from the written word. Also worth mentioning are archives, treatises and libraries of all types (from a set of tablets to digital libraries), handwriting tools (from feather pen to biro). Tools connected to the invisible world (microscope) and outer space (telescope) can also be added without difficulty. Sea voyages and the great expeditions (especially the big “discoveries” of the 15th century) have also contributed to the precise shaping of the world map with particular help from the navigational instrument, the sextant.

¹ For the purposes of this paper, the word “knowledge” is endowed with a broader and more varied meaning that includes data, information, (explicit and tacit) knowledge, skills and expertise.

Nevertheless, as we will show, a proper distinction must be made between K.T. and their associated mediums. In this way, writing must be disconnected from a person's thoughts and brain, formalised, transported and transferred to a medium such as clay tablets, then later, papyrus rolls or *scrolls* and the *codex*, before the arrival of digital tools.

The principle effects of the cumulative evolution of the main K.T.

Taking this view, three principle effects may be highlighted.

We will first refer to the **cumulative growth** in the sequential evolution of these K.T. A typical example of this cumulative dimension is seen in the evolution of writing, in sequential order, non-alphabetic, alphabetic, mechanised (printed) and digital. But we will further show that this cumulative aspect is connected to an interaction with other elements, such as, for example, the founding of universities in the Middle Ages and the quasi exponential growth of the book, particularly following the development of printing.

Then there is the phenomenon of **knowledge concentration** already underlined by the philosopher Michel Serres and as reported by Guitart (2009). Thus, a concentration of certain characters is needed to construct a word. A concentration of phrases enables the creation of a book. An accumulation of books might give rise to libraries around which there is a campus (a concentration of students) and a town (a concentration of inhabitants). We will demonstrate that the Internet and its multiple uses, pushes the trend of knowledge concentration to a new extreme.

Finally, we note a **shortening of the timeframe** between the evolution of the different K.T. as they become more "powerful" and sophisticated. Hence, a little over four millennia transpired between script and codex, one millennium between codex and printed word, half a millennium between printed word and Internet which evolved within the space of three decades.

The K.T. spaces and agents triad as a second, transversal, dynamic.

Through this second dynamic, which is more transversal by nature, we will highlight the various structured and interacting components which, in a favourable historical context, contribute toward the creation and distribution of knowledge and innovation throughout the course of this long history. There are three components: the *K.T.* (described above and constituting a type of fulcrum which will not be covered here), the *settings* and *agents*, which operate and invest individually or collectively, and the *spaces* and *environmental context*.

The settings.

Their main purpose is to contribute towards collecting, preserving, exploiting, mobilising, utilising, changing and creating knowledge in the broad sense of the word. We will distinguish four main types: institutions, organisations, communities and geographic agglomerations.

When it comes to knowledge **institutions**, we will specifically refer to the monasteries and the important role played by the copyist monks of the Middle Ages in the transmission of classical culture. This can also be said of the royal academies founded from the 17th century onwards. Naturally, the leading libraries must also be mentioned.

As for the **organisations** that contribute to knowledge creation and transmission, some are explicitly dedicated to learning, such as for example the universities that date from the Middle Ages, others to academic research, such as university laboratories. Within the commercial sector we will refer to the business research and development departments that appear from the end of the 19th century onwards within certain large firms like General Electric or Bayer (Caron, 1997; Caron 2010). Their main purpose is to create knowledge with a view to exploiting it for marketable and, where possible, innovative products and services.

The **professional communities and groups** also offer conditions that are favourable to the production and transmission of knowledge. They are formal, like the corporations that emerge from the 18th century onwards, or informal, such as the communities of

practice that exist within large organisations, particularly over the last few decades. (Wenger, 1998; Cohendet, Créplet & Dupouët, 2006; Bouchez, 2015).

The spaces and environmental context.

Urban (or regional) spaces have also encouraged the exchange of information and the circulation of knowledge. As Fossier (1992) shows, fortune, power and culture have, since antiquity, concentrated in cities. Recently, the term “economies of agglomeration” or “knowledge agglomeration” has been used to describe those geographic agglomerations in which there is a concentration of qualified agents and knowledge-focused organisations (university, research centre, etc.). The proximity and density of intellectual capital helps increase the potential for those interactions that facilitate the creation of new knowledge (Bouchez, 2014). This contextual, environmental (or cultural) dimension may in some cases act as a vehicle and driver for knowledge creation and innovation development.

The agents.

These agents are people or collectives acting in isolation, or more often, interacting, formally or informally, often within the context of these various settings and spaces. They help produce, exchange, validate, exploit, distribute and transmit, in different forms (spoken, written or digital), fragments of knowledge or a variety of themes that may result in new ideas, new knowledge that leads to innovation. These agents have existed throughout history from the first storytellers, copyists, translators, scholars, researchers, teachers, consultants, etc., but are sometimes also “ordinary citizens”.

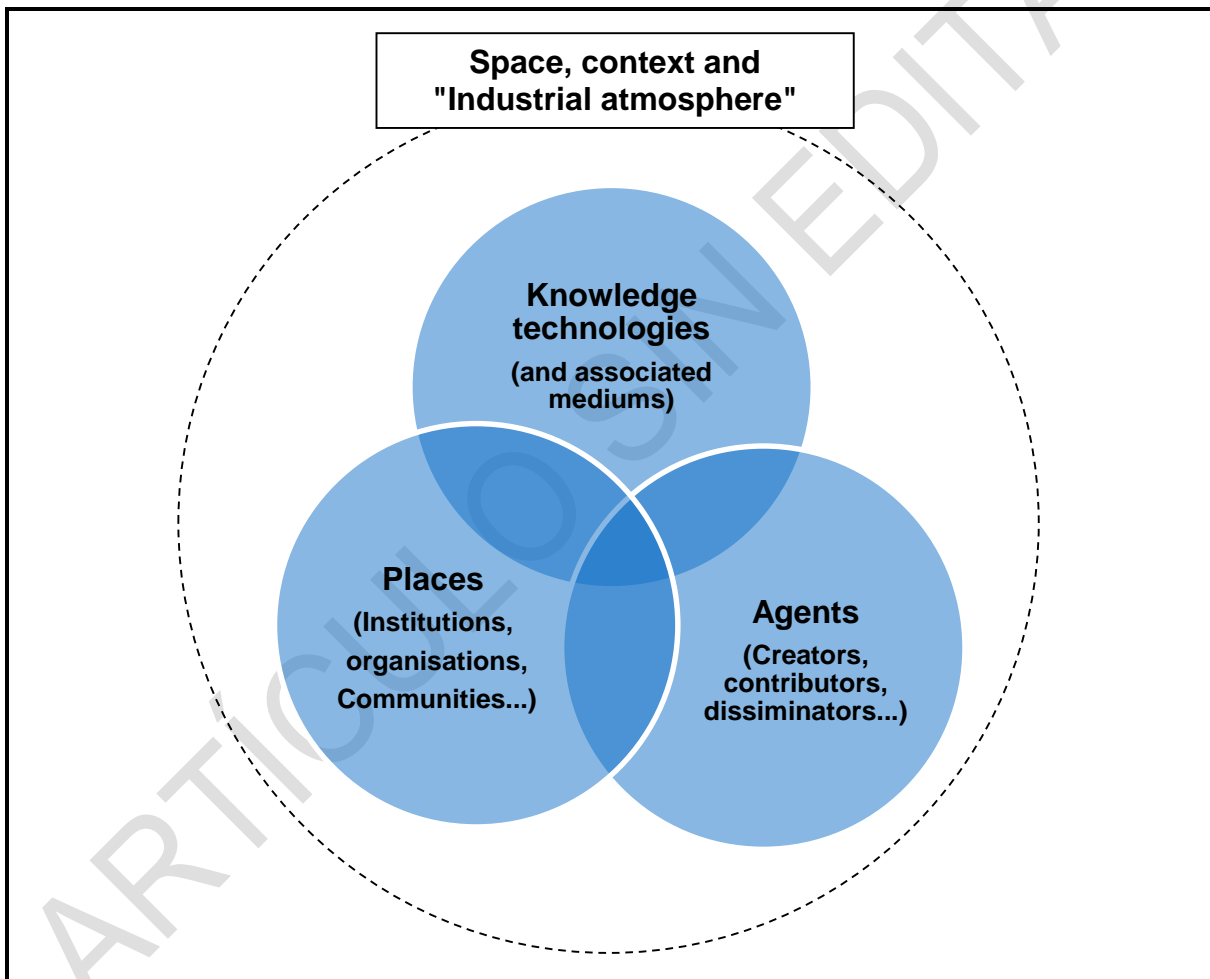
An interactive dynamic.

The schematised graphic in the box below highlights the various interactions developed and illustrated in the paper that follows. Please note that the transversal interactive dynamic has in some senses already been examined in great detail as a systemic model (Ermine, Pauget, Beretti & Tortorici, 2004) in connection to the accession of Henri IV. Let us also point out that, taking a slightly different slant, a particularly stimulating and robust perspective has been developed by Grataloup (2015) around the concept of “geo-history”, a term coined by Braudel (1997 [1941-1944]). Grataloup in effect defines the concept as an intellectual approach taken by

companies, which favours neither a temporal dimension (history) nor a geographic dimension, but strives to fuse the two types of analysis.

These are the constituent elements of the dual longitudinal and transversal, dynamic that can be fully examined by means of examples that appear throughout history. This will be covered in the second section.

Figure 1. Interactive transversal dynamic of the creation, distribution and application of knowledge and its components



Source: Adapted from Bouchez (2012).

Examples and illustration of these dynamics

We are now going to illustrate the dual dynamic of *longitudinal* and *transversal* creation, distribution and application of knowledge by means of a series of noteworthy historical examples. Naturally, these two dynamics are never “pure”. Their illustrative qualities

tend towards one dynamic or the other. Further, as we shall see, two of the examples, the printed word and the Internet, simultaneously show aspects of both dynamics as these are so interconnected that they are difficult to separate. They will be shown alongside the transversal examples.

Examples of longitudinal dynamics.

These dynamics will be illustrated by the development of K.T. and their mediums: non-alphabetic writing, the alphabet, printed word and the *codex* (as a medium).

Non-alphabetic writing and its mediums.

We will describe some of the attributes of this first K.T., as defined by Goody (2000).

Non-alphabetic writing, the first important innovation that appeared in the 4th millennium B.C. (Calvet, 1999), constitutes “*a technique designed to secure the word, a permanent form of expression*”, which thereby gives “*direct access to the world of ideas*” (Higounet, 2006). Ifrah (2000) points out the analogy of writing as a “*system*” that allows “*articulated language*” to be secured and which is one of the most powerful “*intellectual tools of modern man*”. Writing (particularly subsequent alphabetic writing) arises as a process of explicitation, which is a condition necessary to the development of knowledge (Goody, 1977), and the transcription of word and thought. Storing and reorganisation becomes possible.

The principle **mediums** associated with this form of writing, which enables word and thought to be formally logged, are clay tablets (Bonfani et al., 1997) probably made by the first “*knowledge bearer*” scribes (Gingras, Keating & Limoges, 2009), then the *volumen*, or scroll, used in Egypt at the beginning of the 3rd millennium B.C. (Barbier, 2012). They successively support non-alphabetic, then alphabetic writing and are definitively replaced by a medium developed in the 5th century: the *codex*. In antiquity, the library is a medium that enables scrolls to be assembled and classified in one location, thereby illustrating the phenomenon of knowledge concentration referred to earlier. The most renowned libraries are those of Assurbanipal, in the 7th century B.C. and Alexandria.

The alphabet and the rationalisation of the written word.

The alphabet represents a process of the simplification of symbols and an economy of characters. Around the 14th century, the Ugarit scribes on the Syrian coast had the “*brilliant instinct*” to artificially modify traditional cuneiform material in their own way by reducing it outright to around thirty characters, thereby formulating the alphabet (Higounet 2006). This is the Latin alphabet, which doesn’t settle at twenty-three letters until the 1st century B.C., when it becomes “*Western thought’s ultimate tool and the modern world’s principle means of expression*” (Higounet, 2006).

Naturally, this innovation has contributed enormously to establishing the securing and development of knowledge and ideas in a way that is inconceivable within a solely oral context. Criticism is now possible (Barbier, 2001), as is the art of commentary and debate (Goody, 1977). Knowledge is safeguarded and preserved in a way that is more explicit than was possible with non-alphabetic writing.

Printed word.

As previously mentioned, this innovation incorporates both dynamics. As this section concerns the longitudinal dynamic, it is important to stress that this K.T. facilitates the unlimited and exact reproduction of letters and that it has set symbols in basic categories that have remained unchanged since (Higounet, 2006). The result is that this innovation leads to a considerable reduction in production costs (Blair, 2011) as well as a reduction in production times, thereby making works more accessible and generating a consequent growth in the market linked to the development of alphabetisation (Darnton, 2008). Printing generates growth and movement and also promotes exchange, and the creation of knowledge and ideas. It is fair to say that by the mid 14th century printing has outstripped the written manuscript (Eisenstein, 1983). It supports the process of formalising and distributing artisanal knowledge, as well as production, particularly from the mid 17th century onwards, with mediums such as dictionaries, encyclopaedias and (metallurgical) treatises linked to the consolidation and accumulation of formal knowledge.

The codex, a medium that grows out of the volumen, as a key innovation.

Seen within the context of the longitudinal dynamic, the *codex* is a medium that metamorphoses out of the *volumen* (simple scroll) in that it is an object made of folded and collated pages. These are browsed by “(simply) turning the page” (Johannot, 1992). Mercier (2002) successfully applies the term “*book with pages*”. In the West, this object, at first hand-written then printed, becomes the benchmark, the “*standard book*”. Although its invention may date back to Rome (Melot, 2006), it has survived to this present time of screen-technology ... The *codex* only really comes into its own with the proliferation of books that is made possible by printing.

The fundamental transformation of the *volumen* has three main advantages:

First, **optimisation of space and cost**. The organisation of a larger amount of text within a smaller volume also makes it possible to incorporate the content of a larger number of scrolls (Chartier, 1994) making the *codex* less expensive than the *volumen*. This supports the argument for the concentration of knowledge within a smaller space.

Next, **increased ease of reading**, particularly with respect to pagination and the fact that the *codex* can be opened and closed easily without needing to be rewound. It is easier to warehouse from the point of view of stacking, storing and labelling.

Finally, **ongoing standardisation and streamlining**, which facilitates the production of books within a series (Darnton, 2008). So, looking at the development of K.T. mediums, the too narrow tablet has been replaced by a scroll which, being too short and difficult to handle, has in its turn been replaced by the *codex*, which has survived to this day alongside new, digital mediums.

Industrialisation, rationalisation and information processing.

During this period, which runs from the early 19th to the mid 20th century, it is possible to observe an interest in and a progressive focus on the world of information processing and the use of new K.T., particularly in the world of paid workers whose numbers grow

significantly at the junction of these two centuries. Here, we highlight the work of the mathematician Babbage (1832) on the mechanisation of his “*operations of the mind*” (through his “difference engine” and his “analytical engine”), and the concept of “*division of operations mechanics*” popularised by Smith ([1776], 1976) with the example of his famous pin factory. Chenu (2005) considers Babbage to be the first to highlight the commonalities between “*processing technology*” and “*tangible matter*”, to use Halbwachs’ (1938) terminology. Furthermore, the “*tertiary revolution*” (Caron, 1997) or “*administrative revolution*” (Gardey, 2008) is connected to the invention and use of new K.T. that are specifically centred on office work, which was developing at that time (mechanisation of writing, calculation, document reproduction, data processing, etc.).

Babbage’s work and trials, as well as the pioneers of office work mechanisation, are without question the precursors of the Internet. This K.T., which is transversal by nature, means that mechanised writing and the Internet simultaneously feature in both dynamics.

Table 1 summarises the evolution of the longitudinal dynamic (including elements that are both longitudinal and transversal, such as the alphabet and the Internet).

Table 1. The development of “knowledge technologies” (K.T.) as a longitudinal dynamic of knowledge creation and distribution

PERIODS	KNOWLEDGE TECHNOLOGIES	Associated mediums
4 th millennium B.C.	Handwritten text	Tablet,
3 rd millennium B.C.		Scroll
A.D. 4 th century	Alphabet (Greek, then Latin) <i>(Longitudinal and transversal)</i>	Libraries
A.D. 1 st century		Codex
From 15 th century	Mechanised writing	
From 17 th century		9. Dictionaries and treatises
From 19 th century	Data processing technologies	Machines <i>(for writing, for counting ...)</i>
Second half of 20 th century to present day	Internet, Web 1.0 Web 2.0... <i>(Longitudinal and transversal)</i>	All digital technology tools and devices

Source: Bouchez (own creation).

Examples of transversal dynamics.

These dynamics are particularly illustrated by the “*knowledge metropolis*” of Alexandria, the resurgence of intellectual life in the Middle Ages, the age of printing (complemented by its longitudinal aspect), the formalisation and distribution of artisanal knowledge and the production of treatises, dictionaries, encyclopaedias and, finally, the Internet and Web (integrated memory, which is both longitudinal and transversal). They will be described by referring to the various constituent parts of this dynamic.

Alexandria, ancient knowledge capital and intellectual centre.

The first transversal example concerns the city of Alexandria, antiquity’s knowledge capital.

A “knowledge metropolis”. The will of one man, Ptolomy I Soter, King of Egypt, ensures that towards the end of the 4th century B.C, Alexandria, his new capital, gradually becomes the Mediterranean’s intellectual centre. The city will have the

character and prestige of a “*universal knowledge metropolis*” (De Polignac, 1992) or a “*knowledge capital of the world*” (Canfora, 1992) akin to a “*new world centre, a place where intellectual innovations converge*” (Jacob, 2007).

Reference institutions: the library, founded in 290 B.C. (Jacob, 1991), and also the prestigious museum annexed, welcomes scholars and intellectuals from across the Greek regions. The museum, “*centre of culture and knowledge*” (Canfora, 1992), built fifteen years after the library (Jacob, 1991), received scholars that were recruited and appointed by the royal kingdom. Above everything, they were all, each within their own field, expected to contribute to the development of the humanities and science (Giorgiades, 1982). The library at their disposal and annexed to the museum proved to be an indispensable adjunct. The idea of a “*complete (and universal) knowledge*” was centred at the *universal library* built by the king in 290 B.C. (which held the world’s collected and classified essential works), thus attracting intellectuals from across the Hellenic and Greco-roman Mediterranean region.

The mediums. These are, of course, the *volumen* – which numbered 450,000 ... (Jacob, 2007) – on which all the texts were “deposited”. The scholars’ practice of annotating the margin with “discussions” and notes leads us to deem that this medium was a place where knowledge was created.

The agents. As well as the knowledge capital’s eminent creator King Ptolomy I Soter, we must add the successive line of librarians, above all Callimachus who built a renowned catalogue with which to navigate the countless creations. Finally, the scholars and intellectuals who visited these institutions and, in some cases, opened up new perspectives in the field of knowledge.

The renewal of intellectual life in the Middle Ages.

This renewal is the second example of the transversal dynamic, which is demonstrated in a number of ways.

A new favourable environment. It is primarily marked by the intellectual and trade renaissance emerging from towns throughout Western Europe towards the end of the

10th century (Lemarchand, 2009). The economic strength of the medieval merchants who concentrated their business there contributes to this urban development (Le Goff, 2001).

Professional communities and institutions: knowledge corporations (universities), libraries and monasteries. The *universities* that are founded during the 12th century constitute "*the main centres for the education of an intellectual elite as well as the preservation and transmission of knowledge within Europe*" (Gingras Gingras, Keating & Limoges, 2009). *Libraries* richly stocked with religious texts play an important role in conservation and transmission, particularly of Greek literature, comparable to the role of the Western abbeys with respect to Latin literature (Labarre, 2001). Finally, we cannot omit the Carolingian scribes' impressive work in knowledge preservation (Riché, 1996).

The new intellectual agents. We must, naturally, mention the "*member of the university corporation*" (Le Goff ([1957], 1985). His work is intellectual, "*he does not do manual labour*" (Dubar, Tripier, & Boussard, 2011). The clerk must also be included, characterising the intellectual who belongs to an elite that knows how to read and write (Gingras, Keating, & Limoges, 2009), as well as translators (Le Goff ([1957], 1985), notaries and professional copyists (Fossier, 2000).

A medium whose use changes: "*The book's entrance into the century*". With these words, Barbier (2001) describes the way that, as part of this urban renaissance, the *volumen* utilised in the religious world transfers to being used in the civil and business spheres. The emergence of universities will, naturally, trigger the production and supply of publications needed to meet the demands of students and masters, as well as the appearance of the first big libraries built and resourced outside monasteries.

The printing era and the mechanisation of writing.

In order to reflect the impact of this new innovation, we will conclude by examining its transversal dimension.

The innovation environment. This is primarily related to the state of European, particularly German, society during the mid 15th century (Bechtel, 1992), as well as the consequent collective emulation that followed (Caron, 2010). In fact, it is impossible to understand the development of printing without analysing and understanding the mood of “the Rhine spirit” prevalent at that time.

The connection between mediums, which enables innovation creation. Melot (2006) highlights a favourable “*conjunction*” between two elements: the *codex* and the Latin alphabet, with the latter offering the reader a “legibility” that contributes to the creation of mechanised writing in the West and guarantees its success. Guitart (2009) stresses the link between two earlier inventions: typeface and printing press. Analogies with the idea of the technical system as defined by Gille (1993) are patent here in that they are “*coherent and compatible*” with the social system of the time. The innovation is taken up gradually thanks to the book’s continued mechanisation and its contribution to knowledge distribution.

The agents. Caron (2010) highlights this innovation’s collective dimension by stating that it reached its apogee within the metal working realm in the years 1435-1450. But the historian credits Gutenberg with the ability to coordinate the various elements and components of this future innovation, “*because he was placed at the junction of various types of knowledge in the centre of Mainz*”.

The formalisation and distribution of artisanal knowledge (15th – 18th century) and the production of treatises, dictionaries and encyclopaedias.

This phase in the accumulation and formalisation of knowledge also has a number of constituent elements.

It is situated within the **context** of the birth of industrial capitalism (Halleux, 2009) involving “*a quantum leap*” that leads to the need for “*the standardisation of processes (...) and knowledge that is coded within organised publications*”.

The agents are primarily artisans (the custodians of tacit knowledge), scholars, experts and the first engineers. The latter will turn a dispassionate gaze on working practices with a view to formalising them (Caron, 2010).

The institutions and organisations are primarily represented by the Royal Academy of Science (1666-1793) as the producer of scientific knowledge, the corporations that emerged in the earlier phase and are linked to the “applied arts” (trade groups) and the “liberal arts” (universities), and the engineering schools founded in the 19th century.

Finally, the mediums include dictionaries, encyclopaedias and treatises relating to the collation and accumulation of formalised knowledge, particularly taking into account advances made in printing, concerned with knowledge collation and organisation (Pinault, 1993). *L'Encyclopédie* (1751-1772) is the beacon and symbol of the Age of Enlightenment with its desire to show “*the arrangement and evolution of human knowledge*” (D'Alembert, [1751] 2000).

At this point, it is important to mention two important yet very different figures by way of transition. The first is the work of the great historian Koselleck (1973) on the subject last mentioned. He took a fresh approach to the Enlightenment as a “threshold era” within a context of “temporalisation” and as a theory of modernisation, particularly with regard to the unprecedented material expansion that came about. In a different vein, the other important figure here is Saint Simon (2013) whose complete works have now been published at last. The researchers who carried out this comprehensive task (Al-Martary, 2013) put forward the author’s forceful ideas. In particular, his conviction that a society that operates as an “industrial system” must ensure the circulation of three fluid social elements: money, knowledge and recognition (Saint-Simon, 1803). This is itself based on the communication networks that unclog the sclerotic “feudal-military society”, and an appetite for a type of horizontal, non-centralised organisation, which also presages the future.

The Internet and the Web: precursors and pioneers, potential and uses.

Our final example, which simultaneously covers the longitudinal and transversal dynamics, contributes to the creation of knowledge and innovation to a level never before seen. We will, logically, close this section with the potential that can be found in a collaborative economy based on knowledge.

Note that the spaces, places and general context are primarily focused on the economic agglomerations of the San Francisco region and *Silicon Valley*, its universities and its research laboratories.

The creation of K.T and their mediums is tied up with agents, particularly since the middle of the decade: TCP and IP protocols by Robert Kahn and Vincent Cerf in 1974 (who in the same year co-created the term Internet), World Wide Web by Robert Cailleux and Tim Berners-Lee in 1989, who also created the hyper text link in 1990, and the Web 2.0 propagated by Tim O'Reilly (2005), and associated collaborative devices.

However, we will also mention the role of unsung pioneers and forerunners such as the visionary Otlet (1868-1944) and his “electronic telescope” which enabled him to read books shown in the hall of major libraries from his own home. This later becomes the telephoto book (Otlet, 1934). Bush (1945), in a celebrated paper some years later, describes a device that he calls a “*memex*” and shares similarities with Otlet’s “*electronic telescope*”. It enables people to “*stock all books, archives, correspondence and everything mechanised so that they can be consulted extremely quickly and with total flexibility. It is an intimate extension of memory.*” Ever present is the desire to accumulate and share knowledge made accessible to the largest possible number of people and all of humanity.

The potential of a collaborative economy founded on knowledge. The emergence of Web 2.0 in the mid 2000s in fact represents a symbolic and decisive marker in the creation of a new collaborative environment that is particularly utilised in large corporations through social networks that build on the communities of practice that appeared a decade earlier. The convergence of the contemporary knowledge

economy (Foray, 2000, 2009; Bouchez, 2012, 2014) and diversified digital technologies, particularly at the heart of organisations, enables the development of a new socio-cognitive eco-system that engages the collective intelligence of the “crowd” (Surowiecki, 2004), and a collaborative form of knowledge creation that pushes the boundaries of what is possible.

Table 2 summarises the evolution and interaction of the longitudinal dynamic associated with these K.T. (columns 2 and 3 from the left) and the transversal dynamic (columns 2 to 5, including its constituting elements: K.T., spaces, places and agents).

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Table 2. The development and interaction of the longitudinal and transversal dynamics of knowledge creation and distribution

PERIODS	“KNOWLEDGE TECHNOLOGIES”	Associated mediums	SPACES/PLACES (organisations and institutions)	AGENTS
4 th millennium B.C.	Handwritten text	Tablet		
3 rd millennium B.C.		Scrolls		
4 th century B.C.	Alphabet (Greek, then Latin)		Libraries	Librarians
3 rd century B.C.				Scholars and academics
A.D. 1 st century		Codex		
From 13 th century			Monasteries Universities	Professors Translators Clerks Copyist
From 15 th century	Printed word	Formalisation of tacit artisanal knowledge		
From 17 th century		Dictionaries and treatises	Academies	Artisans (tacit knowledge) Experts Engineers
From 19 th century	Technologies related to information processing	Machines (for writing, for counting)	Research laboratories	Researchers
Second half of the 20 th century to the present day	Internet Web 1.0 Web 2.0 ...	All digital technology tools		Consultants Knowledge managers Community managers...

Source: Bouchez (own creation).

Conclusion: towards a collaborative economy and a “new shared world”

This paper has enabled us to highlight the longitudinal and transversal combined dual dynamic as a process that, over a long time period, contributes to the creation, distribution and use of knowledge, as well as its potential result in innovation, and whose final, most successful phase is a resource of an unprecedented type and range. The contemporary knowledge economy combined with digital technologies is certainly the most advanced and successful to date, but it represents only one stage of this evolution. Over the last twenty or so years, there has been a profusion of written work and statements made by agents, whether researchers or essayists, regarding the dawn of this new world of the knowledge economy. This idea lies at the heart of the new “industrial” revolution, source of innovation and growth. Many of these thinkers and observers obscure history by failing to point out that the process of creation, distribution and use of knowledge, as well as its possible result in innovation, is as old as antiquity itself. Wallerstein (2004) powerfully states that, “*the history of analysing world systems is anchored in the history of the modern world system and the knowledge structures that are its fruit*”.

Nevertheless, at the very least, the contemporary knowledge economy unlocks positive trends and opportunities as the new collaborative practices open a window onto a new “shared world” Cristol (2014), sometimes described as the world of “CO” (co-production, collaboration, cooperation, co-development...), whether it concerns knowledge, practice, and also largely material and immaterial services, based on trust, sharing and solidarity. But this optimistic view must be balanced by a much darker vision: that relating to the excessive privatisation and marketing of knowledge, whose negative effects should not be minimised (Bouchez, 2014).

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