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Harnessing collective intelligence: the evolution and application of group synergy in the digital age

Aprovechamiento de la inteligencia colectiva: la evolución y aplicación de la sinergia grupal en la era digital

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Abstract

The aim of this paper is to explore the concept of collective intelligence and its historical and contemporary impact on human development. Collective intelligence, defined as the ability of groups to make better decisions than individuals, has evolved from primitive survival strategies to modern technological applications. Theoretical principles, practical examples and collaborative projects illustrate its potential in the solution of complex problems. This study examines the role of collective intelligence in market and organisational adaptation, highlighting how it can be harnessed by companies to enhance competitiveness in high-risk environments. The research also explores the interdisciplinary nature of collective intelligence, spanning sociology, economics and information technology. By fostering collaboration and utilising digital tools, organisations and societies can better navigate dynamic, fast-changing environments.

Keywords: collective intelligence, group decision-making, collaboration, organizational adaptation, innovation, AI

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Resumen

Este artículo explora el concepto de inteligencia colectiva y su importancia histórica y contemporánea en el desarrollo humano. La inteligencia colectiva, definida como la capacidad de los grupos para tomar mejores decisiones que los individuos, ha evolucionado desde estrategias primitivas de supervivencia hasta aplicaciones tecnológicas modernas. Los fundamentos teóricos de pensadores y ejemplos prácticos y proyectos colaborativos ilustran su potencial para resolver problemas complejos. Este estudio revisa el papel de la inteligencia colectiva en la adaptación del mercado y de la organización, haciendo hincapié en cómo las empresas pueden aprovecharla para mejorar la competitividad en entornos de alto riesgo. La investigación también destaca la naturaleza interdisciplinaria de la inteligencia colectiva, que abarca la sociología, la economía y la tecnología de la información. Al fomentar la colaboración y utilizar herramientas digitales, las organizaciones y las sociedades pueden navegar mejor en entornos dinámicos y cambiantes.

Palabras clave: inteligencia colectiva, toma de decisiones en grupo, colaboración, adaptación organizacional, innovación, IA

1. INTRODUCTION

The history of humanity is deeply intertwined with the evolution of collective intelligence. Human survival has always depended on cooperation and shared knowledge. From cave drawings to oral traditions, societies have transmitted knowledge in ways appropriate to their developmental stages. Today, the rapid spread of information through digital channels has revolutionized how humans interact and share discoveries, creating unprecedented opportunities for collective action and problem-solving. This paper explores the historical and modern significance of collective intelligence, highlighting its role in decision-making, societal progress, and organizational adaptation.

The study of the new reality in economic terms therefore requires the involvement of interdisciplinary tools to show the synergy of processes in the broad context of the management of the individual-entity relationship, considering the operating conditions in the new economic and social environment. The aim of this study is to show the changes taking place in the external and internal environment of the company on the ground of management science, because of the spread of the phenomenon of collective intelligence.

2. THEORETICAL CONCEPT

Historical approach to the concept of collective intelligence has been developed around since the mid-19th century, mainly in the natural sciences. The first scientific articles on

the subject appeared in a context extending the study of IQ, which was dealt with by, among others, Wechsler. Wechsler described the phenomenon of collective intelligence as something more than just a group of intelligent individuals behaving in a certain way, proving that interactions result in much better-quality solutions to problems than even the most intelligent individuals would be able to produce (Wechsler, 1971). Engelbart, on the other hand, referred to this phenomenon as the phenomenon of 'enhanced intellect' emerging from teamwork supported by the computational power of computers (Engelbart, 1962, p. 105; Engelbart and English, 1968). Later, the same researcher used the term 'collective IQ' when describing the wider implications of this phenomenon (Engelbart, 1995). Talking about intelligence per se and collective intelligence as a concept it is worth to recognize that intelligence is a dynamic construct influenced by ongoing research and societal changes (Sternberg and Salter, 1982).

In the 1980s and 1990s, the concept of collective intelligence began to be used to describe the phenomenon of herd behaviour in insects (Frank, 1989), groups of mobile robots (Brooks and Matarić, 1993), groups of humans (Atlee, 1999; Isaacs, 1999), and electronically assisted human communication and cooperation (Smith, 1994; Levy, 1997; Heylighen, 1999). The first books directly referring to the term appeared in the 1990s and dealt directly with IT applications in teamwork (Smith, 1994) and the exchange and spread of ideas in cyberspace (Levy, 1997).

The concept of collective intelligence, primarily in sociological research on group decision-making, emerged in the 1980s,. Pierre Lévy describes it as a form of intelligence that is universally distributed, coordinated in real time, and visible in its application (Lévy, 1997). Lévy considers the project of collective intelligence as a "humanistic project", playing an important role in civil society through, among other things, increased access to knowledge (Lévy, 1997).

A first definition of collective intelligence in an economic context was found in the article by Malone, Laubacher, and Dellarocas (2009), in which the term was used to describe any form of collective action, with intelligent characteristics, within individuals or groups. From this perspective, 'incremental' intelligence is not only a process occurring within an individual's intellectual capacity, but also congregational intelligence as a new added value appearing in certain types of group activity. This notion appeared also in 2001, when Tadeusz Szuba from AGH University of Science and Technology, proposed a formal model of the phenomenon of collective intelligence (Szuba, 2001), but only in relation to parallel processing within Web 2.0. Never the less in all this theoretical attempts collective intelligence is not merely the sum of individual abilities, but a new value created through interaction and collaboration.

In recent decades, there has been a massive rash of collective activities on the Web, to mention only Google's project to create and link web pages to solve specific problems, often by incorporating non-standard approaches emerging at the interface of the

knowledge of many individuals. A typical and most often cited example is the Wikipedia project created by thousands of people around the world with almost no control (is classical management still needed in such a reality?) and no financial motivation in the form of remuneration (which clearly shows that standard approaches to involving people in external activities are also being modified).

3. METHODOLOGY

This study analyzes the phenomenon of collective intelligence through a review of theoretical frameworks and case studies from various disciplines, including sociology, management, and technology. The methodology involves the examination of historical examples of collective intelligence, and modern applications based on AI. It also investigates collective intelligence in organizational and economic contexts, focusing on how companies can harness this synergy to develop the marketing strategy or how to adapt to high-risk environments.

Tha aim of the study is to prove the thesis that entities able to exploit the new potential of collective synergy are better adapted to operate in the increasingly common high-risk environment, and that, consequently, structured entities, which are not resistant or slow to react to changes in external and internal conditions, lose their competitive advantage by not being able to refer to the existing values and strategies operating in a deterministic world.

4. FIRST APPLICATION

The first instance of the power of collective intelligence being experienced on an ongoing basis, thanks to the participation of the media, allowing entire communities of the modern era to participate in the experience, was the Apollo 13 mission of 1970, - a collective team of competent people was considered the main factor for success, as it generated the collective ability to respond to an unforeseen situation. This mission, although it did not achieve its goal, considered to be NASA's greatest success in the history of space conquest. Every failure is just a new experience. Demonstrating that in extreme situations everything depends on the individual and on the ability to use the knowledge and abilities of all team members as a collectively intelligent entity.

More commonly available experiences of collective intelligence are instances of successful team activities in sport (e.g. football, volleyball or basketball matches), where fans become part of the spectacle and the interaction with the team builds a unique community of experience.

The same phenomena can be observed in companies that are able to create collaborative teams, where the human factor ceases to be an aggravating factor and becomes the basis for the collaborative factor by activating collective intelligence as a success factor in the post-industrial era, when it is not resources that determine victory,

but the ability to combine and use information in a rapidly changing external environment.

5. DEVELOPMENT OF THE CONCEPT

Experienced reality undefined Collective Intelligence is an ambiguous term, the definition of which depends on the semantic context of the term used. A great many authors have been referring to this phenomenon for more than a quarter of a century, the intensity of which is growing exponentially with the pace of development of information and information technology. Moreover, the term has a slightly different meaning in Anglo-Saxon culture and a slightly different meaning in Eastern culture, ranging from the economic sphere of influence of Russia to countries operating in the culture of Islam and Umma community dependencies.

The earliest scholarly works relating to collective intelligence (Hiltz and Turoff, 1978) defined the concept as the ability to make collective decisions better or at least as good as the ability of each individual member to act gives the group. Smith (1994), on the other hand, defined the concept as a group of people undertaking specific actions as a coherent intelligent organism governed by a single intellect that is more than the sum of the actions of independent actors. Levy (1997), in turn, defined this kind of collectivist as a form of universal distribution of intelligence improving itself continuously, coordinated in real time, and producing, because of such a mode of action, a more efficient use of the resources and competences of individuals. Intelligence as such can also be defined in many ways, which I will also cite for the sake of order.

Most commonly, the concept of intelligence is defined in process terms - "Intelligence is a very general intellectual capacity that, among many other things, includes the ability to rationalise, to plan, to solve problems, to think abstractly, to grasp very complex ideas, to acquire knowledge rapidly, and to learn by experience" (Gottfredson, 1997). A similar approach in defining intelligence can be found in the 2006 Encyclopaedia Britannica as 'the ability to adapt effectively to the environment', or as 'the ability to solve problems and create products that are valued within a given culture and external circumstances' (Gardner, 1983). Adaptability, flexibility, niche-finders, or agility are at the core of many contemporary theories of management under increasing uncertainty (Kozminski, 2016).

The concept of intelligence is used most prominently in psychology as a statistical factor for measuring an individual's ability to perform across a wide range of different cognitive tasks. This factor is often referred to as general intelligence, i.e. intelligence that can be measured by IQ tests. However, it is not clear whether tasks performed with the support of modern computer technology can still be considered a manifestation of intelligent behaviour (Searle, 1999).

The definition of intelligence developed within MIT's Collective Intelligence Centre very comprehensively defines collective intelligence as 'a group of individuals acting

collectively in an intelligent manner'. A definition conceived in this way does not define intelligence as such, but only determines the factors necessary for its existence, complementing, as it were, all classical approaches defining intelligence. By including the activity factor, we are describing the behaviour that manifests intelligence (the example of Wikipedia, in this approach, is not a manifestation of collective intelligence as such, but the collective action of the people creating this body of knowledge is). To define an action as a manifestation of collective intelligence, it is necessary to determine which groups of individuals are affected by it. Regarding the economic and social behaviour analysed in this book, it will be *a group of people acting together for a given purpose and/or within a given organisation*.

6. THE ECONOMY AS A COLLECTIVE ACTION

The national economy or the EU common market can also be considered as the sum of collective intelligence or the resultant of the collective actions of many actors. In this sense, a specific example of collective intelligence is also the economic theory of games that considers the behaviour of competition, which allows us to choose behaviour that maximises our utility while considering the 'intelligent' behaviour of other individuals.

The creation of norms and rules that organise social life is shaped on a similar basis. Acting individually, we anticipate the response of the collective behaviour of the community in which we live - we maximise the rewarded behaviours and limit the punished ones, while reproducing the patterns applied to our behaviour in the creation of successive collective norms (written or not) that limit the individual's freedom of action, and the externalities generated by it (both negative and positive).

Another element of the definition is collectivity, which implies the existence of some form of relationship between individuals that enables the notion of collective action. This does not imply permanent cooperation or a community of goals and values, but only the existence of at least a temporary interdependence that makes collective action possible (Malone and Crowston, 1994). A classic example of such action is the interaction of supply and demand in each market as a result of the individual action of many actors.

Also innovative solutions of a cooperative collective turn out to be the most effective, as they benefit from the resources and experience of a large number of actors (in the new reality, it seems questionable to maintain the registration of patents covering new solutions resulting from collective action, when they are not the result of R&D investments of a single entity and the determination of even the percentage of ownership of commercialised research - paradoxically, the registration of patents may lead to abuse and appropriation of the effects of collective action).

7. HOW TO MEASURE CI

The most difficult thing to define is to determine the measurement that indicate the intelligence of the collective action taken. While we have IQ tests to measure the intelligence of individuals, the intelligence of a collective action is not the sum of the intelligence of individuals, and may occur even when individuals do not have high IQ levels (although a certain level is necessary for cooperation as a competence to cooperate, and here the level of individual intelligence may be a facilitating factor, but also an individual with a high IQ lacking the ability to cooperate may be counterproductive in creating synergies of collective intelligence).

Moreover, the assessment of whether a given collective action bears the hallmarks of intelligent action or not depends to a large extent on the observer (but also on the customers, suppliers, regulator, etc.), which by the very fact of interaction influence the behaviour of the observed collective (to some extent, Hilderberg's indeterminacy principle also applies in the social sciences, the application of a given filter of a form of activity can show the effects of cooperation in a study; but already changing the parameters of observation will only give a result that confirms the dispersion of intelligence, so the optics used are crucial for capturing focussed intelligence).

MIT's Center for Collective Intelligence (CCI) has been exploring methods to measure and enhance collective action, particularly through the lens of "collective intelligence," which refers to the enhanced problem-solving capacity that emerges from collaboration between people and machines. Their research includes creating metrics to measure the "collective intelligence" of groups, which refers to the enhanced cognitive ability that emerges from coordinated action. Factors such as the size of the group, the diversity of participants, and the digital tools they use all play a role in boosting a group's ability to address difficult problems. One of the center's major initiatives, the Climate Plan Accelerator, leverages these insights to help governments and organizations formulate and execute impactful climate strategies (MIT Center for Collective Intelligence).

8. INTERDISCIPLINARY CHARACTER OF CI

8.1. Technology

The new millennium conducted into the era of collective intelligence as an interdisciplinary phenomenon demonstrating entirely new possibilities for the functioning of human groups and their ability to create reality. This phenomenon very quickly emerged from the field of cybernetic research and entered business, economic and social and political life. The only prerequisite was access to simple communicators based on mobile or IT networks, and finally access to the Internet through any medium. Collective intelligence, thanks to information technology, began to manifest itself in all spheres of life (Szuba, 2001; Hamilton, 2004; O'Reilly, 2005; Howe, 2009). However, the best-selling author of the bestselling book The Wisdom of Crowds James

Surowiecki (Surowiecki, 2005) and other authors popularising the phenomenon (Tapscott and Williams, 2006; Ridley, 2010) have undoubtedly been most credited with popularising the term. It was also around this time that the first scientific conferences on collective intelligence emerged (Kowalczyk, 2009; Bastiaens, at al. 2010; Malone and von Ahn, 2012) and the first research centres specialising in this topic (Canada Research Chair in Collective Intelligence, University of Ottawa; since 2002; Centre for Collective Intelligence, MIT, since 2006).

The interdisciplinary nature of the concept of collective intelligence, as shown earlier, is not an entirely new concept. Observations of this phenomenon are very common and have been confirmed by many examples throughout history. What is new is the fact that it has intensified and can occur without spatial and temporal barriers (the latter so far only in one direction) thanks to the development of ICT technologies. The development of IT tools may (but need not) foster the emergence of collective intelligence. From the perspective of collective intelligence, an individual using a networked computer (whether local or global) is a peripheral entity. The phenomenon of collective intelligence can be observed in the interaction between two or more peripheral units that act with a common goal of increasing computing power by expanding access to information and enhancing computing capabilities, creating crowdsourcing, supporting actions taken through social media, or creating cooperation and enabling group actions through platforms, webinars, or design tools. These activities do not include artificial intelligence due to the lack of a human factor, but already collaborative efforts to create artificial intelligence is an example of collective intelligence collaboration.

8.2. Medicine

Collective intelligence (CI) is the combined knowledge and problem-solving ability that arises from the collaboration, competition, or coordination of multiple individuals, surpassing the abilities of any single person. This concept has been applied in a variety of fields, offering distinct advantages in areas like medical decision-making, social computing, and innovation management. In the healthcare sector, CI has been utilized to enhance diagnostic precision and improve patient care by synthesizing the expertise of multiple professionals. A scoping review by Radcliffe et al. (2019) highlights how pooling insights from different medical experts can lead to more informed and accurate clinical decisions.

Similarly, in business, CI facilitates collaborative innovation by aggregating user input and experiences, leading to more robust problem-solving strategies, as explored in the design of CI applications for specialized tasks like mobile travel guides and educational tools (Gregg, 2010). Furthermore, the taxonomy of CI presented by Feijuan He and colleagues categorizes it into isolation, collaboration, and feedback paradigms, each offering unique mechanisms for harnessing group insights, whether in biological,

economic, or digital environments (He et al., 2019). These applications demonstrate how CI can enhance decision-making, optimize resources, and foster innovation by leveraging the collective knowledge of diverse participants.

8.3. Management

Intelligence as a cognitive phenomenon studies intellectual abilities manifested in behaviours such as perception, linguistic abilities, memorising, logical thinking, etc. The study of collective intelligence overlaps with cognitive science insofar as intelligent behaviour emerges in situations of interaction within a group. An excellent example that verifies the emergence of such new added value at the behavioural level of the individual is the observation of cooperation and group interaction, which is most easily observed under simulated conditions in the Development Centre competence test. When emotionally involved, our brains do not distinguish between real and fake situations, so that group behaviour can be observed, triggering responses from individuals with or without the hallmarks of competence-based intelligence.

In organisational theory, this applies to all behaviours relating to group problem solving, organisational "memory", organisational learning, etc. This raises the question of what boundary conditions for organisational functioning must occur for the phenomenon of interaction within collective intelligence to emerge, and how far it can be influenced by individuals, if at all, not excluding the leader.

In the business world, collective intelligence (CI) promotes collaborative innovation by gathering user feedback and experiences, resulting in more effective problem-solving approaches. This is exemplified by CI-driven applications designed for specific purposes, such as mobile travel guides and educational tools (Gregg, 2010). Additionally, Feijuan He and colleagues developed a taxonomy of CI, categorizing it into isolation, collaboration, and feedback paradigms. Each of these paradigms offers distinct methods for utilizing group insights, whether applied in biological, economic, or digital contexts (He et al., 2019). These examples illustrate how CI enhances decision-making, optimizes resources, and drives innovation by harnessing the collective knowledge of diverse individuals.

8.4. Social Science

Social sciences dealing with group behaviour, such as sociology, political science, but also economics or management, refer to the phenomenon of collective intelligence when studying the behaviour of group entities, or individuals grouped in a network. Individual political choices or consumer behaviour are therefore not subject to this analysis, as long as they do not create dependencies within a mutual interaction determined by external regulations, market mechanisms, government policies or organisational culture. In this respect, it is also possible to study how 'intelligently' an organisation behaves in

a given external environment, developing or not adaptive mechanisms and effectively or ineffectively using resources to meet the ever-changing needs of the market (which it can also create itself).

The collective intelligence approach is based on the analysis of interactions and dependencies that are catalysed by information technologies, leading to a significant acceleration of social processes and a more frequent occurrence of a critical mass capable of bringing about unexpected and rapid social change even through individual events. An essential role is played here by the speed at which information spreads, which, especially in social networks, is subject to enhanced selective perception based on anchoring heuristics, but already at group level. The power of such a diffusion process can be as much constructive (aid actions) as destructive (suicides because of mass hate action or other hate crimes).

The occurrence of the phenomenon of collective intelligence does not in itself imply the generation of pro-social behaviour, it only means the enhancement and acceleration of group action with all its baggage of impulsive reactions to real or apparent threat. On the other hand, the potential of collective intelligence could probably find solutions to most of humanity's problems if only a significant part of this networked human collective recognised that these external problems are also their problems for which they take co-responsibility.

8.5. Marketing

The concept of the "wisdom of crowds" in marketing revolves around harnessing collective knowledge to drive innovation and strategy. This approach relies on methods such as crowd data analysis, innovation exploration, insight development, and validation of those insights. One fundamental framework for comprehending the efficacy of wise crowds encompasses four critical conditions: diversity of opinion, independence, decentralization, and aggregation. These conditions facilitate the ability of crowds to collectively generate insights that surpass individual contributions, analogous to the 1884 experiment wherein a crowd accurately estimated the weight of an ox through the averaging of their predictions (Surowiecki, 2005).

In the realm of marketing, the identification of patterns within crowd-generated input is of paramount importance. Initial submissions frequently illuminate pivotal themes, which ought to be tagged, monitored, and refined throughout the iterative process. In contrast to voting mechanisms that may neglect latent trends or opportunities, crowdsourced concepts permit the revelation of novel insights that resonate with overarching market requirements. This phenomenon was illustrated in the crowd-driven development roadmaps employed by a prominent global technology entity. Insights garnered from crowds significantly enhance the success of innovations by supplying novel and pertinent perspectives on the functional, emotional, and social

aspects of challenges, ultimately culminating in more effective solutions and strategic product initiatives.

The most common approach assummes optimal disclosure policy leading to maximization of social welfare. The implementation of crowd wisdom necessitates the establishment of mechanisms whereby agents sequentially select actions influenced by disseminated information, thereby impacting their incentives to investigate and produce novel insights. The primary objective of the optimal disclosure policy is to enhance social welfare through the judicious equilibrium of information dissemination and exploration incentives (Kremer et al., 2013).

Promoting independent forecasts as opposed to herd behavior within crowd-based platforms yields more precise consensus predictions. This phenomenon occurs because independent perspectives serve to preserve the integrity of valuable private information, which could otherwise be obscured by the prevailing public information accessed by users (Da and Huang, 2018).

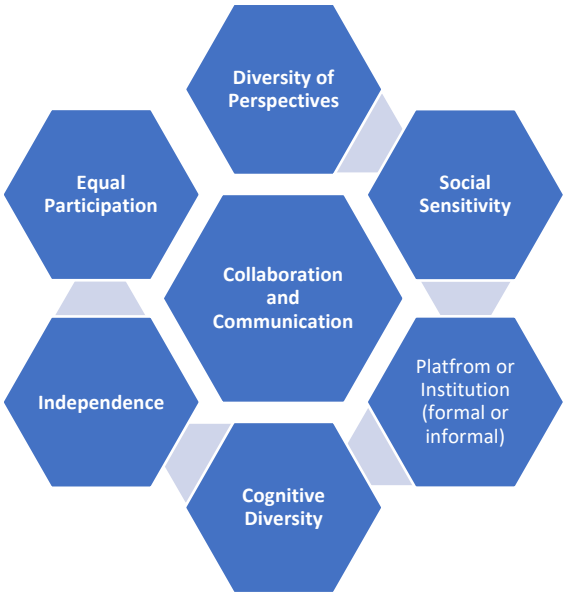
Harnessing crowd wisdom in marketing involves designing optimal information disclosure policies, encouraging independent forecasts, and utilizing select-crowd strategies. These approaches collectively enhance the accuracy and robustness of predictions, making crowd wisdom a valuable tool for strategic decision-making in marketing.

9. IN SEARCH OF DEFINITION

The concept itself has also become very inspiring for researchers in other fields, not excluding fiction or fantasy, to mention our own Stanisław Lem and his intelligent ocean from the planet Solaris. Psychology has made the greatest use of this concept, which has subsequently formed the basis for the analyses of behavioural economics and the research of experimental economics, both approaches that have resulted in Nobel prizes. Psychology provides us with concepts such as crowd psychology (Tarde, 1890), crowd mentality (Freud, 1922), or the collective unconscious (Jung, 1934). [The latter, as an element of the collective mind, is as common in nature as the collective creative consciousness, only that, unlike creativity, it has a 'negative charge' and is characterised by a high susceptibility to reinforcing destructive forces through mechanisms of manipulation]. Sociologist Emile Durkheim in 1893 introduced the term collective consciousness based on shared beliefs and values, which is the basis for generating solidarity behaviour in a group, and the father of modern economics Adam Smith (Smith, 1795) referred to the mechanism of the 'invisible hand' that regulates the allocation of resources in a market economy, and as it turns out such a collective management system can be quite efficient (with some assumptions about which later). It is also useful for learning, as evidenced by the so-called 'hundredth monkey effect', which proves the existence of a non-verbal communication network between representatives of the same species (group), so that new ideas spread much faster than

the possibilities of communication channels would indicate." [In this context, an interesting phenomenon may be the occurrence of synchronicity in the appearance of new inventions and ideas, which is difficult to reconcile with the principles of the legal order of patents and intellectual property].

Figuere 1. Collective Intelligence framework (source: own eleboration)



All kinds of approaches and applications have been developed based on the same idea of community power. Apart the composition of the group described above at he graph we need to mentcion also about the group dynamic which is always difficult to obtain in the equilibrated manner.

Definitions of collective intelligence

1. Collective decision-making - understood as the ability to make a group decision at least as good as, or better than, the decisions of an individual member of the group (Hiltz and Turoff, 1978).
2. A task/goal-oriented group of individual units acting as an intelligent organism with a coherent intellect, being more than a collection of independent entities (Smith, 1994). The important thing here is the goal of action, not the means, so that rules and legal norms are replaced by shared values and a code of unwritten practices.
3. A form of commonly occurring, and ever-expanding, intelligence (Levy, 1997) (symbolically reminiscent of the game MineCraft) evolving in real time and leading to the best allocation of competencies, skills and talents (so recently fashionable in management from the HR level).

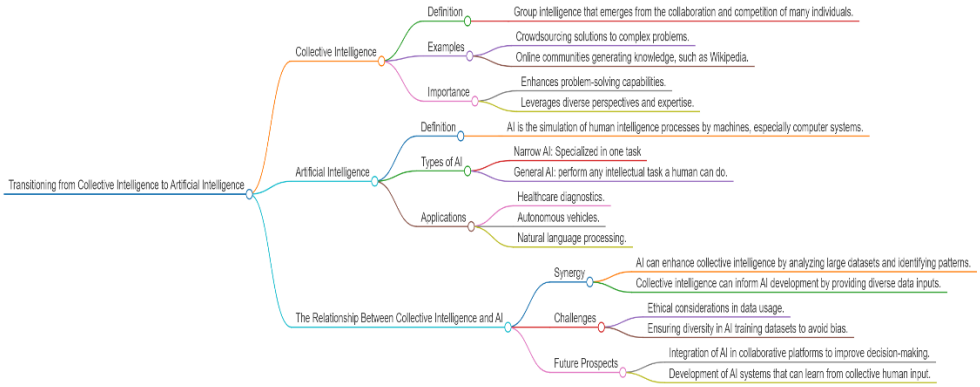
4. The ability of the group to find a better solution or more solutions than those proposed by individually working group members (Heylighen, 1999). This collective option is used daily by most of the population searching the Internet for solutions to their most trivial and most fundamental problems.
5. Collective intelligence, understood as the intelligence of the collective (Atlee, 2003) derived from a variety of sources; and here diversity is very helpful in enriching our perceptions and thus seeing possible solutions to a problem.
6. The general ability of a group to perform a variety of tasks (Woolley et al., 2010) the more diverse the group composition. [As can be seen, the intelligence of homogeneous groups can be self-limiting].
7. Harnessing a large (huge) number of people to solve a difficult problem, leading to the selection of an effective set of solutions by gaining a broader perspective than that available to individuals (Financial Times Lexicon, 2013).
8. The ability for biological, social and cognitive systems to evolve towards higher order, complexity and harmony(Kappeler, 2019). [Comparable to the evolution of natural systems which in turn is the basis of the sustainable development and management approach].
9. Collective intelligence in self-organizing ensembles providing numerous benefits and costs as an outcome of individual and group interests balance, considered as a public good (Leonard and Levin, 2022).
10. Shared group intelligence which emerges as a result of collaboration, joint action or competition between a group of independent individuals seeking a solution to a problem or consensus of a decision to be made (Suran et al., 2020).
11. Collective Intelligence (CI): all non-AI collective intelligence literature. Specifically, publications with the following fields of study: 'crowdsourcing', 'citizen science', 'collective intelligence', 'wisdom of crowds', 'collective wisdom', 'wisdom of the crowd', 'social computing' and 'human computation' (Berdichevskaya et al., 2022).
12. The intelligence of the human collective supported by intelligent machines and internet technologies (Mulgan, 2017) enabling organisations (companies, institutions, universities, etc.) and societies (from the local community to the global community) to think at a larger scale (big mind) as a way of seeking solutions to the greatest challenges of the present day.

Personally, I favour the last definition, focusing on the linkages (structure, dependencies and background) that enable this phenomenal 'neural effect' generating the collective mind and triggering the creation effect in the broad interaction of a group within an organisation, society, or global community using all available technological tools.

10. RESULTS

The transition from collective intelligence (CI) to artificial intelligence (AI) signifies a profound transformation in the methodologies employed for the generation and application of knowledge in the context of intricate problem-solving.

Figure 2 Transitioning from Collective Intelligence to Artificial Intelligence (source: own eleboration)



The transition from collective intelligence (CI) to artificial intelligence (AI) signifies a profound transformation in the methodologies employed for the generation and application of knowledge in the context of intricate problem-solving. Collective intelligence is predicated upon the cooperative efforts of numerous individuals, effectively utilizing a multitude of perspectives and amalgamating their insights to formulate solutions that exceed the capabilities of any single individual. This methodology has been effectively implemented across various domains, including healthcare, business innovation, and social computing, wherein collective contributions significantly influence decision-making processes and foster creativity. In contrast, artificial intelligence streamlines this procedure by utilizing algorithms, machine learning techniques, and extensive datasets to replicate human cognitive processes and, in certain areas, to outperform human-level problem-solving capabilities. AI systems possess the ability to process and analyze data at a magnitude and velocity that far exceeds human limitations, resulting in swift progress in fields such as medical diagnostics, financial forecasting, and personalized marketing strategies. While collective intelligence capitalizes on the aggregated wisdom of diverse groups, AI enhances and automates the extraction of these insights, thereby facilitating more efficient and scalable solutions. Collectively, CI and AI embody synergistic forces in the realm of innovation: CI emphasizes human collaboration, whereas AI augments decision-making through data-centric automation and predictive analytics.

11. DISCUSSION AND CONCLUSION

Collective intelligence is a very broad and interdisciplinary concept adapted in many disciplines with very positive practical applications. Interdisciplinary approaches, such as the theory of games and economic market behaviors, highlight the practical applications of collective intelligence in decision-making and strategic planning.The findings demonstrate that collective intelligence is an effective tool for solving complex problems, often producing better outcomes than individual efforts. Companies that foster collective intelligence through collaborative teams are better equipped to navigate dynamic external environments. However, it is not without challenges, such as the potential for destructive group behaviors or mismanagement of collaborative efforts. The interdisciplinary nature of the concept, involving psychology, sociology, economics, and technology, underscores its complexity and potential. By embracing collective intelligence, organizations can improve adaptability and competitiveness. Collective intelligence offers significant advantages in various contexts, from solving technical challenges to fostering innovation. The evolution of digital technologies further enhances the scope of collective intelligence, creating new opportunities for cooperation on a global scale. Undoubtfully collective intelligence is boosterd by Artificial Intelligence which seems to be the next level of collective collaboration.

12. REFERENCES

Atlee, T. (1999). Co-intelligence and community self-organization. *The Permaculture Activist*, December, 4-10. https://www.co-intelligence.org/CIPol_permacultureCI.html

Atlee, T. (2003). Defining "collective intelligence." *The Co-Intelligence Institute*. https://co-intelligence.org/CollectiveIntelligence2.html#definitions

Bastiaens, T. J., Baumol, U., and Kramer, B. J. (Eds.). (2010). *On collective intelligence: Proceedings of the Symposium on Collective Intelligence, Hagen, Germany, April 15-16, 2010*. Advances in Intelligent and Soft Computing, 76. Springer-Verlag. https://doi.org/10.1007/978-3-642-14481-3

Berditchevskaia, A., Maliaraki, E., & Stathoulopoulos, K. (2022). A descriptive analysis of collective intelligence publications since 2000, and the emerging influence of artificial intelligence. *Collective Intelligence*, *1*(1), 26339137221107924. https://doi.org/10.1177/26339137221107924

Brooks, R. A., and Matarić, M. J. (1993). Real robots, real learning problems. *IEEE Intelligent Systems*, *8*(4), 20-24. https://link.springer.com/chapter/10.1007/978-1-4615-3184-5_8

Da, Z., and Huang, X. (2018). Harnessing the Wisdom of Crowds. *SPGMI: Compustat Fundamentals (Topic)*. https://doi.org/10.2139/ssrn.2731884

Durkheim, E. (1893). *De la division du travail social*. Free Press. (Original work published 1984). https://anarch.cc/uploads/emile-durkheim/the-division-of-labor-in-society-1984.pdf

Engelbart, D. C. (1962). *Augmenting Human Intellect: a Conceptual Framework*. SRI Summary Report AFOSR-3223, Stanford Research Institute, Menlo Park, CA, October. Engelbart, D. C., and English, W. K. (1968, December). A research center for augmenting human intellect. In *Proceedings of the December 9-11, 1968, fall joint computer conference, part I* (pp. 395-410).

Engelbart, D. C. (1995). Toward augmenting the human intellect and boosting collective IQ. *Communications of the ACM, 38*(8), 30-32. https://doi.org/10.1145/208344.208352

Financial Times Lexicon. (2013). *Collective intelligence*. https://www.ft.com/

Frank, N. R. (1989). Army ants: A collective intelligence. *American Scientist, 77*(2), 138-145. https://reasonabledeviations.com/notes/papers/army_ants_collective_intelligence/

Freud, S. (1922). *Group psychology and the analysis of the ego* (J. Strachey, Trans.). Boni and Liveright. https://ia802907.us.archive.org/17/items/SigmundFreud/Sigmund Freud %5B1921%5D Group Psychology and the Analysis of the Ego (James Strachey translation, 1949).pdf

Gardner, H. (1983). *Frames of mind: Theory of multiple intelligences*. Basic Books.

Gottfredson, L. S. (1997). Mainstream science on intelligence: An editorial with 52 signatories, history, and bibliography. *Intelligence, 24*(1), 13-23. https://doi.org/10.1016/S0160-2896(97)90011-8

Gregg, D. G. (2010). Designing for collective intelligence. *Communications of the ACM*, *53*(4), 134-138. https://doi.org/10.1145/1721654.172169

Hamilton, C. (2004). Come together: Can we discover a depth of wisdom far beyond what is available to individuals alone? *What is Enlightenment Magazine*, May-July. https://enlightennext.org/

He Feijuan, Yudai, Pan., Qika, Lin., Xianglin, Miao., Zhouguo, Chen. (2019). Collective Intelligence: A Taxonomy and Survey. *IEEE Access*, 7:170213-170225. https://doi.org/10.1109/ACCESS.2019.2955677

Heylighen, F. (1999). Collective intelligence and its implementation on the web: Algorithms to develop a collective mental map. *Computational and Mathematical Organization Theory, 5*(3), 253-280. https://doi.org/10.1023/A:1009690407292

Hiltz, S. R., & Turoff, M. (1978). *The network nation: Human communication via computer*. Addison-Wesley.

Howe, J. (2009). *Crowdsourcing: Why the power of the crowd is driving the future of business*. Crown Business. http://doi.org/10.1108/07363760910965918

Isaacs, W. (1999). *Dialogue and the art of thinking together*. Doubleday Currency. https://www.researchgate.net/publication/263457041_Dialogue_and_the_Art_of_Thinking_Together

Jung, C. G. (1934). *The archetypes of the collective unconscious* (2nd ed., Vol. 9, Part 1). Bollingen. https://www.jungiananalysts.org.uk/wp-content/uploads/2018/07/C.-G.-Jung-Collected-Works-Volume-9i_-The-Archetypes-of-the-Collective-Unconscious.pdf

Kappeler, P. (2019). A framework for studying social complexity. *Behavioral Ecology and Sociobiology*, 73, 1-14. https://doi.org/10.1007/s00265-018-2601-8.

Kowalczyk, R. (Ed.). (2009). *Computational collective intelligence: Proceedings of the First International Conference on Computational Collective Intelligence*, Wroclaw, Poland, October 5-7, 2009. Springer. https://www.semanticscholar.org/paper/Computational-collective-intelligence.-Semantic-and-Nguyen-Kowalczyk/a980f3394d25e16af185193c2db6d21c4994876e?utm_source=direct_link

Koźmiński, A. (2016). Polish Business Management: A Contredanse of Theory and Practice. *Central European Management Journal*, *24*(4), 10-24.

Kremer, I., Mansour, Y., and Perry, M. (2013). Implementing the "Wisdom of the Crowd". *Journal of Political Economy*, *122*, 988 - 1012. https://doi.org/10.1086/676597.

Leonard, N., and Levin, S. (2022). Collective intelligence as a public good. *Collective Intelligence, 1*. https://doi.org/10.1177/26339137221083293.

Lévy, P. (1997). *Collective intelligence: mankind's emerging world in cyberspace, trans. Perseus*.

Malone, T. W., and Crowston, K. (1994). The interdisciplinary study of coordination. *ACM Computing Surveys, 26*(1), 87-119. https://doi.org/10.1145/174666.174668

Malone, T. W., Laubacher, R., and Dellarocas, C. N. (2009). Harnessing crowds: Mapping the genome of collective intelligence. MIT Sloan School of Management Research Paper No. 4732-09. http://ssrn.com/abstract=1381502.

Malone, T. W., and von Ahn, L. (2012). *Proceedings of the Collective Intelligence 2012 Conference*, Cambridge, MA, April 18-20. https://arxiv.org/abs/1204.2991v3.

Mulgan, G. (2017). *Big mind: How collective intelligence can change our world*. Princeton University Press. http://digital.casalini.it/9781400888511

O'Reilly, T. (2005). What is web 2.0? Design patterns and business models for the next generation of software. *O'Reilly Media, Inc.* https://oreilly.com/web2/archive/what-is-web-20.html.

Radcliffe, K., Lyson, H. C., Barr-Walker, J., and Sarkar, U. (2019). Collective intelligence in medical decision-making: a systematic scoping review. *BMC medical informatics and decision making*, *19*, 1-11. https://doi.org/10.1186/s12911-019-0882-0.

Ridley, M. (2010). *The rational optimist: How prosperity evolves*. HarperCollins.

Searle, J. (1999). The Chinese room. In R. A. Wilson and F. Keil (Eds.), *The MIT encyclopedia of the cognitive sciences* (pp. 115-117). Cambridge, MA: MIT Press. https://web.mit.edu/morrishalle/pubworks/papers/1999_Halle_MIT_Encyclopedia_Cognitive_Sciences-paper.pdf

Smith, A. (1795). *The theory of moral sentiments*. A. Kincaid and J. Bell. https://philpapers.org/archive/BONTTO-4.pdf

Smith, J. (1994). *Collective intelligence in computer-based collaboration*. Lawrence Erlbaum. https://l3d.cs.colorado.edu/~haleden/refbase/show.php?record=9283&submit=Cite&citeType=PDF

Sternberg, R. J., and Salter, W. (Eds.). (1982). *Handbook of human intelligence.* Cambridge University Press. https://assets.cambridge.org/97811087/03864/frontmatter/9781108703864_frontmatter.pdf

Suran, S., Pattanaik, V., & Draheim, D. (2020). Frameworks for collective intelligence: A systematic literature review. *ACM Computing Surveys*, *53*(1), 14:1-14:36. https://doi.org/10.1145/3368986

Surowiecki, J. (2005). *The wisdom of crowds*. Anchor. https://www.asecib.ase.ro/mps/TheWisdomOfCrowds-JamesSurowiecki.pdf

Szuba, T. (2001). *Computational collective intelligence*. Wiley. https://dl.acm.org/doi/10.5555/516996

Tapscott, D., and Williams, A. D. (2006). *Wikinomics: How mass collaboration changes everything*. Portfolio. https://seeingcollaborations.files.wordpress.com/2014/08/don-tapscott_-anthony-d-williams-wikinomics-_-how-mass-collaboration-changes-everything-portfolio-2008.pdf

Tarde, G. (1890). *Les lois de l'imitation*. Felix Alcan. https://cdsa.aacademica.org/000-034/765.pdf

Wechsler, D. (1971). Concept of collective intelligence. *American Psychologist, 26*(10), 904-907. https://doi.org/10.1037/h0032223

Woolley, A. W., Chabris, C. F., Pentland, A., Hashmi, N., and Malone, T. W. (2010). Evidence for a collective intelligence factor in the performance of human groups. *Science, 330*(6004), 686-688. https://doi.org/10.1126/science.1193147