

Collective Intelligence: A New Model of Business Management in the Big-Data Ecosystem

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Abstract

We are immersed in a world characterized by globalization, the widespread use of technology, the transition from administrative management to smart management, the networking of companies and the use of knowledge as an intangible asset, which raises the need for a review of the logic and practice of current business management. This situation requires rethinking and assessing the validity of these management systems to respond to changes in the business environment and market volatility. Our interest is twofold. The first is to study how different sets of business factors collectively work to get the company to operate and manage change, volatility and uncertainty within the Big-Data ecosystem framework. The second is to lay the foundations for the development of a management proposal based on collective intelligence (CI), whose key factors are interaction, interactive learning, distributed collaboration and the valorisation of knowledge in all its dimensions.

Keywords: Collective intelligence, Big Data Ecosystem, Interaction, Valuation of knowledge, Business management.

JEL: C42, C44, D21, D46, D71, D81, J24, M12, M14, M15, M54.

1. Introduction

The logic of the Big-Data paradigm has rendered obsolete traditional forms of management based on attacking the consequences (costs and profits per product unit) rather than the causes of the problems faced by companies. This paradigm has also given rise to the emergence of new forms of business management based on relevant intangible assets, such as the degree of knowledge possessed by the company and the intelligence stocks of its employees. Assets that are recognized today as valuable for the development of business management in the 21st century.

In complex systems such as companies, the decisions that are made are linked to the exploitation of the knowledge and collective intelligence of its workers, to the extent that they enable the transformation of interactivity, learning and collaboration into economic value.

Hence the importance of studying the role of collective intelligence, understood as the real capacity of a group of people or workers to solve the problems that affect them, which in turn strengthens their cohesion and collaboration as a group. This kind of intelligence is now manifested in entirely new ways, as new communication technologies, especially the Internet, have made it possible for a large number of people around the world to work together in ways never before possible in human history (Malone 2004). The usefulness of collective intelligence is manifested in different areas of activity such as marketing, electoral processes and the design of public policies, among many others. Summing up, it is a new business and institutional management model in which it is possible to measure and verify the interaction and collaboration between its workers, as well as with technology, with the aim of designing intervention policies and improving productivity and business results.

In any context where the predominant business management is hierarchical, integration and understanding efforts among the members of the work teams of the company will be conditioned or limited in their shared relationships. These structures are more closed to horizontal communication and limit collective intelligence, causing loss of skills and knowledge of those members who are below a certain level and do not have options of participation or opinion on certain problems faced by the company.

The rest of the work is structured as follows. In Section 2 we deal with the problems related to the management of companies and its relationship with the exploitation of collective intelligence. In Section 3 we carry out a brief review of the state of the art of business management and the exploitation of collective intelligence, in addition to analyzing the role of Digital Disruption in the development of the CI. In Section 4 we study the considerations to be taken into account about CI in the Big Data Ecosystem. In Section 5 we offer some ideas and advancements for the elaboration of a proposal to exploit CI at the business level. Finally, we include a sixth Section of conclusions.

2. Approaching the Problem in Collective Intelligence

It's amazing how Big-Data can wake us up to the world around us. We talk about how the logic of human beings' actions is changing as electronic devices allow us to experience, in real time or not, sight, sounds and even smells, from the comfort of our offices, living rooms, study spaces, etc. The impact of these changes also has a significant impact on the way we manage our economic-social activity, especially the way we work, interact and participate in a company's environment.

Such technological and non-technological changes and advances altogether are changing the logic of action of citizens, companies, public entities and institutions in general (Peñaloza & Vargas, 2018). And they accelerate the immersion of all economic-social agents in the Big-Data ecosystem, stimulating the development of concepts and theories that better capture the growing complexity of the structure of phenomena and business relations. This complexity is expressed in huge amounts of data, which provide greater predictive power and better meaningful solutions in knowledge-based environments and digitization (Hitt et. al., 2007).

In this context, many of the problems related to the traditional management model of the company are associated with the fact that key factors that influence the type of organizational structure, business performance, ways of working and sources of profit of the company are not taken into account. These key factors include interaction, collaboration, individual and collective learning, and decentralization of decision-making, among many others.

This perception involves observing and analysing management phenomena from a multidimensional perspective that involves nesting, interdependence and redundancy of information. However, the traditional management practice is basically interested in a one-dimensional perception of management phenomena, an interest that is reflected in the development of an individual, group/equipment, industrial or regional analysis, etc. Metaphorically speaking, the traditional model can be understood as the use of lenses that only allow us to observe the different levels in which a phenomenon manifests itself as a single analytical level, so that its understanding will be incomplete and limited as far as the management process is concerned.

Therefore, the shift from administrative management to smart management calls into question the basic fundamentals of the company's traditional management model, as it moves from a centralised organisational structure to a decentralised network and from the use of tangible assets to the use of intangible assets (knowledge, interaction, shared responsibility, etc.). Processes which, in turn, are major challenges, namely given the need to accelerate the transition from the digitisation process to the contextualized incorporation of new forms of interaction and collaboration. The relevance of this observation lies in the need to incorporate these events into the business management process, both tactical and strategic. The idea is to build a new management model based on a process of integration of the individual intelligences by equipping them with analytical and descriptive processing capabilities and empowerment for shared decision-making in the company (collective intelligence).

From this perspective, it is understood that collective intelligence is an essential part of the business management process and is based on the connection between people and between people and/or computers. The idea is to facilitate the production of ideas, to exchange ideas and arguments, and to improve the company's "social sensitivity". However, this presents us with new challenges related to the identification of the different types of intelligence and personalities that best contribute to achieving the goals of optimizing collective knowledge, to transform the enormous amount of data that companies have today into value.

In short, facilitating the path to a smart business management model involves studying how different sets of business factors work collectively to get the company to operate and manage change, volatility and uncertainty as it makes its immersion in the Big-Data ecosystem. And it aims to achieve not only its adaptation to the different scenarios and maintain its competitiveness in the long term to respond to the volatility of the markets in which it operates, but also to encourage collective decision-making based on evidence and logical reasoning on the various complex issues that are part of business management.

3. State of the Art: Big-Data the Revolution in Management

The need for a review of the logic and practice of today's business management requires rethinking and assessing the validity of management systems, to respond to changes in the business environment, market volatility, interaction and collaboration between workers and technology.

Due to the intrinsically hierarchical nature of companies, management models are characterized by establishing *watertight hierarchical relationships*, which extend to the lower levels (areas, departments,...), where access to information is completely asymmetrical and flows in a single direction. The information goes from the company's management to departments or areas with almost no feedback. It is a model in which interaction, learning and collaboration do not have any real and effective relevance in decision-making, except for some anecdotal reference of an executive (CEO or Manager) who has spoken with one of its employees.

Indeed, numerous theoretical discussions and empirical research have identified relationships between different dimensions that are nested among each other. The discussion around these relationships has covered aspects such as: relationships between environmental factors and organizational structures (Pfeffer & Salancik, 1978; Aldrich & Pfeffer, 1976), between organizational technologies and organizational structures (Fry & Slocum, 1984; Comstock & Scott, 1977; Thompson, 1967; Woodward, 1965), between the organization of individual subunits and attitudes (Hulin & Roznowski, 1985), between group norms/stimuli and individual behavior (Hackman, 1992), between departmental structures and individual attitudes (Brass, 1981; Oldham & Hackman, 1981; Rousseau, 1978; James & Jones, 1976), and between work climate/culture and individual behavior (Martocchio, 1994; James, James & Ashe, 1990).

All these studies, which describe hierarchical relationships in management, explain the influence of relationships associated with one dimension on other analytical dimensions or estates, and point out the need to rethink the current form of business management. More specifically, they show that today's top-level executives tend to make predictions about company performance and results based on a set of general and incomplete information, and almost never take into account the direct and indirect contributions of their workers or their various departments, which are treated as black boxes that execute their orders or decisions. Moreover, they act as the sole creators of economic and business value.

In fact, in any type of company, interdependent relationships cross all the dimensions or strata that comprise it (Hoffman, 1997), putting into question the old hierarchical relationships based on a vertical nesting of decisions, which cancels the contributions of individuals and working groups. This suggests that any study of individual behaviour within a company or company should not only take into account (measure) individual attributes but should also take into account the characteristics of the environment in which workers work and the nature of the operations they perform.

The effects of interaction are at the heart of the theories of contingency and interaction between different strata. Researchers have often lamented the difficulty of identifying interactions between the different levels at which business management problems occur. Hence the importance of developing capacities to detect interactions and new forms of learning and collaboration between workers. This detection is determined by the extent of cross-interaction between workers and between workers and the management team.

This means that the relationships between parties and events that occur through interaction-collaboration become much more relevant, as immersion in the Big-Data ecosystem becomes widespread, with the result that the elements that form part of the business management architecture become more and more rationally connected and purposefully shared (Von Bertalanffy, 1968).

The relevant question in this situation is: How to connect people and computers so that they are collectively smarter than people, teams and computers have ever been acting individually? It is a question of devising new bottom-up mechanisms to facilitate effective and efficient collective decision-making at the enterprise level. To this end, it will be necessary to design a networked platform to manage ideas, alternatives and debates, within and outside work teams, and at the enterprise level on the alternatives, the tactical actions and the complex business strategies.

In general, management specialists have a long history of recognizing that organizational and management phenomena develop within complex and dynamic systems. For this reason, collective intelligence studies emphasize the fact that identification of patterns typically associated with what is considered "smart" is not sufficient to consider a company or work team smart (Malone & Klein, 2007). On the contrary, multiple skills and competencies, such as communication, consensus readiness and interpersonal skills, are needed to effectively integrate individual intelligences and obtain optimal solutions to the problems faced by companies.

This leads to the study of the characteristics and conditioning factors in which "distributed collaboration" is developed within companies, and how to build an organization more sensitive to interactions, learning, collaboration and shared responsibility.

Collaboration is philosophically different and possibly more demanding than cooperation, where the desired results are relatively clear, the distribution of future returns can be negotiated in advance and the cooperating parties essentially act in their own interest (Miles et al., 2005). Collaboration often involves unpredictable outcomes and depends largely on trust and a shared commitment to the values of honesty and fairness.

In contrast to cooperation, collaboration implies that the parties take into consideration both the interests of others and their own (von Krogh, 1998). Collaboration can be directed towards any mutually desired goal: identifying and then solving a problem, resolving a conflict, creating a new product or business, and so on. Companies that opt for collaborative practice as a strategy should be able to develop the capacities, structures and processes to support a collaborative approach. For example, Nokia has a network of more than 300 high-tech small businesses and has developed trust-based relationships with them for continuous interaction to facilitate the development of certain technological innovations (David, J. et al. 2007).

This type of praxis implies the recognition that a collaborative approach is essential in the knowledge management process to capture a significant part of the economic value associated with an action, performance or innovation (Teece, 1986). In other words, the aim is to build a management system in which the business conversation involves all the company's professionals and technicians without exception in addressing critical issues, with the aim of promoting collective decision-making based on logical reasoning and the presentation of arguments and evidence.

Similarly, in terms of learning and/or self-learning, the effects of feedback from experimental and cognitive developments make it possible to convert the results into a shared and collaborative learning process. In this process, the regulatory learning systems stimulate the reflexive function of knowledge, interpreting the environment based on knowledge itself. While organizational systems use this energy to organize and reduce internal entropy, and limit external entropy (Mele, et al., 2010).

3.1 The Role of Digital Disruption in the Development of Collective Intelligence

The relevant question that arises in the knowledge economy is: How can a multitude of people be smarter than the sum of its parts? One possible answer can be found in the concept of digital disruption, understood as the change that occurs when new digital technologies and new business models affect the value proposals of existing goods and services (Rouse, 2014).

It is clear that new technologies drive a revolution in the internal and external functioning of companies and that, in their process of digital transformation, they promote new working models based on open innovation and collective intelligence as their most significant engines. This perception of disruption poses new challenges related to the constant search for innovation, learning and collaboration, as a way of working in the company and in its relationship with customers, collaborators and suppliers. In this context, business management needs to answer a set of questions such as: What is the role of each individual in this process of exploiting collective intelligence (CI)? What would the organizational principles of the company be to optimize CI? What would be the rules and restrictions for the exchange of ideas through communication technologies? and How do they relate and communicate with the new digital environment, both internally and externally?

Indeed, the rapid increase in the use of mobile devices, not only for personal use but also for work, has increased the potential for digital disruption in many areas of business activity. This is why the concept of collective intelligence has acquired a leading role not only in taking advantage of all the opportunities that arise in uncertain environments, with digital transformation as a backdrop but also to define the new business management model.

4. Considerations of Collective Intelligence in the Big-Data Ecosystem

4.1 From Division of Labour to Collective Intelligence

The contextualization of the discussion of the specificity of collective intelligence opens the possibility of positive results through collaboration, whose scale exceeds individual capacity. However, it could be argued that this is a generic effect of any form of collaboration in which individuals come together (Tomasello, 2014).

Indeed, knowledge is distributed and shared among different individual agents whose cognitive abilities and rational faculties are limited in many respects (Kahneman, 2012). As one would expect, this is also the principle behind the division of labour that underpins the functioning of complex social and economic systems: when humans work together, they achieve better results than individuals who work on their own.

The result of joint activity for tracking a phenomenon is not only more extensive but also greater than individual contributions. The term "superior" refers to the possibility that group activities produce a qualitatively different, but not necessarily optimal, performance than the sum of individual actions. Thus, if all that is needed for a network or group of people to offer a smart solution is to divide the work between multiple actors (classic scenario of the division of labour), it would be difficult to explain how the "total sum" differs in terms of individual knowledge and competences.

But the most visible cases of collective intelligence show that what makes the fusion of individual intelligences into a qualitatively different phenomenon is the fact that, by joining forces, people sometimes achieve results that could only arise as a result of their interactions and collaboration. The product of these interactions and collaboration is said to be qualitatively different from simple aggregation because the interaction itself contributes to generating something radically new.

4.2 How can Companies Prepare for Digital Transformation while Discovering the True Value of their Organisation's Data and Exploiting the CI of their Workers?

The trends prevailing in today's business dynamics are towards continuous and widespread change and increasing interdependencies (White, 2000), in turbulent environments characterized by uncertainties and entropy. To better understand these changes and manage the process more effectively, a more dynamic and comprehensive vision of business management has been suggested including the exploitation of collective intelligence. This involves integrating the complexity of the relationships between workers and managers, and between workers and computers, in order to better understand disruptive processes and the flow of real organizational change and management model.

The need for strategic management to complement the digital transformation of companies is a fact, as it is the exploitation of collective intelligence to transform it into actionable intelligence. Why? Because "many collaborators" are smarter than a few; and because collective wisdom shapes businesses, the economy and society. However, we must bear in mind that digital disruption has a positive or negative impact not only on the development of different economic industries but also on the different professions, skills and competences of the elements that make up the society of knowledge.

4.3 Limitations of Collective Intelligence

Let us remember that the wisdom of work teams is defined as any group of people who can act collectively to make decisions and solve complex problems (Surowiecki, 2005). In practice, however, not all groups behave wisely; for example, a multitude of investors go mad in a market bubble. One possible explanation is that this occurs when the decision-making environment is not prepared to accept collective intelligence as a resource and a productive investment, and loses the benefits of personal judgments and private information that forms part of the background of workers. Therefore, the work team will only be able to achieve the level of success of its most capable member, rather than surpassing that level.

The manifestation of these limitations coupled with the managers' fear of losing "control" appears when it exists: **too much centralization**, for example, an excess of bureaucracy does not allow collecting the wisdom of low-level workers; **too much compartmentalization**, for example, when the information held in one department is not accessible to other departments of the company (work islands); **too much imitation or status quo**, so decisions are limited to doing what has "always worked".

Another constraint in the implementation of CI is related to the measurement and evaluation of its effectiveness, as it is a logical structure for capturing the knowledge resulting from reflection and critical thinking based on logical and experimental reasoning.

Similarly, we can point out that current systems of collective deliberation or reflection tend to be biased in various ways (MIT-CCI-Center for Collective Intelligence studies). Among the most prominent biases we have:

- **Informational pressures**, which occur when opinions are not independent and action comes from imitation, according to the established guideline that "the majority cannot be wrong".
- **Social pressures**, which appear when interacting with other participants distorts one's own opinion by the presence of negative factors such as fear of conflict, fear of ridicule or being marginalized from the group; or even by opportunistic and figurative attitudes.
- **Common knowledge effect**, which arises when the participant is satisfied with the information and knowledge he or she already has, and does not explore new sources and perspectives that enrich the analysis of the problem.
- **Polarization bias**, which manifests itself as a tendency to the radicalization of positions or proposals regarding any issue that involves cultural, social or political values, to the point of turning them into dogmas or automatically defending positions, without any reasoning or considering the evidence.

In short, business relations theory holds that the behaviour of a single autonomous element is different from the behaviour of that element when it interacts with other elements.

5. Basics for a Management Proposal Based on Collective Intelligence

In this Section, we present some ideas and advances for the elaboration of a management proposal based on collective intelligence, whose key factors are interaction, learning, collaboration and the transformation of knowledge into value in all its dimensions. This means a flexible and reversible organizational design that makes possible the integral transformation of the company, responds to changes in market conditions and incorporates the impact of technological innovations. The structure consistent with these requirements is based on the formation of open and dynamic, highly interrelated and complementary work teams: teams of multi-purpose professionals, articulated by the network communication highways (Intranet), which are permeable to brainstorming, creativity, shared learning, distributed collaboration and decentralized decision-making (Peñalosa & Vargas, 2017)

Thanks to the Internet and computers, our ways of working and our work habits have been transformed, but also our way of thinking and organizing our economy and infrastructure, and our lives have changed. The 21st century is the history of collaborative interactions and actions, where groups have learned to exploit the benefits of diversity and heterogeneity. As a result, companies are shifting to more decentralised and flexible ways to better meet their customers' demands and increase business performance.

In general, the basis for generating a proposal for network management based on the exploitation of the CI includes a set of considerations such as the following:

5.1 Diversity, Independence and Intelligent Aggregation:

When we talk about diversity and its impact on the effectiveness of collective intelligence, we refer to cognitive heterogeneity, understood as the diversity of experiences, skills and professional maturity of managers and employees of companies or firms, which can be analyzed both individually and collectively (Hambrick, et. al. 1996). This heterogeneity will influence how information is interpreted and used, as well as how interaction and collaboration are managed (Weingart, et. al. 2005; Naranjo, 2007).

Cognitive styles define the ways in which individuals encode, process and communicate information, and are related to their respective functional and educational specializations (Kozhevnikov, et. al. 2005). Having the right amount of cognitive style diversity is important for team performance. Previous research suggests that collective intelligence allows not only high performance at a given time but also better performance over time, even in tasks that do not require a team to explicitly learn a new procedure or body of knowledge (Engel, et al. to. 2014; Aggarwal & Woolley, 2013; Woolley et al. 2010; Gibson & Cohen, 2003).

On the other hand, interdependence can be described as the extent to which the participation of several individuals is required to complete a given task, and to achieve a specific objective in order to obtain a given result, i.e. to complete the work (Wageman, 1995). Interaction among group members is vital to organizational work (Van der Vegt, Emans & Van de Vliert, 1999), as it could have a significant impact on individual and/or team performance (Guzzo & Dickson, 1996). One

characteristic related to interaction, and which influences team results, is interdependence. In this regard, theory and research suggest that interdependence in both tasks and results is positively related to the functioning of work teams or companies (efficiency, effectiveness, decision-making, etc.) (Allen, Sargent & Bradley, 2003; Gully, et. al. 2002; Shaw, et. al. 2000; Van der Vegt & Van de Vliert, 2001; Janssen, Van de Vliert & Veenstra, 1999; Wageman & Baker, 1997; Wageman, 1995).

Since the CI is understood as the integration of individual intelligences for efficient knowledge management and their transformation into value, knowledge aggregation, considering many sources, can produce more information (synergies) or less information (redundancy) than the sum of its parts. This attribute can provide working groups with innovative and creative problem-solving strategies that will be better than solutions generated by non-interacting individuals. They can also provide various forms of collaboration and coordination among working group members or between groups (Bettencourt, 2009; Watkins, 2007).

In this context, the quantification of information in terms of aggregation does not imply the arithmetic sum of such intelligences, but rather the merging of them, considering the interdependencies existing between individual intelligences, to create a system of collaboration and competition between the members of a work team or the workers of a company.

5.2 Factors Facilitating the Development of CI

If we consider the different perspectives immersed in collective intelligence, one way to integrate them is to identify the attributes or set of attributes that are common in CI. Attributes that allow us to examine the factors that facilitate the development of collective intelligence, such as diversity, learning or awareness, while among the factors that inhibit it are prejudice or market failure, among others.

A key issue in the CI-based business management strategy is to determine how each of these factors map specific and generic components, and how they use concepts and theories to facilitate the development of collective intelligence. Among the most relevant mechanisms to make a working group smart, that is, to turn it into a learning and collective collaboration machine, we have:

- **Diversity:** The group includes members with a wide range of knowledge or skills (and the ability to recognize successful and unsuccessful outcomes).
- **Relative independence:** group members use their own knowledge and skills without being over-influenced by others. When members of the group influence each other a lot, some negative results can occur.
- **Relative decentralization:** the actions of the group members are merged in such a way that they find an adequate range of stability, so that individual knowledge is global and collectively useful and maintains its uniqueness and location.
- **Compliance:** mechanisms that generate similarities among the majority of the group members.
- **Influencers:** individuals who have some differences among group members.
- **Internal peer reviewers:** mechanisms that make individual group members rewarded for their successes and penalized for their failures.
- **Non-monetary incentives:** social-entrepreneurial recognition, visibility at work and rewards in kind based on contributions and fostering collaboration.
- **Relative rivalry:** stimulation of competitiveness between groups (corporate games).

5.3 Dense Communications Structure

Dense communication structures can be said to improve the productivity of members of a group or between groups. One of the mechanisms through which structures improve productivity is by improving user identification and trust in the group. For example, management of "mutual knowledge" is a problem if the work teams are geographically distributed (Cramton, 2001), as long as the bandwidth of the communication system is narrow.

In this situation the difficulties of sharing "collective knowledge" are manifested as:

- Lack of specific communication accessible to all users.

- Retention of contextual information.
- Asymmetric distribution of information.
- Difficulty in understanding the importance of information.
- Differences in the speed of access to information.
- Difficulty in interpreting the different solutions proposed.

5.4 Shared Vocabulary and Infrastructure

Label vocabulary is the basis of social navigation and shared expression in a user community, and its evolution is based on the influence of the user community and personal tendencies (Sen et. al. 2006). The shared vocabulary is formed by the set of tags used by users or user groups, where the personal tendency is manifested as a choice of tags based on personality, preferences and beliefs that they use in their decisions. This trend is evolving as people interact with the labelling system. Hence, the influence of a user group on the labelling system mitigates the impact of users' personal tendencies.

Therefore, group performance will depend on the degree of collaborative creation in developing a common vocabulary to describe the different forms of written, visual and oral communication representation (Schwartz, 1995).

5.5 Cultural Boundaries in the Company

In general, although there is consensus on the fact that organizational culture is relevant to the implementation of a business strategy, there is no consensus on the possibilities of its management to reorient and transform it, given that culture is often not part of the functions of companies, mainly the traditional ones. However, thinking about cultural change in the company means combining rational and logical aspects with creative and emotional visions. It is like a simplifying approach to the diversity of opinions, with a descriptive-objective approach and subjective appraisals and valuations.

For example, a culture based on the importance of rank or position makes it difficult for a lower-ranking person, who is more capable than his or her superior, to carry out collaborative work. The lower-ranking person is usually told what to do. This practice is not collaborative and may be a manifestation of the reluctance to share solutions and decisions with others because they see information control as a source of power within the company.

However, the main barrier to collaboration within the company may be the difficulty in building a culture of agreement or consensus when different points of view exist. This can hinder effective decision-making. Even if the cooperating members succeed in reaching an agreement, they are likely to agree from different perspectives. This type of behaviour is called a "cultural boundary" (Blau, 1970). Hence, the importance of becoming aware that people in their multiple facets can group their wills asymmetrically or symmetrically and create joint workspaces with added values that are compatible with business scenarios.

5.6 Incentives for Distributed Collaboration

Here the question is how to build a dynamic and coherent incentive system, with strategic management based on collective intelligence. This dynamic system should mainly motivate activities and actions that stimulate the exploitation of collective intelligence. Therefore, it is not a system for the motivation of employees as isolated units, but of transforming the social value created by employees together into economic value (commercialization).

Although theories such as motivation and all its substitutes guide us on the right track, it is logical to think that there is no magic formula to obtain the best possible collective performance of its employees. In general, the development of an incentive scheme includes stages such as:

- Exhaustive diagnosis of the current situation and clear determination of long-term objectives, as well as those of the work teams or teams of professionals that make up the company.
- Evaluation of the company's human capital stock
- Definition of new jobs and their role in the work teams
- Establishment of a scale of non-monetary and monetary incentives (preventing the latter from becoming a "grandfathered right")

- Inclusion of an item dedicated to the incentive system in the company's budgets (the item must be flexible and the incentives must be dynamic)
- Communication of the criteria and conditions of this system to all employees in the company.

5.7 How Collective Intelligence Operates in the Business Environment

A CI-based management system is part of the corporate brain of the company and extends from collecting data from different sources to managing collective action to generate value. This management system has a double role: one is to coordinate and channel the generation of ideas, solutions and proposals from its employees; and another is similar to a search engine to answer questions or doubts from users. The aim is to overcome the deficiencies in communication and knowledge transfer, which are a constant in large corporations, where internal communication mechanisms are not always agile as might be expected from them.

The implementation of a corporate digital brain would involve the application of a management system based on question-answer rounds to the group of workers. The first round would focus on the coordinators or influencers raising the problems and mechanisms to their workers to evaluate proposals or suggestions, and for them to formulate their proposals. The second round has the task of requiring employees to order alternatives according to their reliability and feasibility. In the third round, the coordinators will order alternatives according to their frequency (frequency distribution). And so on and so forth.

The digital brain must also fulfil its role of logistical, conceptual, technological and predictive support. For example, if employees pose a question to the application, the system should understand the question and look for the answer in its database to provide it to the user. If it doesn't find it, it must be able to predict which people within the company might answer the question or doubt, and send a notification to raise the issue and encourage them to post that information in its database. Of course, the system will learn from this process and the application will be self-sufficient if someone repeats the question in the future.

Synthesizing, the application analyses the interactions between workers in real time and provides companies with this data so that they can know who is the most participatory, on what issues they need to be trained and in which areas they have the most experience. The application must report at all times the data being shared, although responsibility for its misuse will ultimately lie with the company itself. In this process, the CI will evolve with the successes, misunderstandings, problems and solutions with which it lives; and it will acquire skills, will learn to solve and evaluate the results, and to structure its way to face complex situations plagued with uncertainty.

6. Conclusions

Greater access to information and greater direct participation of workers are realities that companies must take advantage of, to transform collective knowledge into economic value, in the sense of achieving better results from the interaction between people and between people and technology, as an intangible resource for organizational and business design.

Enabling heterogeneous, active and continuous spaces for mutual communication and organized participation, allows the maturation and improvement of a group's collective intelligence. Especially if it is characterized by diversity as a source of corporate advantage and if the social elements of understanding, empathy and collaboration are enabled and mature.

It is necessary to improve the capacity of collective intelligence measurement and to study which types of intelligences and personalities best contribute to the objective of optimising collective knowledge.

For smart management and for the company or work team to be smart, it is not enough to identify the behavioural patterns that have typically been associated with "being intelligent". Other communication skills, consensus preparation and interpersonal skills are needed to form effective teams.

Knowledge transfer is the factor that determines the necessary competencies and competitive advantage for the integration of intelligence in the company or organization. This is because the richness of solving many problems can be limited or enhanced by other factors inherent in the group, such as its history, conflicts, successes, learning and capacity for cohesion and collective understanding.

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