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An Open Innovation Business Model Based on Collective Intelligence

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ABSTRACT:

It is proposed to have a study on a business model based on Collective Intelligence. Collective intelligence is defined as the ability of a group to solve more problems than its individual members. The idea brings that a group of people can solve problems efficiently and offer greater insight and a better answer than any one individual could provide. The present paper focuses on an open innovative business model based on collective intelligence as well as various forms and roles of collective intelligence in the business applications. A special work is carried out towards the implementation of collective intelligence at different levels of society. Technical concepts like Dialogic, Co-evolutionary, Flow-based, Statistical and Human-machine CI are applied for open innovative business model.

Keywords **-** Collective Intelligence – Artificial Intelligence – CI Layers – CI Forms – Innovation Business Model – ABCD - CCI.

1. INTRODUCTION:

Collective Intelligence refers to harnessing the power of a large number of people to solve a difficult problem as a group. The idea is that a group of people can solve problems efficiently and offer greater insight and a better answer than any one individual could provide. Collective Intelligence can also be a valuable marketing tool. Collective intelligence is the capacity of human communities to evolve towards higher order complexity and harmony, through such innovation mechanisms as variation-feedback-selection, differentiation-integration-transformation, and competition.

Collective intelligence is about making our application more valuable by tapping into wise crowds. More formally, collective intelligence (CI). Collective intelligence is an active field of research that predates the web. Scientists from the fields of sociology, mass behavior, and computer science have made important contributions to this field. When a group of individuals collaborate or compete with each other, intelligence or behavior that otherwise didn't exist suddenly emerges; this is commonly known as collective intelligence. The actions or influence of a few individuals slowly spread across the community until the actions become the norm for the community.

Collective intelligence is powering a new breed of applications that invite users to interact, contribute content, connect with other users, and personalize the site experience. Users influence other users. This influence spreads outward from their immediate circle of influence until it reaches a critical number, after which it becomes the norm.

Useful user-generated content and opinions spread virally with minimal marketing. Intelligence provided by users can be divided into three main categories. First is direct information/intelligence provided by the user. Reviews, recommendations, ratings, voting, tags, bookmarks, user interaction, and user-generated content are all examples of techniques to gather this intelligence. Reviews, recommendations, ratings, voting, tags, bookmarks, user interaction, and user-generated content are all examples of techniques to gather this intelligence. Second is indirect information provided by the user either on or off the application, which is typically in unstructured text.

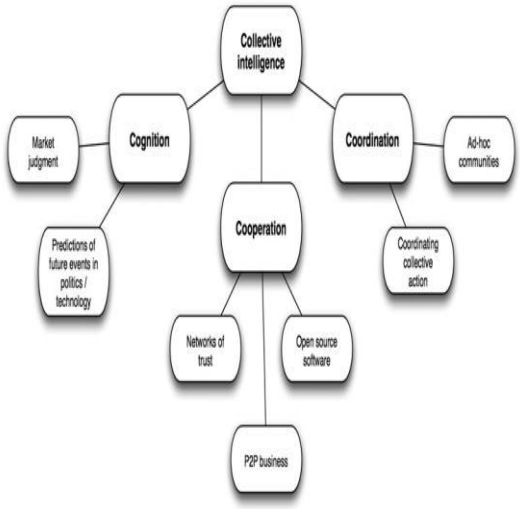

Fig.1 Collective Intelligence

Blog entries, contributions to online communities, and wikis are all sources of intelligence for the application. Third is a higher level of intelligence that's derived using data mining techniques. Recommendation engines, use of predictive analysis for personalization, profile building, market segmentation, and web and text mining are all examples of discovering and applying this higher level of intelligence.

II. COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE:

Artificial Intelligence (AI) is the area of computer science focusing on creating machines that can engage on behaviors that humans consider intelligent. The ability to create intelligent machines has intrigued humans since ancient times and today with the advent of the computer and 50 years of research into AI programming techniques, the dream of smart machines is becoming a reality. Researchers are creating systems which can mimic human thought, understand speech, beat the best human chess player, and countless other feats never before possible.

III. APPLICATIONS OF ARTIFICIAL INTELLIGENCE:

1. Deduction, reasoning and problem solving: Early AI researchers developed algorithms that imitated the step-by-step reasoning that humans use when they solve puzzles or make logical deductions. By the late 1980s and '90s, AI research had also developed highly successful methods for dealing with uncertain or incomplete information, employing concepts from probability and economics.

For difficult problems, most of these algorithms can require enormous computational resources most experience a "combinatorial explosion": the amount of memory or computer time required becomes astronomical when the problem goes beyond a certain size. The search for more efficient problem-solving algorithms is a high priority for AI research.

2. Knowledge representation: Knowledge representations are central to AI research. Many of the problems machines are expected to solve will require extensive knowledge about the world. Among the things that AI needs to represent are objects, properties, categories and relations between objects; situations, events, states and time causes and effects; knowledge about knowledge (what we know about what other people know) and many other, less well researched domains. A representation of "what exists" is an ontology (borrowing a word from traditional philosophy), of which the most general are called upper ontologies.

3. Learning: Machine Learning has been central to AI research from the beginning. In 1956, at the original Dartmouth AI summer conference, Ray Solomon off wrote a report on unsupervised probabilistic machine learning: "An Inductive Inference Machine". Unsupervised learning is the ability to find patterns in a stream of input. Supervised learning includes both classification and numerical regression. Classification is used to determine what category something belongs in, after seeing a number of examples of things from several categories. Regression is the attempt to produce a function that describes the relationship between inputs and outputs and predicts how the outputs should change as the inputs change. In reinforcement the agent is rewarded for good responses and punished for bad ones. These can be analyzed in terms of decision theory, using concepts like utility. The mathematical analysis of machine learning algorithms and their performance is a branch of theoretical known as computational learning theory.

4. Natural language processing: The natural learning processing gives machines the ability to read and understand the languages that humans speak. A sufficiently powerful natural language processing system would enable natural language user interfaces and the acquisition of knowledge directly from human-written sources, such as Internet texts. Some straightforward applications of natural language processing include information retrieval (or text mining) and machine translation.

5. Motion and manipulation: The field of robotics is closely related to AI. Intelligence is required for robots to be able to handle such tasks as object manipulation and navigation, with sub-problems of localization (knowing where you are), mapping (learning what is around you) and motion planning (figuring out how to get there).

VI. CONSCIOUSNESS AND COLLECTIVE INTELLIGENCE:

If we think of consciousness as the ability to be aware of the external environment and our presence within it, one of the potential advantages of Collective Intelligence would be an increased awareness of more elements of our environment and a wider range of potential options for how to interact with it.

The real power of CI in relationship to consciousness goes deeper. One of the areas that most scientists and thinkers struggle with in the field of consciousness is explaining how it is created. At this point the best we can figure is that it is an emergent phenomenon that arises from the interaction of the comparatively simple elements that underlie it. In the case of a human brain it is the collective interaction of neurons. In the case of a bee hive it is the collective interactions of all the hive's members. The key to how CI enhances consciousness, resides in the mystery of the synapse.

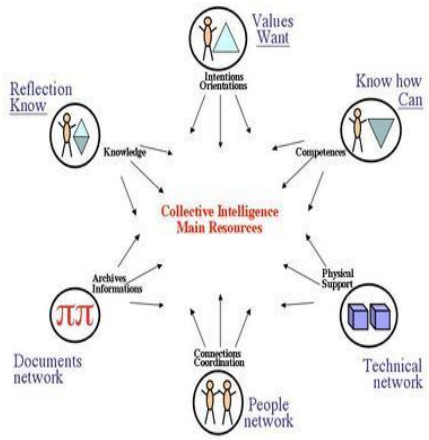

Fig.2 Collective Intelligence Resources.

V. BENEFITS OF COLLECTIVE INTELLIGENCE:

1. Higher retention rates: The more users interact with the application, the stickier it gets for them, and the higher the probability that they'll become repeat visitors.
2. Greater opportunities to market to the user: The greater the number of interactions, the greater the number of pages visited by the user, which increases the opportunities to market to or communicate with the user.
3. Higher probability of a user completing a transaction and finding information of interest: The more contextually relevant information that a user finds, the better the chances that he'll have the information he needs to complete the transaction or find content of interest. This leads to higher click-through and conversion rates for your advertisements.
4. Boosting search engine rankings, the more users participate and contribute content, the more content is available in your application and indexed by search engines. This could boost your search engine ranking and make it easier for others to find your application.

V. FORMS OF COLLECTIVE INTELLIGENCE:

There are many forms, manifestation of CI, and correspondingly, many tribes of its practitioners.

1. Dialogic CI: A diverse group of participants suspend their old mental models and engage in dialogue that values the emergent whole higher than its parts. Variations of this approach include Bohmian dialogue, generative conversation and enlightened communications.

2. Co-evolutionary CI: This form of CI builds on the power of such evolutionary mechanisms generating intelligence over time as trial and error, differentiation and integration, competition and collaboration, etc. Its examples include: ecosystems, sciences, and cultures.

3. Flow-based CI: A group of people become so absorbed in a shared activity that they experience being completely at one with it and one another. Ensembles, high-performance sport teams, astronauts, and others in that state of communion, report on both an enhanced state of autonomy, and collective intelligence.

4. Statistical CI: Individuals thinking and acting separately in large crowds can reach successful conclusion about their collective cognitive, coordination or predictive challenges. Examples include the intelligence of markets and cases popularized in the Wisdom of Crowds.

5. Human-machine CI: This form of CI leverages the synergy of the human mind and its electronic extensions, drawing on the best capacities of both. The "collective" includes symbiotic networks of humans and computers working together and developing compound capabilities. It can also support all other forms of CI.

VI. LAYERS OF COLLECTIVE INTELLIGENCE:

The five layers that constitute the collective Intelligence will be described in the following subsections.

1.Personal Intelligence: The Personal Intelligence layer deals with enabling users to both upload and access multimedia information submitted to the intelligent services using a range of devices, from mobile phones to PDA's and personal computers. Once multimedia content is submitted to the intelligent services, a series of processing and analysis procedures take place in order to exploit, share and reuse the extracted knowledge. Users and context modeling paradigms will be employed to enable personalized access to the content and knowledge available from the proposed applications. Applications and services based on collective intelligence would be expected to have reached their peak of usage by 2015.

Fig.3 Personal Intelligence

2. Media Intelligence: The first and main step towards efficient "Media Intelligence" deals with automated analysis and semantics extraction from raw visual, textual or audio content and associated metadata. Analysis focuses on each modality in isolation and without taking into account any contextual information or the social environment. However, it does take into account prior knowledge, either implicit, in the form of supervised learning from training data, or explicit, in the form of knowledge driven approaches.

Extracting knowledge from raw data forms a huge research problem on its own so work in this field is expected to advance current existing state-of-the-art techniques for each modality, while a significant effort will be devoted on

- Adapting to the individual domains of interest and intelligence methodologies,
- Handling heterogeneity of unstructured user-contributed resources and
- Supporting interoperability with contextual information.

Three main processes are proposed, text analysis, visual information analysis and speech analysis.

In text analysis process, textual information is of fundamental importance in every scenario where humans are involved. They are used to pass information explicitly to other people. Textual information is pervasive and – with the coming into existence of the Web - its availability is increasing. Intelligent techniques are required to enable automatic Information Extraction (IE) from text and make this information available for further processing.

Visual information, that is, still images and especially video, tend to impose huge requirements on current repositories or social networks in terms of storage or transmission due to the size of the data involved, yet its contribution to the knowledge and intelligence of related applications remains insignificant. Research in disciplines like image processing, pattern recognition and computer vision has been ongoing for decades but satisfactory performance can usually only be achieved in constrained domains, scales and environments.

Speech is a natural, pervasive and efficient means for communication among people. Therefore, it is the privileged modality in many situations where safety and convenience issues require hands- and eyes-free interaction with computers or ask for a direct access to information (no menu navigation, no typing). Its ubiquitous and easy-to-use character makes also speech the primary communication channel in emergency scenarios.

3. Mass Intelligence: Masses of users contribute their knowledge to communities in the Web 2.0. They organize and share media such as images on Flickr, videos on YouTube, bookmarks on Delicious, personal opinions, and others. Within such systems, the users can provide feedback by valuating the content provided and conduct assessments. This can be done, e.g., by participating in discussions and answering questions in a community portal.

Thus, Mass Intelligence combines the information from mass user feedback in order to extract patterns and trends that cannot be extracted by single content items. Facts and trends will be recognized and modeled by interpreting user feedback on a large scale. The key research challenge of Mass Intelligence is the questions whether this mass of users can give new insights that would not be possible by considering the individual.

4. Social Intelligence: Social intelligence results from the monitoring, analysis, recognition, and understanding of the needs and capabilities of individuals and communities from their information usage and communication interaction patterns. Social intelligence delivers social information which may be used to improve other processes. At its simplest, social intelligence can be seen as a social markup process on actors and communication acts which provides social information as part of the pragmatic dimension of communication. For instance, consider the recognition of "hubs" in emergency situations such as during a hurricane. Providing these well-connected individuals with critical information will reach a broad set of people rapidly with minimal communication requirements, because the hubs are the individuals that spread messages most effectively. Or, consider the identification of authorities. In media intelligence or mass intelligence, content of these users should receive more emphasis and attention.

Watzlawicks's communication model serves as the base for deriving the social intelligence layer. Social intelligence consists of three interconnected layers, namely the content layer of communication messages, the meta-layer of communication messages, and the structural information layer derived from social interaction which represents the state of the communication process in a community.

Analysis at the meta-communication layer needs a strong link to mediaintelligence: For example, digital audio streams coming to a emergency callcenter may be analyzed for emotions. Recognizing emotions may help in evaluating the urgency of the situation. In another setting, pictures about holiday resorts may be classified according to their emotional appeal. The exact wording of messages contains hints on the social background of the sender, so does the pronounciation of speech.

5. Organizational Intelligence: In contrast to Personal Intelligence, the Organizational Intelligence deals with the sharing of knowledge between the individual members of an organization. As a consequence, the role of Organizational Intelligence is to bring the right piece of knowledge at the right time to the right person of the organization in order to support decision making. This knowledge is not necessarily produced by individuals, but rather by the interaction with Personal, Media, Mass, and Social Intelligence. The persons addressed with Organizational Intelligence can be either within the organization or member of an external organization. Traits of professional organizations such as enterprises and governmental agencies are strong and often legally enforceable rules and boundaries. The associations of persons to the organization or parts of the organization are typically clearly defined such as a person being member of the R&D department, human resources, etc. In addition, also the role is typically known like head of group or silver command in emergency response. In contrast, non-professional organizations are only loosely coupled. The association of persons to the non-professional organization can be fuzzy such as being member of a neighborhood community or a group of friends. In addition, the roles may not be clearly defined in non-professional organizations. For example, for a group of friends that is planning and spending a weekend trip to a foreign city it is typically not

clear or even defined who takes the organizer, leader etc., role in the group.

The goal of Organizational Intelligence is to best support the professional as well non-professional organizations in carrying out its tasks and achieving its goals. To this end, we need to know the actors involved in the organization and how they are organized. We aim at modeling and managing the information flows and decision processes within the organizations. Here, we need to understand the decisions that are to be made, processes to be carried out, and which tasks are to accomplish to reach the goals.

Fig.4 Layers of Collective Intelligence.

VII. COLLECTIVE INTELLIGENCE AT DIFFERENT LEVELS OF SOCIETY:

Given the central importance of collective intelligence, let us take a closer look at this phenomenon. The following examples show how collective intelligence might be applied at a variety of levels: in groups, organizations and communities.

1. Groups: An individual IQ test compares individuals' problem-solving skills with the problem-solving capabilities of others their age. In a similar manner, we could demonstrate the existence of group intelligence by comparing how well various groups solve problems.

In a classic experiment, group intelligence was measured by presenting small groups of executives with a hypothetical wilderness survival problem. All-female teams arrived at better solutions (as judged by wilderness experts) than all-male teams. The women's collective problem-solving capabilities were enhanced by their collaborative style, while the men's efforts to assert their own solutions led them to get in each other's way. Significantly, the resulting difference in collective intelligence did not occur because the individual women were smarter than the individual men, but rather because of a difference in gender-related group dynamics.

2. Organizations: Can whole organization exhibit intelligence? In November 1997, 750 forest service employees used a technique called Open Space Technology to create, in just three days, a shared vision of change, including action plans. The vision that this group generated covered all facets of forest service activity, and the employees were genuinely excited about implementing the action plans they themselves had developed. This one-time exercise had a lasting effect upon the larger system.

Several organizations and networks, such as the Society for Organizational Learning, research and promote the capacity for organizational intelligence by helping corporations build a culture of ongoing, high-quality dialogue that examines the whole-system dynamics in and around the organization. Just as group intelligence depends on things such as group process, organizational intelligence depends on organizational factors. These factors range from an organizational culture that promotes dialogue to organizational memory systems (files, records, databases, minutes, etc.). They include systems that collect and utilize feedback (learning inputs) from inside and outside the organization, as well as efforts to understand the feedback dynamics (cycles and interdependencies) that govern the organization as a living system. When such things are in place, an organization can create, accumulate and use understandings and solutions which become part of the organization itself knowledge that outlasts the tenure of individual employees and executives. In other words, the organization is learning, exercising its intelligence and applying it in life the same way an individual does.

3. Communities: What would community intelligence look like? Perhaps we see a budding example of it in Chattanooga, Tennessee, which in the early 1980s was reeling from local recession, deteriorating schools, and rising racial tensions. Several dozen citizens formed Chattanooga Venture, an on-going, cross-class, multi-racial organization that involved hundreds of people in an inclusive effort to set and achieve community goals. Of 34 specific city-wide goals set in 1984, 29 were completed by 1992, at which point Chattanooga Venture again convened hundreds of citizens to create new community goals. Among the goals realized through this process was the creation of Chattanooga's Neighborhood Network, which organized and linked up dozens of neighborhood associations to help people co-create a shared future right where they lived, enhancing their community intelligence even further. Chattanooga Venture provides a glimpse of the sort of ongoing collective intelligence we could build to solve problems, to learn together, and to generate a better life right at home.

There are many other inspiring examples of the effort to develop community intelligence. Many of these have been carried out using the approach of Asset Based Community Development (ABCD). This community organizing approach does not directly address a community's problems or treat citizens as clients in need of services from government and nonprofit agencies. Rather, it sees citizens as assets and as co-creators of their community.

ABCD organizers help citizens discover map and mobilize the assets that are hidden away in all the people who live in their community, as well as in the community's informal associations and formal institutions. Those resources, brought out of their isolation and into creative synergy with each other, are then used to realize the community's visions.

VIII. AN OPEN INNOVATION BUSINESS MODEL BASED ON COLLECTIVE INTELLIGENCE:

Fig.5 Collective Intelligence Business Model.

Open innovation and crowd sourcing can utilize the same business model, in that they both apply the collective intelligence system for innovation and problem solving.

The primary consideration pertains to the organization in which the business model is being implemented. When going outside the organization for input from others, it is necessary for managers of companies to make sure the internal organization understands the goals to collect knowledge of the crowd community. It is also just as important to attend to the internal knowledge, and include internal staff in the effort. Understanding the internal organization and identification of where there are gaps is critical when deploying an open innovation business model.

The second tenet addresses the market segmentation; which customer groups are being targeted and the makeup of each group. Value is determined through the customers' lens; therefore it is important to know which customer to target. The customer that is being targeted is the base for the community that will participate in the collective intelligence system. The market segment defines competitive scope and addresses the strategic question of where does the product compete?. Market segmentation focuses on the division of the markets customer base to create a competitive advantage. Understanding the market segmentation is critical to both the business model, and ultimately competitive advantage. By focusing on the specific customer base, the organizational teams will have a better understanding of the buyer needs and their purchasing behaviors and the differences between the segments. Noting the differences between segments also helps to define the value chain for a competitive advantage. For example, the affluence of the community may require special services that cost more, but also provide greater value for that segment versus another. Market segments also have variables such as product variety, buyer type, channel, and geographic locations. Each variable impacts the breakdown of segments by creating the differentiating factors of the segment.

The third tenet requires that managers understand which parts of the value chain best support the delivery of the offering , and to reach differentiation in the open innovation business model over other business models. The value network connects the internal components of the value chain with the external components and is at the core of the business model. Connecting the components requires support from marketing, sales, support, and finance. Most importantly it requires an understanding of the customer and their needs. All of these factors lead to the development of a competitive advantage. Technology is connected to this principle, that understanding the role of technology in competitive advantage is the value chain. A firm, as a collection of activities, is a collection of technologies. This concept does not ignore the importance of process, but rather it focuses on the importance of technology as the supporting element in the value chain. Technology supports every aspect of the value chain from primary activities to support activities. Knowing where technology supports these activities in the value chain is important, as the CI system requires technology to connect with the community and harvest the information it produces bridging the internal and external knowledge.

The fourth tenet is revenue generation where the primary focus is on the cost structure and the margins associated to a product of service. Managers should ask questions such as how much will a customer pay?; How much will the product or service cost to create?; and How is value created and delivered?. There are several things to consider when looking at cost structure and margins, including (a) price, (b) costs, and (c) margins, which drive

the value proposition. Understanding the cost structure is important in the open innovation business model as it also drives sustainability.

The final tenet in the open innovation business model is competitive strategy. Competitive strategy focuses on creating differentiating factors in the value chain in ways that make them difficult for competitors to replicate. This requires internal focus on key processes and the use of resources to support and sustain the business model.

IX. ROLE OF COLLECTIVE INTELLIGENCE IN AN ORGANIZATION:

The goal of this study is to provide executive leadership and their teams with information about how to use collective intelligence, specifically crowd sourcing and open innovation, to support innovation as a way to create a competitive advantage. The final outcome of the study is presented in the form of a set of five recommendations for how these two types of external knowledge should be implemented to support innovation.

Role 1: Focus on creating an innovative organizational culture, in which experimentation and failure are supported and encouraged.

Role 2: Create a collective intelligence (CI) system by answering the four primary questions: Who is performing the task? Why are they doing it? What is being accomplished? How is it being done?

Role 3: Focus on the utilization of an open innovation business model by developing a plan for and defining the primary tenets of the model, to include (a) value proposition, (b) market segmentation, (c) value chain, (d) revenue generation, and (e) competitive strategy.

Role 4: Map out the four types of innovation: 1) Neutral, 2) Positive, 3) Negative, and 4) Open. An organization should operate in all 4 quadrants, but for market leadership open innovation is the most critical.

Role 5: Understand how the CI system can be deployed into the value chain where internal and external knowledge is leveraged. Define how the CI system will integrate with the current value chain and which parts exist to support the system and which elements need to be developed.

X. ADVANCEMENT OF COLLECTIVE INTELLIGENCE:

While people have talked about collective intelligence for decades, new communication technologies especially the Internet now allow huge numbers of people all over the planet to work together in new ways. The recent successes of systems like Google and Wikipedia suggest that the time is now ripe for many more such systems, and the goal of the MIT Center for Collective Intelligence (CCI) is to understand how to take advantage of these possibilities.

XI. CCI RESEARCH PROJECTS:

1. Climate CoLab: Using new collaboration tools, to harness the collective intelligence of large numbers of people to address the problem of global climate change.

2. Collective Prediction: To combine human and machine intelligence in flexible new ways to make accurate predictions about future events such as product sales, political events, and outcomes of medical treatments.

3. Deliberatorium: This is exploring how to integrate ideas from argumentation theory and social computing to help large numbers of people enumerate the issues, ideas, and tradeoffs for complex problems with much greater signal-to-noise and much more systematic organization than existing (e.g. forum, wiki, or idea-sharing) technologies.

4. Nonlinear Negotiation: This project is investigating ways to help large numbers of individuals come to agreements about complex problems with many interdependent issues.

5. Enabling Knowledge Management: This project explores how emerging media technologies, including social computing and virtual reality can enable new more powerful modes of knowledge management.

CONCLUSIONS & FURTHER ENHANCEMENT:

1. Collective intelligence is defined as the ability of a group to solve more problems than its individual members.
2. The idea brings that a group of people can solve problems efficiently and offer greater insight and a better answer than any one individual could provide.
3. The applications of Collective Intelligence enhance an innovative business model for an enterprise.
4. Role of Collective Intelligence in an enterprise brings effectiveness.
5. Further work will be carried out towards the Collective Prediction and Nonlinear Negotiation.

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