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evKnowledge

The "Pico – Knowledge Dynamics" Project

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The "Pico" Project

The Pico – Knowledge Dynamics Project promotes research into the study, analysis, and management of the evolutionary dynamics of knowledge systems, through a highly innovative approach. The initiative, which originates within the evTek – Evolutionary Technologies research area, as part of the Evolutionary Knowledge Project – evKnowledge, is aimed at developing innovative methodologies and

tools for the creation, organization, and exchange of knowledge, through the application of the fundamental principles of evolutionary research.

In this historical moment, characterized by growing interest in digital technologies, the spread of the web, and the creation of high-tech products and services—such as robotics and artificial intelligence—the Pico Project is especially focused on developing an original conceptual approach and new methodological and digital tools oriented toward the analysis and management of knowledge in all its forms: extended-sense knowledge management.

Among the most significant research areas are the Process of Metareality Formation and the Theory of Operators. An optimized program is currently being developed for the implementation of web platforms strongly oriented toward Knowledge Management and the creation and management of adaptive semantic search engines. These engines, through user behavior analysis, are capable of evolving toward increasingly high levels of performance in terms of semantic relevance of the results provided. New techniques and tools are being studied for the assisted creation of semantic maps of large document archives, enabling rapid and efficient organization of knowledge bases that are easily accessible even to users who are not particularly tech-savvy or experienced.

Knowledge Dynamics

Knowledge Dynamics is the discipline that studies the evolutionary dynamics of knowledge through a strongly innovative approach, resulting from research conducted within the framework of Evolutionary Knowledge, and in particular within the “Evolutionary Physics” research area. Much of the theoretical framework and analytical methodologies developed in the field of evolutionary physics are extended to the domain of Knowledge Management, with particular reference to the Process of Reality Formation and the Theory of Reality Operators.

Knowledge, in the broadest sense imaginable, encompasses the product of all evolutionary exploration of Reality carried out by living beings in their constant search for gradients through which to extract Information in its infinite forms: energy, nourishment, opportunities for reproduction, communication, well-being, pleasure. Every living form—from the most elementary to the most complex, from simple ecosystems to entire societies—acquires, processes, and expels Information in countless forms and at multiple levels of complexity.

Within the framework of Evolutionary Knowledge, Information is defined as the set of relationships that organize the parts of a system, from the most elementary level of the infinitely small to the most complex living forms, and up to the most evolved cognitive functions and systems.

Knowledge is part of universal Reality, which consists of the process of manifestation of Force—the fundamental causal entity that continuously gives rise to the Whole, the infinite evolving Universe. In a universal sense, Knowledge constitutes the essence of that process which, in terms of Evolutionary Physics and Metaphysics, is defined as Metareality.

As part of this universal Reality, Metareality is itself an evolutionary process, governed by the same fundamental functional principles that regulate the existence and evolution of the material Universe. In the immaterial world of Knowledge—so complex and articulated—these principles are expressed in ways that are less deterministic than the strict natural laws observed in the phenomenal world of matter.

With the emergence of life, the cognitive process we call Metareality began. Physical Reality and Metareality, as complementary aspects of universal Reality, co-evolve, co-constructing Reality itself.

The dynamics of Metareality—the discipline that studies the evolutionary dynamics of Knowledge—is based on a fully constructivist approach. In this sense, and with regard to the human dimension, the dynamics of Metareality encompass and integrate cognitive psychology and, more broadly, all cognitive sciences grounded in an evolutionary constructivist approach.

Metareality consists of the world of “representations”—cognitive models of entities and phenomena of Reality that living beings continuously construct through their interaction with the world. Perceptions, sensations, emotions, dreams, thoughts, concepts, meanings, and so on. Metareal forms are immaterial structures and forms produced by “finalistic” agents—living beings or synthetic agents (e.g., software programs). Here, we are far removed from the immaterial forms that populate spiritualist theories, dreamlike fantasies, or archaic and superstitious visions of reality. These picturesque forms are indeed part of Metareality; they are real forms, but “only” as ideas, concepts, fantasies, dreams—in short, representations of an aspect of reality we generally define as fantastical.

For their existence, the forms that populate Metareality require a material substrate that serves as both source and destination. Thoughts, for example, originate from the sentient apparatuses of finalistic agents (the nervous systems of higher living organisms) and can be used, processed, and exchanged—even after having lived an apparently independent life—embedded in the pages of a book, in the electromagnetic waves of a television broadcast, in the acoustic vibrations of a barking dog or the voice of a child calling their mother.

The Universe—the global and unified manifestation of Reality—is Information that gives form to Elementary Action: chaos seeking organization. High-level Information, created, metabolized, and exchanged by living beings in their more or less complex lives, represents the structure and formal content of this part of global Reality that we call Metareality. For analytical and explanatory convenience, we treat it separately, even though—as previously mentioned—the fundamental principles governing its dynamics are identical. These principles, while coinciding, express and co-evolve differently in the Field of Semantic Action (the substrate of Metareality) than they do in Reality (objective, factual, physical—what term should we use?), giving rise to different laws and behaviors.

We are in the realm of cognitive sciences, where animated matter finds the immaterial dimension of feeling, thinking, and the purpose of meaning.

The transition from measuring real facts—with its immense load of “data” to be processed—to the analysis of natural and human phenomena—with its abundant supply of “information” to be exchanged, organized, archived, and reused—and further to the more complex process of seeking meaning and purpose, which characterizes cognitive processes from the most elementary to the most complex, represents a fundamental element in the long evolutionary journey of living beings, who continually experiment with new and more complex adaptive solutions for the survival and development of individuals and species.

Knowledge Analytics

Research, knowledge system management, and the development of increasingly sophisticated tools require refined instruments and elaborate analytical methodologies.

The theoretical and methodological background that serves as a foundation for developing specific techniques is broad and varied. Among the most interesting and useful areas for a global approach to the analysis of knowledge systems are: the study of complex systems, techniques for analyzing and measuring network topology (especially those developed for analyzing the topology of the web and

scientific citation networks), genetic programming, and many of the techniques developed within the field of artificial intelligence.

This entire set of methodologies, tools, and analytical techniques must be integrated and adapted to the distinctly evolutionary approach that characterizes the Pico – Knowledge Dynamics project, and more generally, all research conducted within the Evolutionary Knowledge framework, in order to be truly effective and useful for knowledge research and management.

The most interesting aspects to analyze concern the nature, properties, and dynamics of the main components of knowledge systems: the topology, causal structure, and dynamics of semantic networks composed of concepts (entities/nodes) and relationships (links); the structure of concepts and ontologies; the structure of relationships and their evolution over time and space; matrices of relational modality and intensity; applications that associate real entities with metareal entities; transformations and correspondence matrices that enable comparative analysis of knowledge systems; the analysis of correlations between ontologies; and so on.

The primary purpose of analysis lies in the need to understand the fundamental characteristics of the knowledge systems one intends to intervene on—whether they are small-scale normative or operational bases within small organizations, or vast cultural systems requiring the development of complex intervention strategies (e.g., strategies for raising the average cultural level of a country).

Among the fundamental goals is the need to develop a solid theoretical framework that enables a deeper understanding of knowledge systems—a line of research that has grown in recent decades but had previously not received the attention it deserved, despite being, quite evidently, one of the central pillars of scientific inquiry.

Furthermore, there is a need to study traditional knowledge systems to uncover previously unknown aspects, to understand the dynamics that led to their formation, their properties, and peculiarities. This is a fundamental starting point for serious comparative analysis, allowing us to grasp the common underlying aspects of the development of all human cultures.

Finally, we cannot overlook the crucial contribution of Knowledge Analytics to the development of more effective Knowledge Management methodologies and to the design and implementation of more powerful tools needed to support both analysis and management activities.

Knowledge Management

Knowledge Management is a new area of management aimed at achieving superior performance within productive and social organizations through the synergy of people, processes, and technologies. Change, uncertainty, and complexity are now the key words in the field of management. The domain where Knowledge Management is most actively developing is that of productive organizations, although growing interest is emerging in socially oriented applications.

As the complexity of both the external and internal environment of enterprises increases, Information Technology Management is no longer sufficient to solve the growing internal problems of adaptation and growth, nor to provide effective tools to face the challenges imposed by market evolution. In the transition from previous scarcity to the current state of cognitive saturation due to information overload, the need to make knowledge explicit, organized, presented, and exchanged efficiently and effectively becomes increasingly evident—so as to adequately support both production and decision-making processes.

In this new context, characterized by growing uncertainty and complexity in economic and productive systems, dynamically evolving performance—enabled by the use of “intelligent” methodologies and technologies—are the key factors for strategically leveraging opportunities and facing market challenges.

The “weapons” available to Knowledge Management have gradually expanded thanks to technological advancement and the growing sensitivity toward these issues, which has emerged in leading sectors of the economy and, more broadly, throughout society. Vast and complex document archiving systems, entire libraries available online, increasingly efficient search engines, social networks, creative collaboration tools, forums, wikis, and so on, are now available for uses that go far beyond their original purposes, serving the knowledge management needs of companies and, more generally, all modern organizations. These tools, increasingly affordable and easy to implement, can now be effectively developed and used even by medium-sized and small organizations that previously could not afford the significant investments required.

In summary—and with great simplification—the knowledge management process can be broken down into several fundamental phases:

- **Analysis phase:** to understand the internal and external environment in which the organization operates, the starting situation to be addressed, the nature, properties, distribution, and use of the knowledge present within the organization or its parts.
- **Goal formulation phase:** to identify general and specific objectives and carefully plan what is needed to achieve them.
- **Tacit knowledge elicitation phase:** concerning the processes that allow the emergence of knowledge residing in experience and know-how, both at the individual and group level, and its transformation into a shareable, exchangeable asset that can be embedded in a physical or electronic medium—in the knowledge base.
- **Organization phase:** the activity of collecting explicit knowledge and the tacit knowledge that has already been made explicit often results in a shapeless, chaotic set that requires careful organization to constitute the core nucleus for launching the knowledge system.

Knowledge Tools

This section presents the principles and examples of tools developed for the research, analysis, and management of knowledge. These include tools for building knowledge bases, knowledge-oriented websites, adaptive search engines, semantic network constructors, cognitive engines for extracting and organizing knowledge, expert systems, dynamic dashboards, and more.

The development of these tools is guided by the theoretical and methodological framework of Evolutionary Knowledge and is aimed at supporting the creation, organization, and dissemination of knowledge in increasingly efficient and accessible ways.

These tools are designed to operate within complex environments and to support both individual and collective cognitive processes. They enable the construction of semantic structures, the management of knowledge flows, and the implementation of intelligent systems capable of adapting to user behavior and evolving over time.

The tools also facilitate the integration of knowledge from diverse sources, the creation of semantic maps, and the development of systems for visualizing and navigating complex knowledge domains.

Their application spans various fields, including education, research, business, and public administration, contributing to the enhancement of organizational intelligence and decision-making capabilities.

Semantic Web Applications

The development of the Semantic Web provides fundamental tools, methodologies, and languages for building applications strongly oriented toward the management and exchange of knowledge. These applications are capable, among other things, of constructing distributed semantic networks and automatic reasoners for the retrieval and processing of information and knowledge present on the web, within intranets, or in complex and structured document bases.

Such applications will constitute the essential building blocks for the development of “artificial semantic support systems” capable, in general, of improving access to knowledge and, in particular, of drastically increasing productivity within economic organizations and among personnel engaged in all business activities.

Semantic Maps

Within the context of Knowledge Tools, particular importance is given to Semantic Maps. Just like any physical territory, knowledge can be represented through an explorable map that allows simple, visual, and organic access to the resources available in the underlying knowledge base.

Specifications and development guidelines are currently being defined for systems that enable the visualization and navigation of bi- and tri-dimensional semantic maps.

Theoretical Framework

The project activities outlined above are developed within the theoretical framework of the Evolutionary Knowledge research area. Evolutionary Physics and Metaphysics constitute the methodological and descriptive reference framework, as well as the interpretive model of Reality, within which the distinctly evolutionary approach to knowledge management proposed here takes shape and meaning.

Knowledge is viewed as a dynamic structure in evolution—Metareality—the set of representations of Reality that allow living beings to live and co-evolve in a changing environment. Cognitive adaptation is thus an integral part and driver of physical-biological adaptation.

Evolutionary Metaphysics

The continuous creation and evolution of Metareality—the domain in which the cognitive activity of living beings constantly evolves—is the result of a co-evolutionary process of constructing semantic networks. These networks are created through the interaction of conservative structures (resulting from the activity of constructing the ontological representation of Reality) and dynamic structures (emerging from the activity of constructing the phenomenological representation).

Within the complex cognitive activity of human beings, we refer to these conservative and dynamic structures respectively as “concepts” and “associations.”

The Process of Metareality Formation

The continuous creation and evolution of Metareality—the domain in which the cognitive activity of living beings evolves—is the result of a co-evolutionary process of constructing semantic networks. These are created through the interaction of conservative structures (resulting from the activity of building the ontological representation of Reality) and dynamic structures (emerging from the activity of building the phenomenological representation).

Within the complex cognitive activity of human beings, we refer to these conservative and dynamic structures respectively as “concepts” and “associations.”

Agents and Operators of Metareality

The Process of Metareality Formation is governed by the same principles and produced by the same functional Operators that act within the global and unified Reality, of which Metareality represents a particular aspect—just like physical Reality. These are two different ways of viewing Unity, the Universe. The modes of expression vary, but the nature and functions of the Agents involved are the same.

Reality Agents are centers of causal action that perform the fundamental functions of the Formation Process. Among these Agents, at the most elementary and least complex level, we find operational Agents or Operators of Metareality. At increasing levels of complexity, we encounter quantum Agents, deterministic Agents, and finalistic Agents (artificial sentient agents created by humans—such as computer programs—capable of constructing even a rudimentary representation of Reality and making decisions and acting with purpose).

Ontology of Metareality

This is the set of semantic entities that form the foundations of Metareality’s existence. These are the building blocks that allow natural and artificial sentient beings to construct representations of Reality. It includes the definition and classification of these fundamental entities. Among the most important elements are the core structures of sentient apparatuses, the principles and constructs of logic, and the types of fundamental concepts.

Phenomenology of Metareality

This is the set of semantic relationships that form the foundations of Metareality’s essence. These are the connections that allow natural and artificial sentient beings to make semantic entities interact in the construction of representations of Reality. Phenomenology includes the definition and classification of these fundamental relationships and the types of links that bind semantic entities into increasingly complex structures.

Among the most important elements are the functional connections in sentient apparatuses, relational operators in logic, and organizational schemes that guide the construction of semantic networks.

Semantic Networks

Associations link concepts into dynamic cognitive networks in constant evolutionary adaptation. These networks allow finalistic agents to continuously “measure” Reality, grasping its features and ongoing variations with varying degrees of accuracy.

Concepts and associations organize into semantic networks capable of cooperating and competing with other networks for causal permanence within the meta-real dimension. Through their action in physical Reality, they contribute to the permanence and evolutionary adaptation of the finalistic agents of which they constitute the cognitive dimension.

Systems of Knowledge

Systems of Knowledge are organized, dynamic, and conservative sets of semantic networks—networks of networks—that enable finalistic Agents and living beings to explore Reality evolutionarily and to fulfill the purpose they carry as living entities. This occurs through more or less complex interactions with the environment, aimed at ensuring increasing levels of causal permanence for themselves, their offspring, their species, and sometimes their environment.

Systems of Knowledge thus express the representational schemes of Reality that allow for evolutionary interaction with the world—whether through simple measurements of energy gradients, more articulated recognition schemes (self–other, friend–foe, food–poison), or complex patterns of social, economic, and cultural interaction.

The Evolutionary System of Knowledge

Evolutionary Knowledge represents a global approach to observing the natural and human world, based on a comprehensive extension of evolutionary theory and a critical re-examination of constructivist thought. It is knowledge of Reality and its manifestation—the evolving Universe.

According to this approach, Knowledge must be considered a discipline that is doubly evolutionary: in its object and in its nature. The object is the Universe, Reality in evolution, characterized by its fundamental trait of incessant mutation. Its nature is intrinsically evolutionary, since Knowledge consists of an infinite process of construction in which ideas, models, and representations of the world cooperate and compete to create an increasingly accurate vision of a constantly transforming Reality.

Knowledge itself, therefore, can only be in continuous evolution—toward ever deeper levels of understanding and ever more complex descriptions.

Evolutionary Ontology and Phenomenology

Evolutionary Ontology represents the description of the set of entities that constitute the foundations of the existence of Reality, understood globally as “The Evolving Whole.” For descriptive purposes, we can classify this Reality into: Physical Reality, Metareality (the dimension of cognitive processes), and Meta-Metareality (the metacognitive dimension).

Evolutionary entities—physical, metaphysical, and meta-metaphysical—together represent the fundamental principles, the Agents of Reality and their operational functions, the building blocks that enable the formation of Reality.

Evolutionary Phenomenology represents the description of the types and dynamics of the relationships that constitute the foundations of the essence of Reality. These are the connections that allow the Agents or Operators of Reality to express the processes of constructing conservative and dynamic structures, which form the essence of the Process of Reality Formation. It is an endless cycle that makes the universal network of events increasingly complex and interconnected.

Evolutionary Knowledge Base

The Evolutionary Knowledge Base project aims to create an online resource capable of collecting and organizing the extensive material produced by the author within the Evolutionary Knowledge research area, which includes, in particular, Evolutionary Physics and Metaphysics.

The construction of the knowledge base is supported by the development of a semantic network capable of gathering the main concepts, bibliographic references, and supporting documentation, and of facilitating access to a complex and articulated subject matter.

Beyond Knowledge Management

A focus on future developments, in light of the significant results that are progressively emerging due to the growing attention toward research in the field of evolutionary dynamics of knowledge systems.

The development of increasingly advanced methodologies and tools for the creation, management, and sharing of knowledge—lowering the barriers that limit access—can decisively contribute to a general intensification of human creative expression.

References

Information about the author and research activities

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