Chapter 2
The Non-standard Approach to the Theory of Information: Reflections on Definition and Measurement of Information

2.1 Reflections on Points of Entry and Departure

The mathematical theory of communication and semantic theory of information have been reflected on. Any one of them, while discussing an aspect of information, cannot constitute an approach to a complete theory of information. The two together still lack the elements that will create completeness of the information theory. There seem to be conceptual and logical difficulties in both approaches that place limitations on their applicable domain especially when the process of knowledge production is contemplated between the ontological and epistemic spaces. At the level of epistemology, the analytical interest of the mathematical theory of communication centers on the problems of measurement and transmission of some undefined concept of information and the rate of transmission which are related to events, outcomes and objective probability. Similarly, at the level of epistemology, the analytical interest of the semantic theory of information centers on the problems of content and transmission of the content where the semantic attributes are used to define the concept of information and then measured with inductive probability.

The two approaches do not seem to offer a pathway that will allow an examination between the theory of information and the theory of knowledge. At the level of epistemology, how is information transmission related to the theory of knowing and then to the theory of learning? Is the measure of the content of the information related to the measure of degrees of learning and knowledge, and hence the growth of stock of knowledge? How do the mathematical theory of communication and the semantic theory of communication provide channels of linkage between the epistemological space and the ontological space? It has been pointed out in Chapter 1 that the universe may be seen as composed of matter, energy and information in relational continuum and unity which is represented in Fig. 1.2. Matter, energy and information are essential components for universal existence. The interesting thing among these three categories of existence is that one of them constitutes the primary category of existence, and the other two constitute derived categories of universal
existence that provide foundation for theories of knowing and learning. In matter resides energy and information in an important logical continuum and unity that lead to an important epistemic question regarding the epistemic primacy of existence. Here, there is matter-energy polarity, where matter and energy are inseparably connected by information. This is the principle of universal connectivity between the matter pole and the energy pole in universal transformations within the global actual-potential polarity with neutrality of time no matter how it is constructed. Without the principle of universal connectivity, transformations are impossible and the universe will be in a complete static state. The actual pole is a family of categories of actual varieties while the potential pole is a family of categories of potential varieties. In other words, the universe is conceived as composing of varieties and family of categorial varieties. It is through this understanding that the studies of categories find epistemic meaning and utility.

At the level of epistemology related to the paths of informing, knowing, teaching and learning, information must be connected to methodological nominalism which gives rise to the universality of language development broadly defined over the epistemological space. It is this universality of information-language connectivity that allows encoding, symbolism, decoding and new vocabularies to be developed also over the epistemological space. Again, this principle of universality of information-language connectivity cannot be established with either the mathematical theory of communication or the semantic theory of information. In this respect, learning and knowing will be difficult or impossible which then will make the creation of storage-learning machines out of reach of engineering. What then is information that allows the establishment of the relevant principle of universal connectivity? This requires a global definition of information. The global definition of information must meet the requirements of all the relevant principles of universal connectivity among all ontological elements.

These universalities are spanned by the role of information as a connecter between matter and energy that provide the complex analytical framework and distinctions among important concepts, such as quality, quantity, statics, and dynamics. It must be kept in mind that every phenomenon is defined by qualitative and quantitative dispositions that must be captured under the use of methodological nominalism. While the general definition of information must be neutral to events, processes, states, channels of communication, measurement, semantic structure, modes of transmission, encoding, decoding, and content validity, as well as relevance of application as seen by ontological objects, it cannot be independent of qualitative and quantitative dispositions. Both quality and quantity are attributes of matter in different states of being such that for any qualitative appearance of matter, there is a supporting quantitative disposition of matter in dualistic existence with relational continuum and unity under conditions of categorial conversion of varieties and categorial varieties [R17.15, R17.16, R17.18]. In other words, the general definition of the concept of information must be neutral from decision-choice systems but must derive its structure from the dualistic existence of qualitative and quantitative dispositions of all phenomena. It is because of the search for a general definition of the concept of information that a non-standard approach to the theory
of information is being undertaken to provide a definition which will establish its phenomenon and content. The development of its analytical complexity is what is called a general theory of information. The general theory of information is made up of two parts. Part one is the theory of info-statics and part two is the theory of info-dynamics. This monograph is devoted to the development of the theory of info-statics that will make its subject content explicit. The development of the theory of info-dynamics will be undertaken in a separate volume which will also make its subject content explicit to show the differences and similarities.

2.1.1 The BIT-IT Problem as a Visitation of the Mind-Matter Problem

The mathematical theory of communication and the semantic theory of information are here classified as the classical theory of information. The analytical limitations and conceptual difficulties of this classical theory of information has been pointed out. These classical theories of information are other indirect attempts to approach the debate on the mind-matter problem where BIT is seen in terms of mind and IT is seen in terms of matter in the IT-BIT definitional process to the concept of information. Here, the mind is seen as some immaterial information that finds residence in the material brain which is seen as an information processor under some source-destination dualism with an excluded middle. The BIT in this respect is associated with the mind while the IT is associated with matter in a separable relation where the BIT dominates the IT. Is the mind not the result of critical and complex organization of matter? When the BIT in the mind and IT as matter are viewed in dualistic form, the emphasis is on the mind and hence on the BIT. That is to say, the information is a product of the mind and hence independent of, and fundamentally different from matter. If the mind is an immaterial information, then what is the concept of information? Is information a defined or an undefined phenomenon? Is information impinging on the mind from within the mind or impinging on the mind from outside the mind. The general definition of information must make clear whether the immaterial information is a perceptive reflection of ontological reality or the ontological reality is a derivative of immaterial information in which case it may be concluded that reality exists in the mind, which in this case, suggests that the mind constitutes the primary category of existence where, all other existence are its derivatives. Is this perceptive reflection not subjective and to what extent does it meet conditions of some degree of objectivity? It will become clear that the perceptive information has a continual limitation in all forms of capacity such as collection, retention and processing.

Corresponding to the BIT-IT or mind-matter problem is the question of what is reality and how is reality known. Does reality have qualitative and quantitative dispositions such that they mutually define their existence within the reality? It is this mutual existence that points to the establishment of the scientific area of the
study of measurements, where from quality, a quantity is derived in support of qualitative dispositions, and where, from the quantitative disposition, studies of mathematical spaces and algorithms become scientifically meaningful and useful. If information resides in the mind, how does one find a measure for its content at any relevant decision-choice point? If the universe is continuously creating new information by rearranging existing matter to create new forms, can one say that these new forms are mental reflections and not ontological, and that the claim of reality is valid because of the mind as the immaterial information in the brain, and hence these new forms are defined by some mental images? Just as matter and energy exist in continual transformation in the actual-potential polarity so also is the information as a connector, where a category of information types emerges to keep the connectivity at the level of ontology. Information is indestructible but under continual growth and accumulation to update the information stock which is nothing but accumulated history. This is the principle of information indestructibility that supports the notion that history is indestructible both at the levels of ontology and epistemology. It is this principle of information indestructibility that gives credibility to historical studies, anthropological studies, archeological studies, geomorphological studies and sub-fields that may arise in them such as cultural anthropology and others.

The whole science of environmental transitions, its impact on geomorphological formations and ontological transformation from antiquity to the present is motivated by the principle of indestructibility of information. Such information cannot meaningfully be claimed to reside in the mind neither can it be used to define the mind, where the mind is viewed as the immaterial information in the brain. By viewing the mind as an immaterial information, the information is not defined but is used to define the mind in that the mind is the information as seen in either a mind-matter or BIT-IT problem in defining the concept of information. If the mind is immaterial information, then how does it acquire the cognitive properties of informing, learning and knowing? There is one important thing that distinguishes information from both matter and energy, and that is information has the property of continual accumulation while matter and energy are infinitely closed under ontological transformations through rearrangements of existing characteristics of matter and energy. Without information, matter and energy are not defined and distinguished. However, without energy information communication is impossible.

2.1.2 The Conceptual Foundation on from IT-to-BIT-to-IT

In a search for a general definition of the concept of information before exploring the degree of its content, measurement, properties and uses, it becomes necessary to distinguish between the ontological space and its constituent elements, and the epistemological space and its constituent elements. The relational structure is such that there is a set of ontological elements which are the representation of the IT, and a set of epistemological elements obtained through the BIT-process which must be
considered in the search process. The \textit{IT} is defined in the ontological space by a natural process while the \textit{BIT} is defined in the epistemological space by some epistemic process. The ontological space with the ontological elements is taken as the \textit{primary category of existence} while the epistemological space with the epistemological elements constitutes the \textit{derived category of existence} obtained by an epistemic process from the ontological space. The epistemological space is non-existent without the ontological objects entering into active relations with other ontological objects to develop various degrees of knowledge and freedom \cite{R4.7, R4.10, R8.13, R8.16, R8.18, R8.45}. Given the conditions of existence of the ontological space, everything that is in the universal system takes place in the epistemological space through the activities of ontological agents and their acquaintances. The active relationships among the ontological objects are through their acquaintances which may be mutual or non-mutual. The question then is what acquaintances produce from the ontological objects to establish relationships. The acquainting processes generate elements that allow the multiplicity of relationships to be formed. The results of these source-destination connectors among the ontological objects will be broadly classified as information.

The information informs about a presence of objects which may be states, processes and diverse events in the environment of ontological existence. The actualization of these acquaintances takes place in the epistemological space and is recorded in cognition as an \textit{awareness} and subjective \textit{experiences}. What is the awareness and what is experienced? The acquaintance \textit{informs} about a presence or an existence of some ontological object which may or may not be translated into \textit{knowing}. For the ontological objects to inform about their presence they must have some informing attributes. It is the presence of these attributes that must constitute the foundation for defining the general concept of information that contains the phenomenon, qualitative-quantitative dispositions, measurement, properties and uses. On these bases, three questions tend to arise. What informs and who is informed? What is known and who knows it? What is the relational structure of the informing and the knowing processes? The degrees of acquaintance, awareness, informing and knowing provide entry and departure points into conceptualizing the nature of the epistemological space in terms of the nature of assumptions imposed in order to define the parametric structure of the epistemological space over which one is cognitively working. These assumptions will also affect the nature of epistemic activities and methods of learning and knowing as well as claims and verifications of knowledge.

The elements of both the ontological and epistemological spaces present awareness through their sending and receiving signals of their constituent properties that aggregately define their existence. The awareness of the ontological space may be defined by \textit{ontological signals} the collection of which helps to establish a definition of the ontological space through the characteristics of the ontological elements. Similarly, the epistemological space may be defined by \textit{epistemological signals} the collection of which helps to establish a definition of the epistemological space through the awareness of the ontological elements that are transformed into epistemological elements. The collection of ontological signals will constitute the
basis to define the ontological information. The collection of epistemological signals will constitute the basis to define the epistemological information. The information is thus a surrogate of signals received through the source-destination process. The ontological information is the primary category while the epistemological information is derived from the ontological information. The signals, and hence the information in both ontological and epistemological spaces connect the ontological objects and their epistemological derivatives. By logically dividing the concept of information into ontological and epistemological information and logically uniting them through the principle of relational structure of ontological objects, it is here stated and maintained that information is a property of matter without which information is not definable.

As presented, both the ontological and the epistemological spaces are information defined and connected. It is this information connectivity that give rise to methodological nominalism and the rise of a family of ordinary languages (FOL) creating communicational signals among human cognitive agents over the epistemological space. It also gives rise to the development of a family of abstract languages (FAL) in the epistemological space that may be used to create communication signals among human cognitive agents, among non-human agents such as machines and among cognitive agents and machines. It is through the FOL and FAL that learning and knowing take place. It is through this understanding that learning machines can be constructed in more complex situations. It is useful to keep in mind that both FOL and FAL are representations of the BIT-process and that the cognitive agents and non-cognitive agents are representation of the IT-process. There is no language and there is no BIT in the ontological space. The BIT-process is a property of the ontological space. The ontological information is perfect in terms of exactness and completeness. It is these properties of exactness and completeness of the ontological information that lead to the claim that there is no uncertainty, vagueness, risk or accident in the ontological space. In terms of ontological transformations, the ontological information is also the ontological knowledge in the natural decision-choices that drive the transformations and categorial conversions in the ontological space [R17.15, R17.16, R17.18]. The ontological information is natural, governed by ontological processes and independent of activities in the epistemological space. This does not mean that cognitive agents are independent of ontological processes. In fact, every activity of any ontological element affects the universal environment no matter how small the effect.

Things are different when one critically examines the epistemological space relative to the ontological space which provides identities of ontological varieties from which the identities of epistemological varieties are correctly or incorrectly derived. It is useful to note that corresponding to each ontological or epistemological identity is a defined variety. The epistemological space is a cognitive construct and the epistemological signals are reflections of acquaintances and conceived to constitute the epistemological information. The epistemological signals may pass through noisy channels to generate defective and deceptive epistemological information that will reduce the ability to generate completely worthy knowledge as input into the decision-choice system. The defective component of
the epistemological information is the result of quantity limitation of sender-
receiver signals from the ontological objects to create incomplete information
structures, as well as quality limitation of origin-destination signals from ontol-
ogical objects to create vague information structures [R21]. The assumptions of
information completeness and information vagueness will define the nature of the
epistemological space in which the cognitive agents operate to manage the com-
mands and controls of the decision-choice systems. One epistemic process is to
impose an exact epistemological space whether the information is complete or
incomplete irrespective of the definition of the concept of information imposed to
restrict the useful domain of analysis, thought and synthesis. The assumption of an
exact and complete information structure defines a perfect epistemological infor-
mation space where there is no uncertainty and risk. This space will be referred to
as the exact non-stochastic epistemological space [ENES].

The assumption of an exact and incomplete information structure creates a
limited epistemological information space where there are uncertainties and risks
generated by a quantity limitation of information. This space will be referred to as
the exact stochastic epistemological space [ESES] with quantitative uncertainty
and risk associated with thinking and the decision-choice system. The paradigm of
thought corresponding with the exact epistemological space is the classical para-
digm which is enhanced with probabilistic reasoning to deal with the limited
information component of exactness. The basic foundation of the classical para-
digm of thought is the absoluteness of existence of opposites in separable forms
without relational continua and unity. This is consistent with the concept of dualism
as it has been outlined in Chap. 1 and in [R4.7]. This way of thought development
in the created epistemological space rejects contradiction as a valid truth-value, and
where the existence of contradiction is used as method of verifying validity of
propositions and proof of theorems. This approach to the construction of the
epistemological space is to reject important limitations of cognitive agents. The case
of exact and complete information produces an epistemological space that is a
replica of the ontological space where information is not only perfect but is the
same as knowledge. The case of exact and incomplete information is an admission
of cognitive limitations through acquaintances, but a lack of admission of the
limitation in the FOL and the FAL in the epistemic representations where impre-
cision and vagueness are assumed away.

The other epistemic process in creating an epistemological space is to allow all
the limitations of cognitive agents to define the epistemological space where there is
no claim of absoluteness, where conflicts, imperfections, subjectivity and relativity
are the fundamental attributes of cognitive existence, and, where vagueness and
imprecision are also fundamental attributes of the creation of the FOL and the FAL
in all representations and communications. The fundamental attributes of vague-
ness, imprecisions, conflicts, non-absoluteness and relativity are the result of the
existence of opposites in a multiplicity of relations. This is the principle of oppo-
sites in relational continuum and unity that is generated by polarity and duality with
relational continuum and unity. The result of these attributes is the creation of an
inexact epistemological space whether the information is complete or incomplete.
The assumption of inexact and complete information structure defines an *imperfect qualitative epistemological information space* with uncertainties and risks due quality limitation. This will be referred to as the *fuzzy epistemological space* (FES) with *fuzzy uncertainty and risk*. The assumption of inexact and incomplete information structure defines *imperfect quantitative-qualitative epistemological information space* with both qualitative and quantitative uncertainties and risks. This will be referred to as the *fuzzy-stochastic* or the *stochastic-fuzzy epistemological space* with *fuzzy-stochastic risk* associated with thinking and the social decision-choice systems. The paradigm of thought that corresponds to the inexact epistemological space is the *fuzzy paradigm* which must be enhanced by probabilistic reasoning to deal with the limited information component of inexactness, as well as by possibilistic thinking to deal with components of contingencies and potentialities of the information and information processes.

The fuzzy-stochastic information that defines the fuzzy-stochastic space is further complicated by the possible presence of intentionality of *false information transmission* between sources and destinations of cognitive agents to affect the decision-choice outcomes in social set-ups. The false information that is intentionally transmitted is referred to as the *deceptive information structure*. This defective information structure is made up of two important components of *disinformation and misinformation sub-structures* which are semantic in nature. The deceptive information structure can be weaponized to change the efficiency and effectiveness of the management of the command and control structures of the decision-choice systems. It can also interrupt and change the encoding during the transmission and thus affect the decoding of the information at the destination. The presence of deceptive information introduces an important element of the subjective phenomenon that violates the requirement that DOS (Declarative objective semantic) information be truthful. The deceptive information structure may be used in all communications among cognitive agents over the epistemological space where advantage is sought in any duality and polarity. In this respect, the decoding process may be handled with the tools of the fuzzy paradigm and hence the condition of truthfulness must be dealt with in the fuzzy-non-stochastic space or fuzzy-stochastic space with fuzzy probabilistic reasoning [R4.8, R4.9, R4.13]. Further questions arise as to the relationship between objectivity and truthfulness.

Some important difficulties with knowledge production and the decision-making process arise from the fact that the concept of information is of a diverse nature even within the same specialized discipline. These are difficulties that arise from subjective perception of objective information as one traverses from the ontological space to the epistemological space via an epistemic vehicle. In fact, in the decision-making process, the objective information is not important as input. The most important thing is the subjective perceptive formation of acquaintance of objective information when the concept of information is defined and explicated. It is useful to refer to Fig. 1.2.2 where a complete distinction is made between *objective information* and *subjective information*. Subjective information is a phenomenon of the epistemological space while objective information is the
phenomenon of the ontological space. Both subjective and objective information structures have the attributes of \textit{qualitative and quantitative dispositions}.

The concept of information as defined in the epistemological space must relate subjectivity to qualitative and quantitative dispositions, where the objective attribute is restricted in the non-absolute domain in a fuzzy space. It is here that the \textit{family of fuzzy abstract languages} (FOFAL) with fuzzy paradigm of thought composed of its mathematics and logic becomes extremely useful in dealing with innovations in communications and the development of learning-thinking machines under the principle of self-correction in the framework of human learning-thinking systems. The relational linkage between human learning systems and non-human learning systems requires a search for a definition of a general concept of information explicated to fit specific analytical and decision-choice needs. The purpose of this search is to find a common concept of information from which specific sub-definitions may be abstracted with a family of communication and communication channels among diverse ontological objects.

\section*{2.2 Searching for Defining Factors of a General Structure and Definition of the Concept and Phenomenon of Information}

It has been pointed out in Chap. 1 of this monograph that the universe may be conceptualized as an integrated and inseparable system of matter, energy and information, where matter, energy and information mutually define their individual and collective existence. Matter exists as a collection of varieties and categorial varieties in relational continuum and unity; energy also exists as a collection of varieties and categorial varieties in relational continuum and unity; and similarly, information exists as a collection of varieties and categorial varieties in relational continuum and unity. The system is such that energy and information reside in matter where information is a special linkage between matter and energy. Different appearances of matter are forms of the same abstract matter that constitute the general concept of matter, where specific forms are derivable by methodologies of constructionism and reductionism, and where the general matter constitutes the \textit{primary category of existence} such that matter cannot be \textit{created} or \textit{destroyed} but merely be \textit{transformed} into different forms or varieties with identities. Different forms of the disposition of energy called varieties such as chemical, solar, atomic, electric and others are the same form of abstract energy that constitutes the general concept of energy, where specific forms of energy are derivable by methodologies of constructionism and reductionism, and where the general energy constitutes the \textit{primary category of energy} within the energy field such that energy cannot be destroyed or created but be transformed into different forms. However, energy is a \textit{derived category} of existence from matter where each variety of energy can be mapped onto a variety of matter. Similarly, different conceptual dispositions of
information are forms called varieties of the same abstract information that constitutes the general concept of information, where specific forms are continually being created by methodologies of nominalism, constructionism and reductionism, and where the general information constitutes the primary category of existence such that information cannot be destroyed but is under continual creation and accumulation. It is these properties of continual creation and accumulation of information that separate the phenomenon of information from the phenomena of matter and energy. Both matter and energy cannot be destroyed or created, but information also cannot be destroyed, however, unlike matter and energy, information is under continual creation and accumulation.

An important element of distinction may be noted about information relative to matter and energy. Matter and energy can neither be created nor destroyed but are under continual transformation under the principles of categorial conversion and Philosophical Consciencism of internal arrangements of elements in the universal system, [R17.15, R17.16, R17.18]. Information, however, is under continual creation, storage and accumulation. Thus, Information constitute stock and flow where there is neither stock or flow equilibrium but continual accumulation, while matter and energy are always in stock equilibria with continual internal dynamics and categorial arrangements. It is the definition of a general concept of information that is being sought. The common abstract forms of matter, energy and information constitute the ontological uniformity of existence. The conceptual diverse forms of matter, energy and information in the learning-knowing process constitute the epistemological diversity of existence that is the work of the epistemic process. The essential analytics of the ontological uniformity of existence is the provision of necessary and sufficient conditions for the development of the theory of categorial conversion of forms of matter and energy under methodological nominalism, constructionism and reductionism, where primary categories of varieties are identified and derived categories of varieties are explained leading to explanatory and prescriptive theories of existence of the ontological family of varieties and the family of categorial varieties at both the levels of info-statics and info-dynamics over the epistemological space. The methodological constructionism and reductionism allow the linkage of the corroborator-verification process between the primary forms and derived forms through the activities within the information-knowledge duality [R17.15, R17.20, R17.25, R17.35, R17.50].

The organicity of the universal existence is such that the primary category of existence is the basic matter from which different forms of matter arise through categorial conversion where the conversions are the results of complex interactive processes of energy and information. But what is information? The rise of different forms of matter from within creates a distribution of different varieties of matter which generates different energy distributions with supporting different distributions of information structures. The concept of information and the information structures must be defined in a manner that allows the establishment of relational continuum and unity of varieties of ontological existence which must then be translated into epistemological existence by an epistemic process. It is useful to keep in mind that ontological existence is the primary category of existence while
Epistemological existence is the derived category of existence. It is also useful to keep in mind that different forms of matter will not arise by categorial conversion without active interactions of energy and information that reside in the basic matter. It is from this basic matter that we shall pull out the definition of information and define epistemic paths of explications that are useful for specific needs of knowledge areas as they relate to ontological and epistemological decision-choice systems. The energy and information provide the categorial decision-choice processes for the internal qualitative transformation of one form of matter to another form.

How does one know the differences among types of matter and thus place distinctions for recognition? How can the periodic table be constructed and under what conditions? Under what set of conditions does one distinguish a female from a male, a tree from an animal, or gold from a diamond? Consider a message in a source-destination duality of the form where the source indicates that a package of gold has been sent to a specified destination. What set of conditions will establish the truthfulness of the overall content of the message in the source-destination duality? In other words, what is the set of conditions that allows distinctions and similarities to be placed on elements to create varieties? It is from the establishment of an appropriate set of conditions that a general definition of information must be constructed. It is also from this set of conditions that one must understand the concepts of information indestructability in the theory of info-statics and continual accumulation of information in the theory of info-dynamics. There are three complex distributions that are available for analytical work. Every existing form or disappeared form has an information tray of history. This has nothing to do with epistemological record keeping and is independent of individual cognition. However, it has something to do with ontological record keeping that offers a pathway to the beginning of times without which our scientific search for other forms of existence in the universe is meaningless and useless. The disappearance of the old does not lead to the disappearance of its information structure. However, the emergence of the new brings into being the supporting information structure that presents new conditions of its existence and the possibility of its disappearance through potential acquaintance. The old information is not destroyed and the new information is added on for a continual increased accumulation of the ontological history which is infinitely large and different from recorded and non-recorded epistemological history. It is also this indestructibility of information that defines the usefulness of research into the discovery of what there is and the motivation to find elements of the ontological identity which are hidden from immediate cognition, and places limitation on the human capacity to know, as well as defines the self-correction process of the knowledge-production system over the epistemological space.

Interestingly, it is the same information indestructibility that constitutes the essential motivation in the search for the origins of the universe, and possible existence of other life forms all through the Pharaonic times from ancient to the present. It is the continual accumulation of information that creates insurmountable difficulties and complexity, where illusions of knowledge arise in the possibility space and cognitive imagination in the possible-world space. The general definition
of information must be such as to incorporate these essential elements of universal existence in both the ontological and epistemological spaces. Like energy and matter, it must hold an element of uniformity and yet have a property of universal variety.

The search for a general definition of information seems to break down to a number of attributional levels of intentionality at the qualitative nature when involving humans and non-humans. At the level of humans, there is verbal and non-verbal representations and transmissions. The verbal representation and transmission component of the concept of information belongs to the FOL (family of ordinary languages), where the intelligibility and usefulness within the source-destination duality have semantic attributes, broadly defined, given a particular FOL, that affect the behavioral outcomes with the learning-knowing process and the resultant direction of the management of the commands and controls of the human decision-choice system. The non-verbal representation and transmission component of information belongs to the FAL (family of abstract languages), where the intelligibility and usefulness within the source-destination duality have important qualitative attributes that may or may not include semantic attributes which together affect the behavioral outcomes within the learning-knowing process and the direction of the management of commands and controls of human and non-human decision-choice systems. One thing that stands out clearly as a general definition of information is being sought is that information is active, and in fact the life-blood of all action in the universal existence. This life-blood contains the contents and conditions of transmission.

The general definition of information must capture all these qualitative attributes to ensure the qualitative disposition of information whose presence will affect the quantitative disposition of information and the type of measurement that may be constructed. The question that arises is what this general definition should be. To answer this question, one must find the solution from among all the conceivable concepts of information that engrain qualitative attributes which define the essential elements of the specific concept of information. This should include concepts of human and non-human information structures. To illustrate the problem that emerges from the question, let $D$ be a set of definitions of the concept of information, then $D = \{D_i|i \in I\}$ where $I$ is an index set of available and potential individual specific concepts of information. Every specific concept is defined by its qualitative disposition $\mathfrak{A}$ and quantitative disposition $\mathfrak{B}$ such that one can write a definitional function of the form $D_i = d_i(\mathfrak{A}_i,\mathfrak{B}_i, t)$ such that for any time period and quantity, the specific concept of information depends on the qualitative disposition. The set $D_i = d_i(\mathfrak{A}_i,\mathfrak{B}_i, t)$ must be aggregate to arrive at the general definition of the concept of information that encompasses all specific information concepts that are presently available and may be constructed in the future. This aggregation involves qualitative variables whose values are expressed in the fuzzy space in terms of degrees of importance in contributing to the definition [R4.13]. The degree of qualitative importance may be considered as a fuzzy number which may be specified as a fuzzy membership function of the form $\mu_{D_i}(d_i(\mathfrak{A}_i,\mathfrak{B}_i, t)) \in (0, 1)$. 
This membership function is increasing from the minimum of zero to the maximum of one.

From the viewpoint of principle of opposites, it is useful to design the degree of qualitative unimportance of the input of the definitional function of the form $B_i = d_i(\mathcal{U}_i|\mathcal{B}_i, t)$ with a corresponding membership function of the form $\mu_{B_i}(d_i(\mathcal{U}_i|\mathcal{B}_i, t)) \in (0, 1)$ that is decreasing from one to zero. The logic of reasoning is based on the principles of duality and polarity with continuum and unity where every input is both qualitatively and quantitatively defined in some relative disposition. The decision-choice action for each input into the construct of the general definition of information is such that the degree of qualitative effect is constrained by the degree of quantitative effect. The general definition of information requires the maximization of qualitative disposition subject to quantitative disposition of the defining variables. The problem is simply a fuzzy optimization problem at each point of time and for each input into the defining function of particular concepts of information. This problem may be stated as a fuzzy decision-choice problem in the form $\Delta_i = (D_i \cap B_i)$ and with a membership function that may be specified as:

$$\mu_{\Delta_i}(\cdot) = \left( [\mu_{B_i}(d_i(\mathcal{U}_i|\mathcal{B}_i, t))] \wedge [\mu_{D_i}(d_i(\mathcal{U}_i|\mathcal{B}_i, t))] \right) \in (0, 1) \tag{2.2.2.1}$$

The fuzzy optimization problem may then be defined in two sequential steps of

$$\mu_{\Delta_i}(\cdot)_{\text{opt}} = \left\{ \begin{array}{ll}
\max_{\mathcal{U}_i} & [\mu_{D_i}(d_i(\mathcal{U}_i|\mathcal{B}_i, t))] \\
\text{ST.} & \{ [\mu_{D_i}(d_i(\mathcal{U}_i|\mathcal{B}_i, t))] - [\mu_{B_i}(d_i(\mathcal{U}_i|\mathcal{B}_i, t))] \} \leq 0 \end{array} \right\} \tag{2.2.2.2}$$

It may be noted that the fuzzy optimization structure fit into an analytical duality with relational continuum and unity under the general principle of opposites in the sense that for every degree of qualitative importance, there is a degree of qualitative unimportance. One may conceptualize the problem-solution process in terms of cost-benefit analysis where every cost has a corresponding benefit that gives meaning to the whole decision-choice system and transformation-substitution process. The optimal solution to this qualitative importance problem may be used to form a fuzzy partition in order to form categories and varieties.

The underlying structure of the optimal definition problem of the defining factors of the phenomenon of information and the conceptual problem of the definition of information as represented by the Eq. (2.2.2.2) is a signal disposition that must be related to qualitative and quantitative dispositions of elements. This problem is part of all the epistemological problems of knowing which include the phenomenon of information. Any concept of knowing implies a distinction that involves a distribution of varieties that allows categories of varieties to be created in static and dynamic domains with neutrality of time. Such varieties will be shown to emerge from characteristics which present continual signals in universal existence. This approach to the phenomenon of information leads to a non-standard and general information theory. Here an argument is put forward that the concepts and
measurements of anticipation, uncertainty and surprise cannot be used to define information since such an approach involves circularity of reasoning that offers us no way out of critical cognition. Similarly, the concepts and measurements of possibility and probability offer us no way out in understanding the structure of the phenomenon of information and its definition.

To proceed in the development of non-standard information, it is useful to provide an epistemic reflection of the main ideas of the conceptual definition of standard information theory which involves the definition and structure of information. The theory of non-classical information that is being developed here has become necessary as the result of the problems encountered in all application to which the concept of information is used. The concepts of information and knowledge were introduced in Sect. 1.1 without explicit definitions. It seems that, in most theoretical and empirical works in exact and inexact sciences, information and knowledge acquire interchangeability without specifying the conditions of their substitutability. In this way knowledge is information and information is knowledge. The information-knowledge equality only holds over the ontological space in which case there is no uncertainty, ignorance, surprise and risk. It is useful to state what the concept of information is not by keeping in mind the process-path to knowledge discovery.

The first thing to keep in mind is the phenomenon that may lead to the naming and creation of a concept in terms of vocabulary within a particular language through the principle of acquaintance. The next step is to clean the concept from what it is not and set the framework for its definition and possible explication. Given the definition and explication, it becomes useful to examine the content of the concept (semantic containment, quality), where the content of the concept is subjected to conditions of measurement and unit of measurement (quantity). In general, one cannot meaningfully discuss the content of an unknown concept as well as measure the content of an unknown concept. This is the quality-quantity problem of all concepts in the general knowledge-production system when they are given definitions and explications for clarity, variety and distinction. The steps of the non-standard approach as distinguished from the standard approach in Fig. 1.1 may be presented in a cognitive geometry as in Fig. 2.1. It is useful to observe that in the establishment of the analytical process of the classical information structure and the theoretical development, the phenomenon of information is missing. In this respect, the classical theory of information deals substantially with the quantity side of information. Even the semantic approach to information is also guilty of this emphasis on quantitative disposition as it relates to subjective probability of false-truth acceptance of statements. The question that may be asked is: in what process can the concept of information incorporate both quality and quantity elements of the phenomenon of information in the classical approach and utilize the epistemic machine of the classical paradigm of thought? An important distinguishing factor of the non-classical approach to defining the concept and phenomenon of information is that information is accepted as a property of matter and
energy where the three exist in relational continuum and unity with matter constituting the primary category of existence and energy and information constituting the derived categories of existence.

2.3 The Theory of Knowing and Information Definition a the Non-standard Approach

The theory of knowing is directed to answer a class of fundamental questions. (1) What does the knower know and how well is this known (content)? (2) What is the motivation to know (curiosity and survival)? (3) What are the methods and
procedures of knowing (laws of thought, thinking and reasoning)? (4) How does the knower know he or she knows what is claimed to be known as well as convince others that something is known (verification, truthfulness and communication)? (5) What is the usefulness of what is known (the utility of the known)? This class of fundamental questions of the theory of knowing is different but intimately connected to the theory of learning which must answer a class of fundamental questions. (1) What does the learner learn (the content)? (2) What is the motivation to learn (curiosity and survival)? (3) What are the methods, techniques and processes of learning (methods and techniques)? (4) How does the learner know that he or she has learned the content of what is to be learned (content verification and assurance)? (5) How useful is that which has been learned (the utility of the learned). The theory of knowing is the foundation of all knowledge-production processes. The theory of learning is to ensure the continuity of the known. Both theories of knowing and learning are mutually connected. They both relate to information and knowledge. Information and knowledge are phenomena, while knowing, learning, deciding and choosing are non-communication and non-messaging processes involving content creation. Teaching, on the other hand, is a communication and messaging process involving content transmissions that are intimately connected in the information-knowledge space.

Every phenomenon is defined in quality-quantity space. However, it is always the case that a concept of a phenomenon may be introduced into the knowing and learning processes to capture its qualitative existence without a known process of measuring the qualitative content. Here, the semantic containment is of a qualitative nature defined in a penumbral region of clarity in the space of subjective disposition which relates to qualitative disposition. The phenomenon of information is unspecified in the classical information structure. Since the information phenomenon is unspecified one is not sure of the concept of information on which the classical information theories have been developed. From the general structure of the theory of knowing, the definition of the concept of information must not include the transmission, communication and measurement of its content. The information structures defined by using the concepts of transmission, semantics and communication and content measurements belong to a class that is here referred to as the classical information structure. In general, there are theories of information coding, transmission, communication, measurement and others which are simply sub-theories of the general theory of information which is intended to examine the phenomenon of information and information-production. It is not different from the theory of knowing which is intended to examine the phenomenon of knowledge and knowledge-production. The theories developed around the classical information structure using the classical paradigm of thought belong to a class which is, here, referred to as the classical information theory. The theories developed around the non-classical information structure using the non-classical paradigm of thought belong to a class which is, here, referred to as the non-classical information theory.

The definition of information, however, includes things that inform other elements in the universal space. The concept of information in the process of knowing
must be viewed from two interdependent components of characteristics of objects that express the morphology of ontological elements, and relationships among objects that express the structure and form of epistemological elements. The characteristics of objects are qualitatively defined to bring into view the categorial differences in the ontological space. On one hand, information constitutes the general set of the overall properties of objects, states and processes, and hence presents the set of identities of objects in addition to their behaviors as managed by internal command and control decisions at the state of ontology. This is the ontological information structure. On the other hand, information is a set of relationships among objects as they pass through states and processes by means of sender-recipient moduli which offer necessary and sufficient possible conditions for the management of commands and controls by socio-natural objects under continual transformations, and in particular by cognitive agents in the epistemological space. This is the epistemological information structure. The former is objective in the sense that it exists independently from the awareness of other ontological entities. These entities constitute the ontological identities which exist only in the ontological space. These identities provide ontological varieties. The collection of similar varieties constitutes a category in the ontological space. The ontological categories are an infinite family of categories in the universal system. The latter is subjective in that the relationships and their types that are formed require the awareness of other ontological entities. It is a set of signal transmissions with mutual give-and-take subjective activities which exist in the space of knowing to produce epistemological entities. The subjective information reveals derived elements as epistemological identities to the cognitive agents.

The revealed identities constitute derived epistemological elements which reside in epistemological space and constitute the set of epistemological varieties. The collection of the same revealed elemental identities constitutes epistemological categories as defined by qualitative signals. The epistemological categories are a finite family of derived categories in the space of knowing. Information is the connecting link between the ontological and epistemological spaces, and hence is defined in terms of objective-subjective duality as relationally viewed in term of characteristics and relationships that characterize the universal system of objects, states, processes and events. The universal system of objects, states, processes and events is established within the matter-energy polarity that exists in relational continuum with information as the connector.