Focus and Perspectivism in Viewing Information, Data, and Informing: Fundamental Distinctions

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Abstract

In the theory of knowledge, Nietzsche articulated the principle of perspectivism. Using a simplified example, this paper illustrates how changing the optical perspective dramatically changes the results of observations. In the age of information, we still are far away from a reasonable consensus in viewing information and informing. Callaos and Callaos (2002) tried to integrate the disparate views into a "systemic notion of information" based on the "distributive notion of truth," but it did not bring us closer to a more cohesive view for research and practice. Misplaced focus and ignored perspectives seem to be the root cause of failure. By placing the disparate views into a down-to-earth context of routine human-controlled operations and processes observed in nature, most of them can be clarified, explained, dispelled, or refuted. This paper articulates the most fundamental distinctions that should not be ignored when information is a significant factor that contributes to the success of operations.

Keywords: Perspectivism, focus, information, informing, disparate views, lack of consensus, quality assurance, and materiality of factors in form

Introduction

Many streams of research deal with information and informing. It is an interdisciplinary mix. Information and informing also are of a transdisciplinary nature. Scholarly studies of the subject, glossaries in MIS textbooks, and the terminology used by IT professionals reflect a heterogeneous collection of disparate views that are made from various, frequently not explicitly stated perspectives with a widely ranging focus. Callaos and Callaos (2002) tried to reconcile the disparate views without excluding any of them by resorting to the concept of distributive truth. Their conclusions failed to bring us closer to a cohesive view befitting the theory and practice in this domain. Why researchers investigating phenomena frequently find themselves in awkward positions may be illustrated by two metaphors:

- Plato's metaphor of a prisoner chained in a cave in such a way that anything that moves behind him can be seen only on the opposite wall as the shadows projected by the fire that lights the cave from behind (a very limited perspective), or
- The metaphor of a group of blind men investigating an elephant

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by touching it at different places and reporting what they perceive (a very limited scope and focus)

Whatever the selected perspective and focus are, they may limit the view of some aspects or reveal other aspects that otherwise cannot be seen. This paper

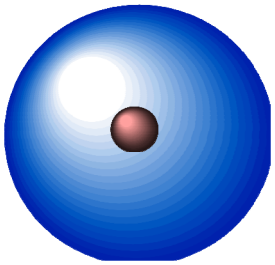
- presents a simple demo of optical perspective to illustrate the concept of perspectivism;
- provides an overview of many disparate views about information and informing within the context of routine operations and processes observed in nature;
- articulates the fundamental distinctions that cannot be ignored in operations without grave consequences and attempts to illustrate them by conceptual schemes, as suggested by Gill (2011); and
- shows how many of the existing controversies can be resolved by viewing information as physical patterns of factors in form in decision making for action and viewing informing as acquiring, processing, and spreading such patterns among resonating entities.

Introductory Demo of an Optical Perspective

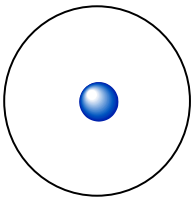
Perspectivism (2010) is a fundamental concept in research and analysis of objects and phenomena; however, it is frequently forgotten, ignored, and neglected. **Nietzsche's** (German philosopher 1844–1900) ("Friedrich Nietzsche," 2007; "Nietzsche, Genealogy, History," 2010) major contribution to the theory of knowledge can be summarized as follows:

> *Knowledge is always perspectival … knowledge from no point of view is as incoherent as a notion of seeing from no particular vantage point. The notion of all-inclusive perspective is as incoherent as the concept of seeing an object from every possible vantage point simultaneously.* ("Friedrich Nietzsche," 2007)

Even when one initially ignores dynamic changes, there are an infinite number of possible optical perspectives, such as the number of points on the surface of a sphere with the observed object in its center. Depending on the object (material or conceptual), from some viewpoints, one cannot see much, while from other points, as from a hilltop, one can see nearly everything. To discover the most fruitful perspective is an **insight**. There is only one chance in nearly infinity (*nearly zero*) of finding such a perspective. Endless confusions arise due to statements made from different perspectives without an explicit articulation of what their authors assume is the focus and the main points of reference. An example of this predicament is the domain of **information** and **informing**. Before going into this subject, an example of optical perspectives will be shown to demonstrate how deceptive human observations may be.



For the sake of simplicity, let us analyze the following. When the observed object happens to be a **point,** one literally sees nothing. A theoretical point is infinitely small. To be seen, it must be represented by a **small circle** in 2D space or a **small sphere** in 3D space. A cross section of two concentric spheres shows two concentric circles. The external circle is a set of geometric points that represent possible viewpoints in 2D space. From each viewpoint, you see the same object, a small circle or sphere of the same diameter. It is always seen the same way, independently of the selected viewpoint or perspective. Why? The discussed object is ideally uniform, an abstraction that **does not exist in reality**. Actual spheres in substance are imperfect approximations of theoretical spherical objects.



The situation changes dramatically when the object is not uniform. For instance, take a **segment of a straight line: _____** such as a segment of a thin wire. To be visible, it must be represented by a sequence of pixels (small discrete elements) but of finite dimension in contrast to geometrical points of zero dimensions. The sum of their diameters determines the length of the segment. For instance, a segment of 20 pixels in Figure 1 is shown in blue.

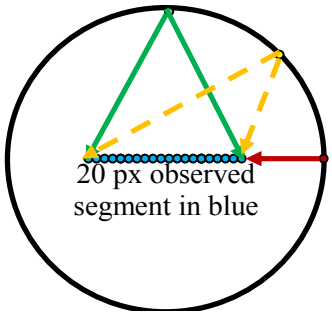


Figure 1

A correct perception of the length of the segment is possible only when the apexes of the isosceles (of two equal sides) viewpoint triangles lie on the circle of a cross section of the sphere of possible viewpoints. Only then does the optical angle reveals the full length of the segment and, thus, yields a correct measurement. Any tilt to the right or to the left decreases the optical angle and skews measurements (e.g., the *yellow dashed triangle*). With a tilt of + or - 90 degrees, the optical angle is reduced to zero. Then one can see only either of the two extreme points of the observed segment, and the perceived length of the segment equals zero if it represents an invisible theoretical point. The same segment represented by a sequence of pixels in Figure 1 visually yields a single pixel, while the viewpoint triangle collapses to a single segment of a straight line, shown in red.

On a grand scale, this reminds us that, until **Copernicus** (Polish astronomer 1473–1543), mankind (observing the sky from its natural but limited earthly perspective) lived under a false impression that our planetary system is **geocentric,** not **heliocentric**.

This demonstration of the optical perspective shows in a simplified manner how easily our observations and perceptions can be distorted. The potential possibilities range from seeing literally nothing through distorted views to the rarest but the most desirable of all views when one sees the length of the segment of a straight line as correctly as humanly and technologically possible. How much more we might be deceived when observing less known and/or more complex objects, concepts, and phenomena.

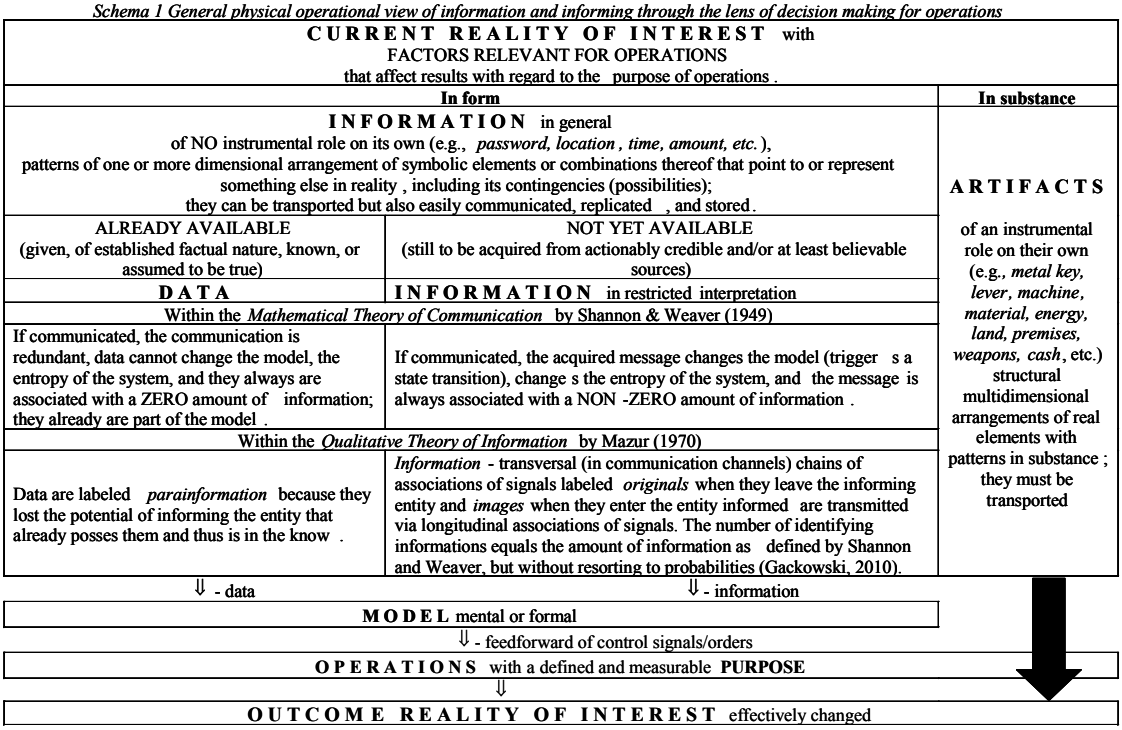
Disparate Views of Information and Informing

Disparate definitions and interpretations of information and informing abound in scholarly literature. Many of them are summarized in the Appendix. Many necessary fundamental distinctions are not even recognized or are ignored despite their potentially grave consequences in reality. Abstract approaches, discussions, and considerations rarely attract researchers and, even less, practitioners.

When investigating an unknown object or phenomenon, one should identify (a) the **object of interest** (the focus), (b) its **framework** (context), (c) the **main point of reference** (the apex of the optical perspective), and (d) a **unit of measurement** (yardstick) of the results. This study uses a down-to-earth ***framework of routine operations*** (see Schema 1) and naturally occurring processes, where information is a significant **factor**. Elements of reality may facilitate or inhibit operations. A ***factor*** is anything that affects the results of operations with regard to their purpose—the main point of reference (the apex in the case of an optical perspective). To affect operations, it must meet certain requirements. In social environments, ***requirements*** pertain to the **physical aspects** of the factor and the **needs** and **expectations** of stakeholders. Operational factors are concepts familiar to researchers, operations managers, project managers, operations researchers, management scientists, commanders, military planners, decision makers, etc.

The object of interest (the focus) of this paper will be information including data and informing including information processing. In general, ***information*** means anything **in form** in contrast to

Schema 1 General physical operational view of information and informing through the lens of decision making for operations



anything **in substance**. Material objects manifest their existence in some form. Forms are patterns that can be objectified as objects in substance or objects that serve only as pointers to or symbolically, thus of no other instrumental role on their own than representing actual or contingent entities (designs). Such ***symbolic patterns*** are one-or-more dimensional arrangements of objects or elements of sets (collections of objects of certain properties; e.g., *dots, pixels*) or combinations thereof (e.g., *letters, numerals, other special symbols*), such as numbers, words, names, identifiers, relationships among them, shapes, graphs, diagrams, schemas, matrices, formulas, rules of reasoning and proceeding, drawings, or pictures that may point to (represent) fragments of reality (e.g., *location, time, recipe, algorithm*) or to contingences (possibilities; e.g., *concepts, ideas, designs*). Hence, patterns in form as patterns in substance can be objectively observed and transported; however, only symbolic patterns can be easily communicated over vast distances and stored in multiple copies for a long time.

Once information viewed physically (not necessarily from an optical perspective) has been put within a realistic context of operations or actions, one may ask, what is the most rewarding (for researchers and practitioners) ***point of reference*** or viewpoint? Processes (including informing and information processing) or actions are always driven by some forces: for instance, for innate matter to attain a static or dynamic equilibrium within a force field, for living species to survive, or for human-controlled operations to serve some desired purpose or one imposed by human will. Communications always serve some purpose; hence, the perspective of the teleological relativity with regard to the p**urpose** should be adequate for most research and practice about information and informing.

To yield tangible replicable findings, the **main purpose** must be **measurable** (e.g., *the lowest level of potential energy for innate matter, chances of survival for species,* while in business *income, retained earnings, return on equity, cash flow* (in critical times), or *saved lives* in rescue operations, etc.). Such a perspective provides a natural common denominator and respective units of its ***measure*** to assess the impact made by any operational factor. Once a well-defined playing field has been established (the **object** of study [focus], **framework** [context], the main **point of**

reference [the apex of the optical perspective—a viewpoint], and a **unit of measurement**), many controversies fade away; they become irrelevant, refuted, or unambiguously resolved. The scholarly study by Callaos and Callaos (2002) serves as a starting point to address the issues. Beyond this, the Data-Information-Knowledge-Wisdom (DIKW) Hierarchy that has become part of the canon of information science and management (Fricke, 2009) will be discussed insofar as it pertains to information and informing. We will always try to deconstruct the focus and perspective that the author selected, whether explicitly or implicitly, and illustrate their consequences.

Fundamental Distinctions

In the domain of information, data, and informing, many distinctions are very loosely defined without explicitly expressed focus and perspective from which they are made (see a summary in the Appendix). Most of them are either forgotten or ignored as if inconsequential in real life. Nevertheless, many of them, when analyzed, turn out to be even fundamental due to grave consequences in the results of research and practice if ignored. For instance, they may either preclude or facilitate research; they may mean success or failure, war or peace, victory or defeat, lethal strike or restrain, collision or no collision, resonate or not, measurable or not, significant or insignificant, usable or not, useful or not, and so on.

The need for more rigors is determined by the very nature of real-life operations (business, manufacturing, education, administrative, or military), not by preference, opinion, or even whim of leading scholars. They are rightly considered to be fundamental because they can be ignored only at one's own peril when used for operations where information, data, and informing (including information processing) are significant factors. Where possible, as suggested by Gill (2011), conceptual schemes are added to facilitate comprehension of these consequences.

We will review and discuss:

1. Information as a physical pattern in form that represents something else (not instrumental by itself) versus information as a construct peculiar to each individual,
2. Information as a thing or as something intangible,
3. Subjectivity versus objectivity of information,
4. Information versus data: What MIS students are taught in textbooks.
   This is presented in (a) Sample views of information and (b) Sample views of data. Both are later illustrated in two subsections about (c) The chasm between information and data: A case of biased entities informed and (d) The possible chasm between facts and the data that purport to represent them.
5. Primacy of informing and information over data: Primary and secondary informing,
6. Data in general versus computer data,
7. Information as data answering questions,
8. Information as data endowed with relevance and purpose,
9. When distinction between data and information is irrelevant,
10. Informing as resonance among informing entities and entities informed and information as a factor that changes models of decision making and operations, and the ever ignored
11. Materiality, usability, and usefulness of factors in form (information, data, and other elements of knowledge).

Information as Physical Patterns or Individual Interpretations

In this study, ***information***, the main object of interest may be anything **in form** in contrast to something **in substance**. Both are material and manifest their existence in some form; otherwise, they are beyond scientific inquiry.

By Stonier (1997), *"information is an intrinsic component of all physical systems…"* (p. 12), the third essence that supplements matter and energy in viewing the universe that describes structural aspects of systems. Thus, information is an intrinsic, always present, and objectively observable component of all physical systems that is ascribed to their organization or lack thereof. This down-to-earth interpretation views information as physical patterns in form that represents structural aspects (the object of the focus) of the universe or of existence, as some prefer. This is the broadest framework or context possible. Of course, its purpose seems not to be a subject of scientific inquiry and cannot be measured. Thus the universe is viewed as **matter** and **energy** that appear in different **forms**.

On the opposite extreme of this spectrum of views stands **Dervin (1983)**, who writes that *"all information is subjective—the real, while the objective or external is only the representation of the real"* and *"information is not a thing but a construction"* (p. 7). By this definition, Dervin's *real* eludes verification. Subjective and real are antonyms unless one charitably assumes that Dervin limited *subjective* only to "peculiar to a particular individual." Nevertheless, this also makes generalizations impossible while they are the essence of scientific quests. We may only know what the subject externalized. Maybe he experienced different *real* associations, inaptly articulated them, or outright lied about them. One cannot rely on unverifiable concepts, neither in research nor operations. To the contrary, the *external,* whether true or not, lives its own life independently of what it was purported to represent and is verifiable. Another of Dervin's statements, "*information is not a thing but a construction,*" turns up-side-down Merriam-Webster's simple interpretation that "*a construction is a constructed thing,*" here an abstract construct, but still a thing.

Also not helpful is **Neill (1992)**, equating information with knowledge *"knowledge representation is not knowledge but representation of knowledge"* (p. 34). Finally, **Callaos and Callaos (2002)** summarize it this way: *"The conclusion is evident: information is generated inside the mind of a person, a subject. It is not an objective entity independent of any person. It depends on the person where it is generated by the data stimulus, as well as on his/her individual experience"* (p. 3).

Thus, Dervin, Neill, and Callaos diverted the quest for the concept of information from what exists or has been communicated to what (in a process free-for-all) particular individuals may make with it or out of it. No generalizations are possible. Information obtained by observation, communication, or transportation may result in loose associations, concepts, ideas, and/or specific patterns of behavior. Depending on the states of specific minds, the said "data stimulus" may even trigger a suicidal explosion. "Data stimulus" will be discussed later. These approaches call for viewing information from all possible individual perspectives. It defies the second part of Nietzsche's contribution to philosophy of science: "*The notion of all-inclusive perspective is as incoherent as the concept of seeing an object from every possible vantage point simultaneously"*. For research and practice, the consequence of these approaches illustrates Dante's warning, placed above the entrance to hell: "Abandon all hope, ye [researchers] who enter here ..." (a realm where everything is specific and different from the rest defies any generalization).

One may paraphrase the situation by the rebellious call, "No taxation without representation!" into "No (verifiable) **interpretation** without (a physical) **representation** (of the real)." The *real,* as defined above, leaves no room for scientific inquiry and for wide practical application. In scholarly literature, these authors and many others reduce the third essence or aspect of viewing the

universe to interpretations rendered by particular individuals from their specific peculiar **perspectives** where even a communicated password (indispensable for further action) is NOT *real*.

Information-as-thing or as Something Intangible

Buckland (1991) makes three distinctions based on the Oxford English Dictionary (OED, 1989); he equates information with knowledge; both are *"based on belief"* (p. 42) and are "*intangible ... that one cannot touch or measure*" (p. 4). At the same time, he allows "information-as-thing" such as documents that he labeled data, which will be discussed later.

The American Heritage Talking Dictionary [AHTD] (1997) defines intangible as "***adj. 1.*** *Incapable of being perceived by the senses.* ***2.*** *Incapable of being realized or defined,*" with antonyms "*real, understandable*, and *comprehensible.*" These aspects make Buckland's concept of information inadequate for research and practice. Only factors in form that can be tested with replicable results for operational relevance, operational meaning (what difference they make), significant operational materiality, and so on can be subject to scrutiny. Concepts that cannot be perceived by senses or sensors are beyond our reach. In operations, factors in form, hence information in its broadest physical interpretation as patterns of signals, affect results of operations as tangibly as factors in substance. For instance, exact *time* and *location* of the target (factors in form, whether labeled data, information, or knowledge) determine the effectiveness of drone attacks and are as necessary for action as those in substance (drones and missiles); their symbolic nature does not make them weaker factors; if unavailable, they render affected actions ineffective.

We DO NOT question information "based on belief" as long those beliefs are strong enough to motivate action and yield verifiable effects. Similarly, in reverse, if for whatever reasons, truth is not believable for actors, it will not be acted upon. Even extreme materialists admit and widely utilize the principle that ideas that control behavior are as material as other forces in nature.

Within the realms of human perceptions and instincts of living organisms, we face a paradoxical divergence between truth and effectiveness. A theory, model, or procedure may be true with regard to its effectiveness if applied, but if not comprehended or believed by actors, it will not be accepted and used, while others widely believed to be true will be accepted and practiced even if wrong (geocentric vs. heliocentric planetary system) or worse, harmful (draining blood from sick patients to strengthen them, etc.). By any stretch of imagination, something intangible without measurable effects is an unacceptable offer for researchers and practitioners.

Subjectivity versus Objectivity of Information

Inexplicable differences in perceiving information not as patterns of elements, but as the subsequent associations, thoughts, ideas, and reactions of particular individuals lead to a common perception that information is subjective, existing only in the minds of humans (Buckland, 1991, p. 3; Callaos and Callaos, 2002; Dervin, 1983, p. 7; Neill, 1992, p. 34). This is the result of **misplaced focus** from what informs to what an informing pattern of signals may trigger. For example, radio signals (patterns in form) may trigger explosions of improvised explosive devices. They are reactions built into devices or planted into minds of suicide bombers. Explosions may be triggered by signals, but by any stretch of imagination, no one interprets them as information. Information viewed as patterns of signals exists independently of human minds. Such patterns may be generated by humans, living organisms, computers, robots, or by otherwise inert matter (*crystals*). Once the original signals are generated by an informing entity, their images exist independently of the originator during their respective lifecycles until, over time, they fade away (e.g., *radio signals, inscription on a grave stone, seeds*), whether or not they resonate with other entities.

Next, information does not necessarily reflect reality; it may represent contingencies (possibilities). Whether a pattern maps reality or what it is purported to represent is a matter of quality of

mapping, not subjectivity or objectivity. Propagated information may even disinform or mislead on purpose. The quality of factors (whether in form or in substance) is a separate but vital issue that pertains only to objective phenomena; it is subject to quality management and quality assurance. The content of an information item (information value) viewed macro or as the structure of the information chain viewed micro, according to Mazur (1970), is always entity and situation specific; it may be of its own unique imprint (e.g., *signature, fingerprints, DNA*) that exists objectively.

The physical view of information provides an incisive insight that everything hitherto considered subjective is the result of insufficiently transparent, unrealized, but still objectively existing differences in representing reality or contingencies of interest by patterns (Mazur's images) of physical states. For observers with full transparency of all processes, as it is with robots and computer-controlled devices, such differences cannot be identified. Recent progress in research of DNA, RNA, and the genome project reveals micro-specificity of living organisms and elucidates previously inexplicable differences in development and behavior. The least transparent of all is still the human mind. Further advances of technology certainly will gradually enable mapping of the human brain as a system of states of its neuron axons. Gradually, we may also reach natural barriers of cognition that are analogous to that articulated in the Heisenberg uncertainty or indeterminacy principle, which considers how measuring certain properties of a system may unpredictably change other properties of that system.

A communicated pattern of signals, information passed from informing entities to entities informed, exists independently of human minds, hence is as objective as any other physical phenomenon. However, the reaction of the entity informed (interpretations, decisions made, and actions triggered are always peculiar—that is, specific—to a particular entity informed (client, consumer, citizen) and the situation in which it occurs; hence, it is subjective, where subjective here is NOT an antonym of objective. With informing entities by design, such as computers or robots, there is no room for ambiguity about what the reaction will be because everything is transparent to researchers and practitioners. With living entities, their interpretation and reaction is frequently unpredictable because they differ, they are developed in different environments, and, thus, they react differently even in the same situations. These reactions are falsely ascribed to the communicated information—the messenger.

The physical perspective of viewing information for operations or extension of replicable knowledge dispels subjectivity of factors in form as the once mythical "ether." A radical departure from *subjectivity* to *physical objectivity* of information defies most of the current deeply held views. Here we touch the fundamental dichotomy in philosophy—objective versus subjective.

The problem of peculiar reactions to communicated information cannot be resolved by informing science alone. Why one marketer markets products differently than the other, why one consumer reacts differently than the other is the subject of marketing research. Subjectivity originates within the discipline that studies marketer and consumer behavior. The sources of subjectivity always lie within the discipline of the field where information and informing originates or is affected by informing, NEVER with the informing system or the communicated information. Studying marketer and consumer behavior can be employed to make information and informing resonate better with them. Within a well-defined context, factors in form (e.g., *information, data, elements of knowledge*) play roles as objective as factors in substance (e.g., *material, energy, tools, weapons, etc.*), and information processing is as objective as processing of material and energy. We posit that the *physical view* of information and informing for operations and extension of replicable knowledge clearly *delineates* which *fields of study* can dispel any perceived subjectivity; it relegates subjectivity to those realms that generate or use information and intersect with informing. The moral is DO NOT blame the messenger (information—a pattern of signals) for the subjectivity it may carry.

Information versus Data: What MIS Students are Taught

Information versus data seems to be one of the most enduring controversies. It exemplifies a lack of perspectivism in views presented by most scholars and authors of MIS textbooks. From the perspective of acting humans (hence ignoring the role of information and informing within innate matter and living organisms), when one views information as factors *in form* (in contrast to factors *in substance*), then data are subsets of information; the label *data* should be used for patterns given and factual to deserve to be assumed true by their users.

Sample views of information

There is a plethora of views regarding information (see the Appendix). Most view it as some kind of data (items 1–4, 9, 16, 21, 22, 24, 25, and 29); some equate it with knowledge (7, 19, 23); as subjective inside the human mind (7, 8, 10); as an answer to a question (11, 15); as interpretation of existence (12); as an elementary association, a transition, a transformation between transversal pairs of signals in communication channels, or a discrete countable unit (21); as organized facts (27); as a factor of change (14); as an understanding of relationships between data, static, and linear (5); as words or numbers (18); as a process of internal forming of a person (6) as the third essence of the universe besides matter and energy (28); as a pattern of elements in form (symbolic) (32); and as some other refrain from any specifics saying: information may be syntactic or semantic; more extensive and logically stronger than data (13).

Thus, a disparity of views is an understatement; it is a subject free for all to interpret, certainly an immature field of inquiry in the age nicknamed the age of information. In a free market of ideas, which one should gain the broadest use? It seems that it is the one that explains most related questions that can be rationally answered. This paper tries to demonstrate that the most potent seems to be the simplest view of information as a physical pattern of elements in form (playing a symbolic role that is of no other role on its own) that does not collide with any established theory, such as the mathematical theory of communications by Shannon and Weaver (1949), the qualitative theory of information by Mazur (1970), decision sciences, and operations management. Alas, Mazur's theory is practically unknown to English readers who deserve at least a short briefing (see more in Gackowski, 2012).

Mazur (1970) defined ***information*** within communication channels as an elementary transition or transformation between transversal pairs or associations of signals and the same between longitudinal pairs of signals as **code**. They form respective chains. Thus, a single transversal transformation from one signal to another constitutes elementary ***information***—a countable unit. To be consistent with Mazur, one needs to use "information" in the English unconventional plural form where necessary. While analyzing the essential types of code and information chains in communication channels, he demonstrated a logical symmetry between them. Transformation of information chains of **originals** into respective chains of their **images** defines ***informing*** (e.g., *transformation of points of landscape into points on its map*). The originals are transformed into their respective images by transversal (in communication channels) chains of **inter-signals.** The above enabled him to distinguish three basic types of informing: (a) ***simulating,*** when chains of images contain more elements than chains of originals, (b) ***dis-simulating,*** when the chains of images contain fewer elements than the chains of originals, and (c) ***confusing***—a combination of simulating and dis-simulating informing. ***Trans informing*** is the term Mazur uses for faithful or perfect informing. It serves as a point of reference for distinguishing rigorously defined less-than-perfect degrees of informing, such as ***degenerated informing***, **pseudo-informing,** and **disinforming** of different degrees. Whatever the case may be, informing, if effective, changes the state of the entity informed and the model of its functioning. Mazur's theory is abstract, but in return, it profoundly accounts for many kinds of practical implications, makes information countable, and

arrives at the same formula of the amount (here, the number) of information without the need to resort to probabilities as Shannon did.

Sample views of data

A similar plethora of views can be found about data (see the Appendix). Most view data as facts (items 2–4, 9, 16, 19, 20, 22, 24, 27, 29, and 32), as a product of observations or descriptions (1, 4, 12, 15, 16, 24, 25, 27, 32), some as a kind of information (13, 18, 21, 32), some use them interchangeably (17, 30, 31), as an objective side of a coin where the other side (supposedly subjective) is information (8), as basic interpretation of existence (12), whatever is stored in a computer (7), or even as meaningless points in space and time, out of context (5).

Certainly, the disparity of views of data is not less numerous than that about information, but they all agree that data are the fundamental component of an information system, as Kroenke (2008) aptly expressed. Data also are the foundation for the widely accepted but also criticized Data – Information – Knowledge – Wisdom (DIKW) Hierarchy. One can easily extend Kroenke's statement that, within the widely accepted framework of people, data, software, hardware, and communication resources, which characterize any information technology (IT) environment, poor data quality literally renders all the other IT resources useless and an expensive waste. Thus, the theories of information lag far behind the enormous advances of IT technology. In addition to the above, there are more disturbing symptoms in the cited definitions.

Most authors feel an inner compulsion to denigrate data in many ways. Ten (items 2–5, 7, 16, 18, 22, 25, 29) out of 32 cited authors insist on complementing their definitions with negative adjectives such as "may or may not be pertinent or useful for a particular task," static, unorganized, "*often has no meaning in and of itself*," "*before they have been organized and arranged that users can understand*," "relatively *meaningless*," "*of no meaning and context*," "*raw facts that can be processed into accurate and relevant information*," which implies that data by nature are inaccurate and not relevant when collected, "*whatever records stored in a computer*," and the pinnacle of all, "*meaningless point in space and time, without reference to either space or time … and event out of context, a letter out of context … without a meaningful relation to anything*."

These statements OFFEND decent researchers and practitioners. Are they spending their time, efforts and resources on collecting data that are, according to them, irrelevant, inaccurate, and serving no defined purpose? Need the data not be well documented with regard to time, space, and other relevant circumstances? Should one not base research or operations only on well-documented data? While understanding of data is desirable, it is not necessary (collecting encrypted messages for the purpose of breaking the code.) The above-quoted statements desensitize students' minds with regard to rigorous thinking and communicating. Students rather need the popular "sensitivity training sessions." Yes, on the one hand, individual transaction data may actually constitute only a miniscule fraction of the total business activity of a corporation. On the other hand, even a miniscule error, if repeated and multiplied a million times by fast computers, may lead to serious miscalculations or a downed passenger airplane. It is similar to a mechanically loose tile that caused disastrous loss of lives and an entire spacecraft.

Unprofessionally collected data with no purpose in mind and no circumstances identified are junk data that should be EXCLUDED from professional considerations. For instance, researchers of global warming denied access to their data. The Sunday Times reports (Leake, 2009),

1. *David Holland, an engineer from Northampton …requested the figures under freedom of information law he was refused because it was "not in the public interest."*
2. *Others … were turned down because they were not academics, among them McIntyre, a Canadian who runs the Climate Audit website.*

3. *A genuine academic, Ross McKitrick, professor of economics at the University of Guelph in Canada, also tried.… The [unit – Climate Research Unit (CRU)] told me they had obtained the data under confidentiality agreements and so could not supply them. This was odd because they had already supplied some of them to other academics, but only those who support the idea of climate change." There could, however, be another reason why the unit rejected requests to see its data.*
4. *This weekend it emerged that the unit has thrown away much of the data. Tucked away on its (CRU) website is this statement: "Data storage availability in the 1980s meant that we were not able to keep the multiple sources for some sites ... We, therefore, do not hold the original raw data but only the value-added (i.e., quality controlled and homogenized) data." If true, it is extraordinary.*

Under such circumstances, scientific progress is blocked. Who paid for this?

Explicitly ALL and implicitly most authors omitted in their definitions the etymology of the terms *datum* and *data* as something *given* or already *known*. In discussions of problems in geometry, mathematics, engineering, and so on, the terms *givens* and *data* are used interchangeably. This omission deprives definitions of data of any perspective with profound consequences: given by whom, to whom, or known or assumed by whom? Can they be informative or not? This is important. Currently, not so much in research but in operations, data are captured not by direct users but by others on behalf of many users, as practiced in most organizations. If these aspects are not clear, it confuses.

On the one hand, when they are captured by their direct users, those data are already known to them. Such data need NOT be communicated to them, and, if communicated, the respective communications are redundant; they change neither their models nor the situations they are in; they cannot be informative to them. Within the mathematical theory of communications, Shannon and Weaver (1949) so defined datum as a factor in form, a physical pattern of signals that, if transmitted, is associated with a zero amount of information because the states of the informing entity and the entity informed were equal with regard to this pattern, and the entropy of the communication system remained unchanged (amount of information statistically measures the difference).

On the other hand, data captured on behalf of many users must be communicated to them. According to most authors, under these circumstances, data appear to end users as informative or as information. If they are communicated, they will be associated with a NON-ZERO amount of information by Shannon.

When all the above is clear, the dilemma of Callaos and Callaos (2002), that "data *might be informative or not*" (p. 7), can be resolved immediately. Data CANNOT provide any stimulus as Boland (1987) suggests. A liberal use of the term *data* leads to a pervasive impression by many that data are the main source of information. This is about what our students are currently being taught. The reality is exactly the opposite, such as in the millennia-long illusion that our planetary system is geocentric instead of heliocentric, which will be the subject of another section that deals with the primacy of informing and information over data.

Thus, data are factual subsets of information meant as factors in form; they cannot be informative to those who know them, to whom they were given. The difference between data and information is as simple as what of a factual nature is to their user available, given, known, or assumed by them to be true while the rest of factors in form remain uncertain—or of not yet of established actionable reliability of information (Gackowski, 2012). The above sample views will now be contrasted and illustrated by real-life examples.

The possible chasm between information and data: A case of bias

This example is as grave as WAR or PEACE, not only in academia, but also for those among the highly educated in elite war academies and experts in intelligence communities, including commanders-in-chief of one former formidable power and another fading power—a world debtor who ignored that distinction. They received information about weapons of mass destruction (WMD) in Iraq; information was provided by ONE defector, which was denied by his former boss; the defector was flagged as an unreliable source by military intelligence ("Curveball," 2011). Without any further corroborating evidence, this information was accepted as fact, or may be even worse, not accepted as fact but presented as fact—an actionable datum for the United Nations and two chains of command up to the top two commanders-in-chief. Later, this defector revealed that he had made it up. Intensive on-site scrutiny with no WMDs found provides the necessary ultimate corroboration for his confession. The need for corroboration is taught during the first semester at law schools. A single witness, even the suspect's volunteered confession with no corroboration from independent sources, is insufficient evidence in courts of law but is accepted as sufficient by alumni of elite academia.

Gill (2011) discusses some underappreciated conceptual schemes that facilitate acceptance of research results where the schemes are not necessarily true. Famous by its sarcasm and simplicity, the Peter Principle (*in a hierarchy, every employee tends to rise to his level of incompetence*) is one of these schemes. This example proved the principle to be more than useful—useful AND true—as assumed or worse only presented as such not by a single individual but by the entire systems of highly educated and trained professional intelligence officers, military commanders, and politicians.

On the one hand, this example presents the case for a clear distinction between information and data and fully addresses Gill's (2011) recommendations:

1. A problem or decision faced by the client. Comment: *two corresponding commanders-in-chief facing a dilemma "to go or not to go to war"*.
2. Communicates how this binary distinction impacts clients' internal models. Comment: *in this case, likely supported even by supercomputers that still are no match for bias of their users*.
3. How it subsequently impacts clients' activities when certain circumstances are encountered. Comment: *nothing less than the classic "Casus belli"—a case of going to WAR*).

On the other hand, this example also reveals the weaknesses (not of Gill's making) of those recommendations when followed to the letter. No one can predict what practitioners may do.

1. Hell-bent politicians may by looking for a PRETEXT ONLY and actually have no model at all or one that is too inconvenient to be used, when their actions are driven by desires, agendas, ideology, or personal self-interest;
2. A lack of supporting facts may be only a nuisance for a coalition of the willing; or worse,
3. They were unable or incompetent to ask the truly right question about the real problem.

The above adds a sobering note that even the best recommendations made with good intensions seem to be no match for human vanity and fallibility. More universal and lasting truths were proposed 200 years ago in a doctoral dissertation (nowadays a feat unheard of) by Arthur Schopenhauer. It is pessimistic but irrefutable because nothing has changed in human nature since the Napoleonic wars: "*A sufficient reason to act is will*" that may be, but not necessarily is, controlled by intellect, while more often controlled by emotions. Blunt threats that are repeated by leaders on both sides of the Iraq/Iranian border and from other places for destruction of other countries are met only with disbelief, even readiness to discuss them without preconditions--instead of their

immediate exclusion and isolation from the international community, cessation of any commerce and cooperation, warranted by such a position.

One also may analyze the case above by applying a **quality-assurance** approach (see Gackowski, 2012, Chapter 11, Factors Contributing to Actionable Reliability of Information). At least 20 factors contribute to actionable reliability of primary information before recognizing it as a reliable datum. **Quality assurance** is a subject rarely discussed on informing science forums. Let's have a look at how tedious such a process may become; let's see whether all aspects of quality were sufficiently scrutinized as it befits problems of the utmost gravity.

1. **Have we received** (from the defector) **disinformation, misinformation, or valid information**? (Outright disinformation must be identified and dealt with first.) Now, we know for sure that we received disinformation, which most of those responsible were unable to detect. Was it possible? Yes. Even worse, it has been detected and ignored (see item 3).
2. **Exploring a variety of sources**. Never depend on a single source. Trust and verify. (This is the only known way to get closer to reality, as taught in the metaphorical 101 course on criminal and other investigations). Most of those responsible failed miserably, but not all.
3. **Did we analyze the reliability of the source** (the defector)? We witness here an unexpected yes. The information has been denied by another defector of a higher rank, his own boss, who had much wider access to the reality in Iraq. ("*The BND traveled to a Gulf city, believed to be Dubai, to speak with his former boss at the Military Industries Commission in Iraq, Dr. Bassil Latif. Latif strongly denied al-Janabi's claim of mobile bioweapons trucks and another allegation that 12 people had died during an accident at a secret bioweapons facility in Baghdad, according to the Guardian. German officials confronted al-Janabi with his boss's denial and did not contact him again until the end of May 2002, al-Janabi told the Guardian. Despite his earlier disputed statements, al-Janabi said, German and U.S. authorities continued to take him seriously." If this was not sufficient, "Curveball" (his code name) had been flagged by the Defense Intelligence Agency as suspect and untrustworthy)* ["Curveball," 2011]. Thus, it borders on insanity.
4. **Did we analyze reliability of mapping reality into the presented evidence?** No, the slides presented by Collin Powell at the UN must have been fabricated somewhere by someone (untouchable).
5. **Quality of presentation of information may mislead users.** Exactly the opposite occurred. Users interpreted what they wanted to see. (Is it not a paranoid schizophrenia?)
6. External factors affecting the reputation of sources—a subgroup of factors, as below:
    a. **Traceability of information to its source**. Non-existent! Intelligence agencies never reached the primary source of information—an actual artifact of a WMD. But in academia, are we doing a better job? Even researchers rightly considered leading among their peers could not escape obvious inconsistencies. In the seminal paper titled "Beyond accuracy: What data quality means to data consumers," on page 9, the authors admit removing *traceability* from their Conceptual Model of Data Quality without explaining why, while later, on p. 11, they stated, "*data source tagging is a step in the right direction*" (Wang & Strong, 1996).
    b. **Availability of communication channels with primary sources**. The mightiest agencies seem not to have one reliable agent on site in Iraq. (We know the ones who operated there before "Operation Desert Storm" had to be spirited out of Iraq by poor, but friendly Polish intelligence operatives. It rather confirms that no human intelligence with feet on the ground was left.) Similar agencies of the former Soviet Union had human sources abundantly planted in all U.S. and British agencies, as the honors bestowed on them attest.

c. **Alignment of attitudes**. (May lead to conspiracy, collusion, and even unawareness of collaboration.) This case is a perfect example: "*They gave me this chance. I had the chance to fabricate something to topple the regime....*" ("Curveball," 2011. It was obvious what politicians were looking for, and the defector conveniently delivered it; both sides were attuned and resonance was assured where scrutiny was due.
d. **Alignment of interest**. Trained professionals should have expected it. Interests of defectors and dictators do not necessarily divert as naïve people expect. Their interests may be identical but for different reasons. Defectors wanted to show the regime as dangerous, and this was exactly the same as what Saddam wanted in order to frighten his not-so-peaceful-and-benign neighbors such as Iran.

7. There are other 10 factors (Gackowski, 2012, Chapter 11) of lesser, but in literature of overestimated weight, that are immaterial in the light of those grandiose blunders.

For the hardcore disbelievers, one may summarize all of the above once more. There is a wide chasm between information and actionably reliable data, a chasm that can be bridged only by tedious verification, scrutiny, and validation, called **quality assurance**. Judging by reactions of colleagues, readers, a plethora of reviewers, and even professional auditors who should be interested in the subject, a discussion of the consequences of ignoring this difference was perceived as not worth their time to analyze, challenge, and criticize this paper, which was declared too theoretical, too remote from practice, and of "*no visible contribution to informing science*." Similarly, in the market of ideas, the presented sample of analyzing actionable reliability of information is not worth the lowest consulting fee. History will likely repeat itself with a new variation of the same or worse horror.

Alisa Zinov'yevna Rosenbaum, known better by her pen name, Ayen Rand, when asked about impressions of how her statements (about the real horrors within Soviet Union) were received by the members of the hearing panel of the **House Committee on Un-American Activities**, she managed only to utter, "FUTILE." This was a testimony of a first-hand, knowledgeable, friendly witness before a panel of friendly listeners, who, for many years, were vilified but right about most cases, as we know now. What would happen to a testimony delivered by a witness of opposing views that everything is rosy in the red paradise? They might be accepted with open arms like by Bernard Show, Bertrand Russell, King Edward VIII (with regard to Hitler), or Jean-Paul Sartre. It illustrates two opposite extremes of bias to informing and the interpretation of the information received: a limitless credulity versus limitless incredulity once mental models have been developed and deeply ingrained.

It took about 200 years for the obvious to Copernicus to be accepted by the rest as a fact; of course, in its main tenet, the heliocentric planetary system, remained intact. Over consecutive centuries, we learned much, much more, thanks to those who continued. One may doubt whether rational, well-intended, clever conceptual schemes, supported by sticky messages, even cloaked in attractive stories if added to Copernicus's opus vita, *De revolutionibus orbium coelestium libri VI* ("Six Books Concerning the Revolutions of the Heavenly Orbs"), would help in overcoming the thick layers of resistance. It is a sobering fact: social interactions are primarily a tug of war of opposing forces, less, an exchange of opposing views and ideas. Frequently with disbelief and reluctance, truth is ultimately accepted but only under favorable circumstances. Nevertheless, we should try our best.

The possible chasm between facts and the data that represent them

About twelve authors relate data to facts (see the Appendix) and a separate section in this paper labeled "Sample views of data". But what are facts? We now face ambiguities even in dictionar-

ies. Their authors imprudently allow facts to be equivalent to "information presented as objectively real" (AHTD) or "information presented as having objective reality" (*Merriam-Webster Dictionary*). This is unacceptable in studies of information quality. Even outright disinformation is presented to appear true. All intelligence agencies run less or more elaborate disinformation services.

In this study, we rigorously separate objective reality from its representation. Therefore, we propose the simplest interpretation. In dictionaries, with regard to objects, fact is "something that has actual existence" (*Merriam-Webster Dictionary*) or "Something having real, demonstrable existence" (AHTD). With regard to events, fact is "A real occurrence" (AHTD) or "a thing done" (*Merriam-Webster Dictionary*). Within the context of operations, however, contingencies that do not yet exist or have not yet occurred but are operationally possible (e.g., *explosives that may explode*) should also be treated as full-fledged factual factors in form. One may summarise as follows for the purpose of this study: ***Facts*** are things that exist, events that occurred, and/or contingencies that may occur. Organizations never or rarely store facts (particularly by computers); they mainly store symbolic representations of facts.

Many—too many—authors (see Appendix, items 2, 3, 9, 16, 18, 19, 20, 22, 27) do not distinguish *facts* from their symbolic *representations*; they take the liberty of listing side-by-side facts with figures, sounds, records, observations, words, numbers, etc., which only MAY represent facts. Some others even asked not to take published definitions too literally. If so, they are up for an ugly surprise. Academicians in the forefront of research tend to be very lenient about judging other researchers lest they hurt the feelings of these researchers but destructively reckless as consumers in their expectations from those who manufacture goods for our comfort. With no hesitation, they expect "zero defects," six-sigma quality, immediate recall of only the "may be" defective products. And all of this is to be administrated by a government that is in blatant conflict of interest as co-owner of bailed-out competing car manufacturers. All of this was amplified by media repeating alleged "horror stories" with sticky and condemning messages in contrast to leniency toward drivers (voters) who allegedly, over a distance of 10 miles, were unable to turn off the engine and stop the car, instead, persistently pressing the accelerator. It seems that they do not deserve the privilege of a driving license.

The same creeps into academia. For instance, some deans and chairs that are teaching and propagating the six-sigma quality in manufacturing, reacted to a joking suggestion that maybe we should gently start with a ONE-sigma learning assurance with a stern reminder supported by the California Faculty Association officers that this way we could lose our students and our jobs. Thus, we exempt ourselves from rigorous quality assurance like hypocrite lawmakers from the laws they even legally impose on others. Neglecting clear distinctions does not edify students who are supposed to be taught and supposed to learn analytical thinking and clear communication. Worse, as instructors and/or authors of MIS textbooks, we offer a literally LETHAL proposition to our inexperienced students and some not-so-experienced practitioners who enrolled in MBA or EMBA programs.

Fisher, Chengalur-Smith, & Wang (2006) describe the USS Vincennes attack on Iranian Flight 655 that took many lives. The ship's captain stated that they had less than 4 minutes to take action—not sufficient to verify the ambiguous information. Many deficiencies were listed as contributing factors to this disaster; however, one of them was also "*duplicate tracking numbers with no computer alert"* (Fisher & Kingma, 2001). A code value (a symbolic *representation*) previously pointed to Iranian Air Force F-14 (a factual existing or potential danger), but, actually, it was IA 655: Airbus A300, a commercial airliner (a different *fact*, but of no danger unless used by terrorists). When you take into account a general commotion caused at the same time by skirmishes with small Iranian speedboats, including a jammed ship gun, many things might have gone wrong. It was not an academic skirmish. The moral of this paper should be clear; despite

many examples to the contrary (see Appendix), never ever list facts and their representations (words, numbers, etc.) on equal footing when defining data, even though dictionaries allow it (AHTD, Merriam-Webster). Their equivalency does not belong to definitions; it must be attained by tedious quality assurance.

Academicians enjoy the luxury of introspection and multiple reflections before they put something in writing, not yet in action. Most of them never had to bear the responsibility of producing a defined result under a deadline in a high-pressure environment to assure financial stability of a business unit or even to participate in only hypothetical war games. Professional experience in running a business or any other operation is not a listed qualification requirement for instructors teaching professional business programs. Business projects, as a culminating experience for business students, have been replaced for the sake of convenience by designated culminating courses or a comprehensive exam. Alas, for such individuals, the difference between facts and figures that only MAY represent facts is an unimportant nuisance that is not worth attention. Nevertheless, such a difference may become very consequential in the heat of fast-moving operations.

This, again, represents the need for rigorous *quality assurance* to close the possible chasm between facts and their representations. An instructor who held MIS students accountable for ignoring that difference was reminded that he unnecessarily *tortured* them instead of attracting them to our college (another example of conflict of interest).

Primacy of informing over data: Primary and secondary informing

Informing science actually is in the enviable position that all participants in informing are interested in its high fidelity. This cannot be said about third parties. Non-professionals may doubt. An informing entity, even when **disinforming,** does NOT wish its ruse to be distorted on its way to entities informed (clients, users). Similarly, the latter, even when expecting or suspecting deception, are interested in receiving uncorrupted, deceptive messages. Undistorted informing should not be confused with *passing valid (faithfully reflecting reality and intentions) information* because this is the *rarest case in communication* among humans and all living entities.

To the surprise of, likely, most readers, *all informing is tainted by intent,* and it should be a priori expected to be so in contrast to those making naïve assumptions that informing entities inform without a bias. Do not expect it unless proven otherwise by extensive scrutiny and corroborating evidence from other independent sources. It is a rarity to be told the truth by politicians of any leaning, as the infamous presidential assertion, “read my lips,” attests. Experienced politicians do not attach much weight to uttered words. The smarter even say that they attach importance only to officially denied statements, and the smartest of all watch for deeds. Politicians judging others by their own measure, when Lenin, Hitler, and, nowadays, others openly declare evil intentions, ignore them for convenience (nothing needs to be done) and also in an honest disbelief in the validity of threats (too horrible to be true—a psychological bias toward normalcy). After this cautious introduction, we can proceed with informing.

At first, researchers and observers try to learn something about the reality of their topic of interest. If so obtained information has been recognized as factual or worthy of preservation it will be internalized, adopted, and stored as data by the original researchers or observers. If we limit ***facts*** to things that exist, events that occurred, or contingencies that are possible, one must establish by whatever acceptable procedure deemed sufficient that the obtained information represents the facts. This belongs to the process of ***primary informing*** that is conducted by researchers and observers where all data originate. It is of fundamental importance because this is the process used to establish the *factual nature* of operational factors in form, including their operational relevance, meaning, and material significance, on-site and on-time availability, actionable reliability, and, finally, operational completeness with other usable factors that are necessary for action.

Once more, the transformation of primary information into primary actionably reliable data requires a tedious process of assuring quality and replicability.

If other researchers or users need those data, they must be acquired by them or given to them—a process of ***secondary informing.*** (Secondary, if not distorted, does not mean of lower rank, but it also requires another layer of quality assurance by anyone who wishes to rely on it.) This is the way awareness of the recognized primary data spreads to other researchers and users. This is not how textbooks typically present information and informing, where the latter is completely ignored (see a summary in Schema 2). Informing usually requires and is closely associated with information processing that is rigorously studied and researched by computer science.

Schema 2 Primacy of informing and information over data:
A simplified conceptual scheme of their flow

1	**Primary informing**	Research and/or observations that yield the initial **primary information**
2	**Primary information**	Subject to quality management or **quality assurance** of **usability** of information items that must be operationally **relevant**, **meaningful**, significantly **material**, **on-site available**, **on-time available**, **actionably reliable** (credible and/or actionably believable), and meet **other necessary situation-specific use requirements**. If it does not overlap with other information, it changes the situation, triggering a state transition, its model, and the entropy of the system; and it is associated with a NON-ZERO amount of information, as defined by Shannon and Weaver (1949).
3	**Primary data**	Subject to applicable procedures that are **deemed necessary** (e.g., *court procedure, FDA approval, registration in the Patent Office*, *Generally Accepted Accounting Principles, Generally Accepted Auditing Standards*, etc.) and aimed at **establishing the factual nature** of the scrutinized primary information to become worth preservation and storing in databases as actionably reliable factors in form—the primary data.
4	**Secondary informing**	**Dissemination (**passing, sharing, spreading) information and/or data by the primary source and/or other subsequent intermediary sources to interested researchers and users (clients). All of them, as not yet available and known, are perceived by recipients as **secondary information** with the same consequences for the clients as the primary information for original researchers and observers.
5	**Secondary information**	Information obtained from other than the original sources are of a second-hand nature, thus vulnerable to distortions and misinterpretations. It also should be subject to **secondary quality assurance,** whether it is **valid** or at least **acceptable for subsequent use.**
6	**Secondary data**	Subject to procedures deemed necessary to establish their acitionable reliability—the secondary data obtained from indirect sources.

As it is with information, computer scientists view information processing more and more in purely physical terms that is met with reluctance in circles of informing science. Recently, Mark Guzdial (2011, p. 13) succinctly articulated a powerful set of what scientists and engineers (why not informing scientists?) should know about the core of computer science:

1. *Matter can be made to remember, discriminate, decide, and do.*
2. *Matter can remember descriptions and interpret and act on them.*
3. *Matter can hold and interpret and act on descriptions that describe anything that matter can do*. (Note, that the human mind was never explicitly mentioned.)

McLeod & Schell (2001) says that information is *processed* data OR (emphasis added) *meaningful* data. This implies that processing can convert data into information with no hint to what kind of processing can qualitatively change quality aspects of data to justify a change of name to information and what makes data meaningful. Using the logic operator OR (likely unintentionally), he suggests that only one of the two may suffice to obtain information from data. One may ask a legitimate question: When data are meaningless (make no difference), does processing make any sense? Certainly, it cannot add operational meaning, which is the basis for their materiality. For example,

1. When sales volume is important to know, data about sales transactions are meaningful.
2. In order to know how to process data into information, one must know how they differ; for instance, in order to know how to make chicken Marsala from a living chicken.
3. One needs to know what makes data meaningful.

Common sense suggests that practitioners at least try to collect meaningful data. Then the data's processing must produce a different meaning, likely a difference in their comprehensibility and ease of use, but this will never change their operational meaning. If one follows the footsteps of Pierce (1958), the father of the pragmatic theory of meaning, meaning likely means a difference in results. If sales volume is important to know, no amount of processing will change its value unless by "creative" accounting. The above illustrates how a liberal approach to ascribing meaning to data by undefined processing, with no reference to operations, confuses all.

Turban, **Leidner, McLean, & Wetherbe** (2006) suggest that processing of data increases accuracy and relevance, which they attribute to information in contrast to data. What level of accuracy and relevance or a combination thereof converts data into information? Second, can processing of data convert irrelevant data into relevant or less accurate data into more accurate ones? Do we know any method of processing data that can improve accuracy of insufficiently accurate data and, similarly, any method that improves relevancy of irrelevant data? Within the context of operations with a defined purpose, it is relatively easy to answer those questions. Relevance (never accuracy) must be determined first because accuracy of operationally irrelevant data is of no interest to practitioners. In the context of operations, relevance is binary (does a data value pertain to any factor in the mental or formal model of operations or not?). If relevant, is the data value of any operational meaning? Will it improve or deteriorate the results? If yes, one should ask is it of significant materiality to be considered, and, finally, at what threshold of significance? If so, will it be on site and on time available? If so, is it sufficiently reliable to act upon? Only now, does it make sense to ask for accuracy of data and how it may impact the results of operations. Thus, the proposed sequence of qualities is unacceptable for practice. Accuracy of data matters only after establishing their relevance, operational meaning, operational materiality, and on-site and on-time availability.

O'Brien & Marakas (2010) equate information with arranged data that add value to the user. First, does a change of value of any object require changing its name? Second, being familiar with at least most of O'Brien's publications and having reviewed one of them, it is embarrassing to make this statement. Any reference to utility value or materiality of information contradicts everything O'Brien published on his own or in cooperation with other authors. But he is not alone; all known authors of MIS textbooks shun the subject of materiality of information or data. The only one who mentions it (Alter, 2002) mocks it as "*more elegant than practical*." This is not helpful to students who pay for these expensive textbooks. Certainly, as long as data or informa-

tion value serves as a significant factor in operations, one may determine its materiality with regard to the purpose of operations. Nevertheless, no amount of arranging those data will change their operational materiality. Data, however, can be arranged in a more or less user-friendly manner with regard to ease of comprehension and use; hence, the arrangement of data may improve the presentation of data and impact efficiency of their use by decision makers and actors but not its operational materiality. Further, the suggested definition still does not explain the essential difference between data and information.

For theoretical and practical reasons, it is time to simplify the disparate opinions. As long as one stays within a well-defined context (point and frame of reference, from the perspective of the mathematical theory of communication, decision sciences, management sciences, and operations management), there is no room for fuzziness regarding the dichotomous nature of primary and secondary informing and of information and data, and, finally, which of them comes first. Confusion originates from **misplaced focus** and unstated **perspectives** about what and from which viewpoints statements are made. One SHALL NOT ignore the difference between the operational perspective (from which data acquire their operational meaning) and the user's or decision maker's perspective (from which the operational meaning of data is perceived, comprehended, and actually applied); both contribute to effective resonance of informing.

To better convey the results of studies, Gill (2011) recommends (#4) developing conceptual schemes with sticky messages that are simple, unexpected, concrete, credible, emotional, and cloaked in a story. Stories facilitate cognitive storage and retrieval of the essence of the issue without challenging the existent knowledge of readers who thus might more easily accept what is germane to their specific situations. Here goes the story about primary and secondary informing.

In one of my previous lives, my transportation needs were attended by two chauffeurs. The first one, befitting his last name, Fear, from time to time instilled fear among passengers, but, admittedly, he served with no actual accident. The other one chauffeured in a stately manner, hence earned a special distinction associated with higher retirement benefits. Nevertheless, both felt equally compelled to share their professional experience with me. (They likely assessed me as too detached from practice and too attached to abstract and nominal things.) They said, "Sir, please listen. In case any of us may be unavailable for awhile, and you will be on your own driving this expensive foreign Bentley, when you notice an approaching car, pay your primary attention to the position of the front wheels of that car and only secondary attention to the turning signals. The latter do not reliably indicate the actual intention of the approaching driver" (underscores represent their verbal emphasis). (American readers may need a comment that it was a second-rank country, with narrow roads, no big trucks, and recreational vehicles nearly unheard of; certainly it does not pertain to U.S. roads.)

One may summarize as follows: The process of primary informing provides us with the primary information. It should be scrutinized before its *factual nature* can be established and recognized as *primary actionably reliable data*. In the previous story, the direct observation appears to be sufficient and even too simple. It is not so. It took mankind innumerable millennia to realize that their direct observation of the sun moving over the horizon was misleading them, while, actually, the earth was rotating. This brings us back to the controversy of information vs. data. It demonstrates how the vast chasm between primary information (maybe an outright disinformation) must be bridged by tedious verification, scrutiny, and validation, called **quality assurance**.

Secondary informing conveys information obtained by others as presented in textbooks, publications, commercials, etc. But here again, the primary data may easily be distorted by presenters and even misinterpreted by readers and users; for instance, the officially announced deceptively massaged "core" inflation rate and the real inflation rate experienced by consumers on fixed incomes. (Food prices doubled, gas prices tripled, health care costs steeply rising, and home equity

cut nearly in half for reversed mortgages is what counts in the existence of retired individuals living on fixed incomes. Falling prices of flat screens, i-phones, and a hedonic increases of the value of the new green cars do not matter anymore.) This is another chasm between the interpretation of inflation by government officials who did not lose jobs and those unemployed or retired and denied COLA adjustment of benefits. In addition, one may notice that government workers got swift salary increases that were later ostensibly frozen. Sooner or later, it leads to social unrest.

Data in General versus Computer Data

Computer-processed and stored data values (Gackowski, 2012) (always some patterns in form) are merely representations of something that is determined and entered by or on behalf of the end user who originated them or are the result of computing. Thus, the **focus** and the **perspective** of assessing computer data must be broadened and must also include the related ***quality assurance*** being in effect. Computer data values should be:

- **checked for** and **rectified** regarding detected quality deficiencies. (There are about 20 contributing factors to actionable reliability of data (Gackowski, 2012, Chapter 11)
- **faithfully** (one to one or with sufficient accuracy and precision) **mapped** into states of computer information systems, as defined by Wand and Wang (1996).
- **not** willfully or inadvertently **distorted** during the data-entry process.
- **not corrupted** while processed according to the prescribed procedures (e.g., *the infamous valuation of mortgage-based securities that later were dumped on the taxpayers*) and/or database design, as defined by Oliviera, Rodrigues, and Henriques (2005).

All of the above require careful planning, design, implementation, monitoring of organizational procedures, including internal and external auditing, and subsequent enforcement to bridge the inevitable gap that separates the conventionally defined data values from the data values actually stored and used by computers. **Computer-processed**-and-**stored data** are NOT by sheer default equal to **conventional data** that **symbolically represent facts.** To bridge the gap, adequate quality assurance must be in effect—a separate challenge for researchers and practitioners who deal with information, information processing, informing, and the use of related technology. This defies Buckland's (1991, or Appendix, item 7) definition of data "*whatever records are stored in a computer*".

Information as Data Answering Questions

Floridi (1999) offers an erotetic definition: "*Information is provided when data answer an explicit or implicit question made by a data receptor*" (p. 106).

First, one asks questions when one needs information, but then the communicated pattern that answers the question cannot be labeled data (the given or already known) when viewed from the **perspective** of the one who did not know and asked the question. Keeping in mind the physical view of information and informing, here, we deal with an example of secondary informing. The mentioned receptor will not be a data receptor but an information receptor, but technically it makes no difference. The one who answers the question uses the data in his/her possession (they are his/her data from his/her perspective) to inform the one who asked the question. The latter will become informed and hence will perceive it as information. Thus, what is a datum for one person may neither be an actionably reliable datum nor information for someone else. Authors of MIS textbooks present an over-simplified view that all information is simply derived from data; while someone's data may only become somebody else secondary source of information in contrast to primary informing obtained from research.

One may need a reminder that in this study we consider an operational fact a thing that exists, an event that occurred, and a potentially possible contingency. The last (third) component of the definition goes beyond conventional dictionary definitions of facts. For instance, in the realm of assisted living in case of choking the related procedure may read "Perform the Heimlich maneuver". On the one hand, this instruction (based on time tested empirical data) with a caregiver who possesses the necessary skill to perform the maneuver it constitutes a contingency--an operational (life saving) fact. On the other hand, with an individual who took a first aid course in order to meet some other requirement (e.g., working in a day care center) the acquired passive knowledge of how to perform the maneuver may not represent an operational fact, this time with potential fatal consequences.

One is immediately reminded here about the potentially disastrous consequences when academic senates of many state taxpayer supported colleges (including nursing school with bachelor and master degrees) voted that a "C- is a passing grade". This is a disgrace. They argue that this is better than no education or no degree at all, while actually it may become WORSE. The above exemplifies the need for making statements that fully account for the different **perspectives** of different entities and the potential **operational consequences** that determine their **operational** or **natural** in contrast to semantic **meaning**.

Floridi uses the example of the price for IBM stock. He considers the price a datum for a person who knows it, but information for a person who uses it to make a decision. Within a physical view of information, data, other elements of knowledge, or tested concepts, the use of any of them does NOT change the nature of the corresponding patterns that symbolically (in form) represent them in order to justify relegating them to a different category labeled information. A knife remains a knife whether used or not. For instance, the current ask or bid price for IBM stock (depending what you are interested in) is a primary datum to those who have access to the direct source. The same; however becomes secondary information to those who still must learn about it. The perception of the nature of this pattern will not change depending whether one uses it or not. Of course, secondary information must also be scrutinized whether it is actionably reliable. In most cases it means whether it has been obtained from a reliable source and can be adequately applied as secondary actionably reliable data.

Finally, the erotetic definition should be completely refuted as incomplete. Will anyone ignore a sign of danger or other warning because one did not ask for the warning? The only redeeming aspect of the erotetic definition of information as 'data that provides an answer to a previously asked question' is that such information may easier resonate with the asking entities, but one cannot be certain.

Warning signs tend to be ignored for many reasons, and many arguments will be raised against taking them seriously, with tragic historic examples. A psychological bias toward normalcy is a known phenomenon. Only a minority of Jews left Nazi Germany when they still were able to leave despite the fact that their intended final fate was widely and frequently publicly announced. Small capitalists rarely fled countries afflicted by revolutions despite Lenin's public statements in writing what awaits them: "*They (the capitalists) are so greedy that they will lend us their money to purchase the noose on which we will hang them.*" Actually, many capitalists lent the money, negotiated commerce, and helped to industrialize the country hell-bent on destroying them. Average citizens wait, not believing that their elected (even more when not elected) government officials, when pushed against the wall, will outright confiscate their money by devaluating it or making it gradually worthless by a runaway inflation. History tends to repeat itself in different countries with a different flavor. Humans try to avoid asking questions that may yield unpleasant answers.

Information as Data Endowed with Relevance and Purpose

Davenport (1997, p. 9), similarly to **Turban et al (2006, glossary),** writes "*information—data endowed with relevance and purpose*". Systems of operations and the situation in which they are conducted endow not the factors per se but their use with relevance and purpose; their processing, however, does not automatically convert them into information or anything else. Relevance and purpose are situation-specific use aspects that are NOT intrinsic to any factor, whether in substance or in form; they do not make factors informative. In general, to be information, a factor must be in form. Data are only subsets of information in general that, from the **perspective** of those that already possess them. They are given, factual, or assumed to be true; hence, by their very definition, they are no longer informative.

Authors of the quoted or similar statements ignore the principle of **perspectivism** of observations, and, worse, they articulate definitions that refer to qualities that do not distinguish the object to be defined from a broader class of objects. This violates the rules of a classic Aristotelian definition. Relevance and purpose do not differ, whether a factor is already given, known, or not, hence, whether they are data or information. In other words, in definitions, *do not attribute use requirements directly to the factor you use.*

When the Distinction of Data and Information is Irrelevant

In the book, *Quality Information and Knowledge,* **Huang, Lee, & Wang (1999, p. 13)**, similarly to Wand and Wang (Appendix, item 30, 31), present the first results of the MIT Project about information quality. These authors use the term "information" interchangeably with "data." We have here an example when the distinction does not matter. If information is any factor in form, including those already given, known, or assumed to be true (hence, data), the quality of the patterns that represent such factors, from whatever **perspective** one assesses them, is unrelated to such a distinction.

Practically, the best definition of quality seems to be the one paraphrased from Wikipedia ("Quality," 2009): ***Users' quality of information*** is an aggregate of their entire experience at all the touch points related to its use. A ***touch point*** may entail one or more aspects (dimensions) of the related user requirements. Thus, it refers to all aspects of the conducted operations. If deficient, it renders ineffective all the other categories of resources (software, hardware, communication) used, and, ultimately, the results of operations in the same manner, whether those factors have already been given or still must be acquired as long as the patterns that represent them, respectively, pertain to the same factors.

Informing as Resonance and Change of Operation Models

Gill (2008) views informing in terms of "*changes to client mental models.*" As true as it is, the **focus** is unnecessarily anthropocentric. Effective informing resonates with any entity informed that is capable of resonating; it changes any model in use, whether physical, descriptive, formal, informal, mental, or stored in computers.

Informing entities may exchange patterns when they can take on different corresponding states within similar ranges so that, by resonance, they may equalize and/or synchronize some of their corresponding states. The ***universally necessary conditions*** that are ***sufficient for effective informing resonance*** between entities (e.g., *inert matter, living organisms, robots, or humans*) are defined in Gackowski (2009, p. 41). Informing that fails to resonate is ineffective. Broadening the focus beyond communications among humans provides researchers and practitioners with down-to-earth insights into informing, which are otherwise hidden from them.

Finally, we arrive at the point where it is possible to suggest ultimately the most important use qualities of data or information for both theory and practice that most scholars, and especially authors of all known MIS textbooks, consistently ignore, while these qualities should be of the HIGHEST interest to researchers, practitioners, and majors in all disciplines. Informing science is transdisciplinary (Gackowski, 2012).

Materiality, Usability, and Usefulness of Factors in Form

After a rather extensive overview and discussion of innumerable aspects of information and data, it literally stuns that an aspect that reigns supreme over all the rest was mentioned by the quoted authors only once. Likely the commonly perceived subjectivity of information blinds authors and suggests it is impossible to assign a well-defined materiality to something perceived as subjective. In 1968, Kofler published his dissertation titled, *On Value of Information.* It is one of the precursors to what we know as **materiality** of factors. Studies about information and informing demonstrate that significant operational materiality of using factors in form literally plays the supreme role over all the remaining use requirements.

In operations, ***significant operational materiality*** is not only a **necessary primary** and **categorical** (universally necessary) requirement, but also is the fundamental, central, and most pervasive requirement related to the use of all factors, including factors in form. In most business cases, it can be interpreted as recommended by the Generally Accepted Accounting Principles (GAAP). Materiality reigns supreme over all the other aspects of information, data, and informing (including information processing). Except for research of unknown phenomena, in operations, practitioners ignore anything INSIGNIFICANT. Significant materiality is:

- **fundamental**—because it is the **only necessary use requirement** that provides each factor with a **sufficient reason** to be considered in operations.
- **central—**because it is **indispensable** for all considerations about **effectiveness** and **efficiency** of operations; it **ranks** or orders all factors.
- the **most pervasive** use requirement—because it **determines the materiality of** the remaining necessary **quality requirements** of the same factor, it determines the materiality of its **necessary companion factors** in tasks, and, to a lesser degree, it affects the materiality of **indirect factors** related to a **direct factor.**

There is probably no more compelling reason to teach MIS students any other concept in this domain than the **significant operational materiality** of factors in general and of data or information in particular. The reality is just the opposite. Literally all authors of the known MIS textbooks ignore this subject. The only exception is Alter (2002), who mocked it as *more elegant than practical*. It illustrates once more how *blind* examiners of the metaphorical elephant miss the central **focal** point of all considerations and the most fruitful **perspective** possible, as required by the postulate of **teleological perspectivism.** Researchers and practitioners should literally assess each factor in the light of the purpose it serves. Purpose is the main point of reference to determine operational materiality (Gackowski, 2012) of operational factors and, among them, information.

Necessary primary use requirements of any operational factor in form, such as operationally **recognizable**, operationally **relevant**, of operational **meaning**, operationally **significantly material**, operationally **on-site available**, operationally **on-time available**, operationally **actionably reliable (**including **credibility** and **actionable believability**), and **other situation-specific necessary primary use requirements**, if met, provide a sufficient reason to consider a single factor in form that is ***operationally usable***. Should not our graduating business students know what makes a datum or an information item operationally usable?

Factors, to be ***operationally useful,*** must first be **effectively operationally usable,** and, second, they must jointly meet the requirement of their necessary primary (categorical) ***operational completeness*** (e.g., *identification of the target, location* and *time* for an effective drone attack) of a direct task or a task that triggers a ***direct task*** (that directly contributes to the main purpose of operations), and, finally, they must be actually **engaged** in operations; otherwise, they are ***usable factors in waiting.*** One must emphasize here that **operational completeness** as task specific is an entirely different concept than completeness of rows and columns in database tables or completeness of mapping of reality into states of information systems. In studies of information quality, only the latter two concepts of completeness are mentioned and used. This is a far departure from the reality of conducted operations, and it is a SERIOUS OMISSION. Marketers, politicians, and propagandists know how to complement their essential messages with other messages that help resonate better. Thus, operational completeness also includes factors that facilitate resonance.

Conclusions

The findings (summarized in the Appendix) demonstrate that the potential in viewing information simply as physical patterns of signals and informing as developing, processing, and spreading such patterns elucidates and demystify many murky issues, confusions, and misconceptions surrounding the discussed concepts. It does not mean that the studies on more esoteric aspects of information should be abandoned. If anyone succeeds in developing provable or at least replicable results using a different approach, it should be discussed and incorporated into a solid body of knowledge.

The common anthropocentric bias blinds scholars and practitioners by limiting them in choosing a broader focus and in viewing reality from the seemingly most fruitful perspective. This bias, as natural it is, unnecessarily limits research. Most scholars limit the role of information and informing to entities with mental processes of cognition, while information that characterizes the structural aspects of the universe does not require for its existence (as matter and energy) to be observed, recognized, and subject to mental processes. At the same time, data and information are objects of all mental processes of entities informed and informing entities. Those, in turn, in operations use matter and energy to arrange reality by some designs. Materiality or added value is usually considered a human concept that is attributed to objective processes only. To the contrary, survival rate is not a human concept but a harsh reality that is related to processes occurring independently of human perception. In natural processes, economy is obvious. Water and electricity always follow the path of least resistance; innate matter and energy tend toward a uniform distribution (states of higher entropy), which is nature's reality and a universal law.

The key to a full comprehension and appreciation of the physical views is to focus one's attention, not so much on what information and informing is or might be per se and in general, but, rather, on its role as an **objective** factor in form in operations and extension of replicable knowledge; where rubber meets the road; where theory meets the corresponding practice. It seems to lay the groundwork for more rigorous research and more enlightened practice, where the determination of materiality of information, data, and any other elements of knowledge should guide practitioners in prioritizing research-and-development efforts.

This paper is presented to elicit challenge, critique, discussion, and suggestions.

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Appendix. An overview of disparate views of information and data with comments in contrast to viewing them as physical patterns of elements

#	SOURCE	INFORMATION	COMMENTS	DATA	COMMENTS
1	Ackoff (1989)	*Data that are processed to be useful*	Usefulness of an object does not justify a change of their name. Definition implies controllers' perspective.	*Symbolic products of observation*	The best, but neglects their factual nature. Definition implies controllers' perspective
2	Alter (2002)	*Data whose form and content are appropriate for a particular use*	Appropriateness does not justify a change of their name.	*Facts, images, or sounds that may or may not be pertinent or useful for a particular task*	Confuses facts and their representations. Pertinence depends on context
3	Awad (2004)	*Reformatted or processed data. Aggregation of data that make decision-making easer; has a meaning, purpose, and relevance; data in context.*	No amount or formatting and processing can add purpose and relevance to data collected without purpose and care for relevance.	*Static, unorganized, and unprocessed facts. Set of discrete facts about events.*	Confuses facts and their representations. Facts remain facts whether organized or processed.
4	Baltzan & Philips (2011)	*Data converted into a meaningful and useful context*	No amount of conversion changes the operational meaning. Change of value or context does not change the essence of data.	*Raw facts that describe the characteristics of an event or object*	Confusion of facts and their descriptions
5	Bellinger (2004)	*Information entails an understanding of the relations between data … relatively static in time and linear in nature … depends on context*	Any relations attributed to data as defined to the right are mere speculations. Why static and linear?	*Meaningless point in space and time, without reference to either space or time.… an event …, a letter out of context … without a meaningful relation to anything*	Useless for practice and research.
6	Boland (1987)	*informing as … information is the **in**ward forming of a person*	Beyond boundaries of science	Unknown	

#	SOURCE	INFORMATION	COMMENTS	DATA	COMMENTS
7	Buckland (1991)	*Knowledge based on belief; intangible; if recorded, it is information-as-thing*	If intangible, beyond boundaries of science	*Whatever records are stored in a computer*	Imprudent assumption of quality of records.
8	Callaos & Callaos (2002)	*… generated inside the mind of a person … by the data stimulus, as well as… individual experience.*	Beyond boundaries of science if not externalized; focuses on the consequences not on the message	[D]atum *as the objective side of the coin, and information is its subjective side*	Both sides of a coin are objective. Not a good conceptual schema.
9	Davenport (1997)	*Data that make a difference*	Who will collect data that make no difference? Undefined perspective.	*A discrete, objective fact about events*	We cannot store facts. Facts are also things in existence.
10	Dervin (1983)	*Is subjective—the real, while the objective or external is only the representation of the real,* and *"information is not a thing but a construction."*	Beyond boundaries of science. Turns up side down; Merriam-Webster's "*a construction is a constructed thing.*"	N/A	
11	Floridi (1999)	*Is provided when data answer an explicit or implicit question made by a data receptor; notoriously a polymorphic phenomenon and a polysemantic concept.*	Will one ignore unsolicited tornado warnings? But questions asked at least improve resonance.	N/A	
12	Faucher, Everette, & Lawson (2008)	*Meaningful interpretation of existence; has purpose and is connected to understanding of existence.*	Proper for philosophical considerations. Improper for routine operations.	*A basic interpretation of existence. It is a purely descriptive construct.…*	Interpretation is not necessary (intercepting encrypted messages to break the encryption)

#	SOURCE	INFORMATION	COMMENTS	DATA	COMMENTS
13	Fricke (2009)	*Can be syntactic (limited to theories of communication) or semantic (focuses on meaning, truth, and other semantic properties); more extensive & logically stronger than data.*	Abstractions inadequate for thinking within the context of routine operations.	*Anything recordable in a database in a semantically and pragmatically sound way (for information science). All data is information.*	One of the best, with rarely explicitly defined perspective. Why limited only to databases?
14	Gill (2010)	*Changes clients' mental models*	True, if informative, but of well-defined perspective; why limited only to mental models?		
15	Goldratt (1990)	*An answer to the question asked*	Unnecessarily limited to humans and only when a question is asked	*Any string of characters that describe something about reality*	Implies factual nature; omits whose data; context – operations.
16	Haag & Cummings (2008)	*Data that have particular meaning within a specific context*	Particular and specific, hence impossible to generalize, context cannot change the nature of data.	*Raw facts that describe a particular phenomenon*	Facts are not descriptions; of no defined purpose & perspective.
17	Huang, Lee, & Wang (1999)	*Use data and information interchangeably*	Quality assurance remains unaffected whether one deals with data or information	*Use data and information interchangeably*	No difference for quality assurance.
18	Jessup & Valacich (2008)	*Information, such as words or numbers*	Words and numbers do not represent much without a convention.	*Recorded, unformatted information, such as words or numbers, which often has no meaning in and of itself*	Useless for practice and research
19	Kroenke (2008)	*Knowledge derived from data, data in meaningful context, data processed, a difference that makes a difference*	Describes object to be defined by another undefined object; a tautology.	*Recorded facts or figures; one of the five fundamental components of an information system*	Figures on their own are useless for practice and research.

#	SOURCE	INFORMATION	COMMENTS	DATA	COMMENTS
20	Laudon & Laudon (2011)	*Data that have been shaped into a form that is meaningful and useful to human beings*	No amount of shaping will change the operational meaning and materiality of data; it may facilitate their use.	*Streams of raw facts representing events occurring in organizations or the physical environment before they have been organized and arranged into a form that people can understand and use*	Facts do not represent anything; they are something of existence or that occurred. Only representations of facts can be organized and arranged.
21	Mazur (1970)	*An elementary association, transition, or transformation between transversal pairs of signals in communication channels; a discrete countable unit*	Abstract definition of patterns of signals; Shannon's formula derived without using probabilities; renders information countable; extends its use beyond communication.	*Term not used. Parainformation represents a factor in form that is available to entities informed, hence equates to datum—the already given.*	Good but ignores their factual nature. Within the context of control, it implies the perspective of the control unit or the controller.
22	McLeod & Schell (2001)	*Processed data or meaningful data*	No amount of defined or undefined processing will add operational meaning that original data lack.	*Facts and figures that are relatively meaningless to the user*	Useless for practice and research
23	Neill (1992)	*Equates information with knowledge, "knowledge representation is not knowledge but representation of knowledge"*	Describes an object to be defined by another undefined object	N/A	
24	O'Brien & Marakas (2010)	*Information ... is data arranged in a meaningful manner that add value to the user.*	It may facilitate use of data, but no arrangement can add operational materiality to a factor in operations that lacks it.	*Facts or observations about physical phenomena or business transaction; objective measurements of the attributes of entities such as people, places, things, and events.*	Confuses facts with observations

#	SOURCE	INFORMATION	COMMENTS	DATA	COMMENTS
25	Rowley (2007)	*Conclusion: information is typically defined in terms of processed data with regard to meaning, structure, value, and purpose* (her summary).	No amount of defined or undefined processing will add operational meaning that the original data lack.	*Elementary description of things, and events of no meaning, value, and context*	Hence, useless for practice and research
26	Shannon (1949)	N/A		N/A	Defines only the amount of information (statistical measure of the difference it makes)
27	Stair & Reynolds (2006)	*A collection of facts organized in such a way that they have additional value beyond the value of the facts themselves*	No amount of defined or undefined organizing will add operational meaning that the original data lack; may facilitate its use.	*Raw facts, such as an employee's name and number or hours worked in a week, inventory part numbers, or sales orders*	Confuses facts with their representations
28	Stonier (1997)	*An intrinsic component of all physical systems; the third essence that supplements matter and energy in viewing the universe; ascribed to their organization or lack thereof.*	Mazur's qualitative theory of information, in the author's opinion, can serve as a perfect elaboration of Stonier's view.	N/A	
29	Turban et al. (2006)	*Data that have been organized so they have meaning and value to the recipient*	No amount of organizing will add operational meaning or materiality that the original data lack.	*Raw facts that can be processed into accurate and relevant information*	Only representations of facts can be processed; no processing adds relevance and accuracy of data.
30	Wand & Wang (1996)	*Use data and information interchangeably*	Within the context of quality assurance, there is no difference.	*Use data and information interchangeably*	Within the context of quality assurance, there is no difference.

#	SOURCE	INFORMATION	COMMENTS	DATA	COMMENTS
31	Wang & Strong (1996)	*Use data and information interchangeably*	No difference within the context of quality assurance.	*Use data and information interchangeably*	No difference in quality assurance.

View of information and data as physical patterns of elements that may serve as reliable factors in decision making for operations appears to eliminate most if not all controversies discussed in the paper or offers a verifiable unambiguous answer to them

#	SOURCE	INFORMATION	COMMENTS	DATA	COMMENTS
32	Author's proposed view	***Primary information***—*any pattern of elements in form* (of no other role on its own in contrast to patterns in substance) *obtained by direct observation of the reality of interest* (existence)	Symbolic representation defined physically as a tangible factor in operations and research and obtained directly from its source	***Primary actionably reliable data***—*primary information scrutinized sufficiently;* provable, at least replicable; *documented with regard to purpose, space, time, and other circumstances.*	Defined as scrutinized primary information that is given (available according to their etymological roots; hence known), factual, actionably reliable, or assumed to be true
		Secondary information *obtained by communication or transportation of primary data by users who did not participate in direct observation, research, and interpretation*	Self-explanatory	***Secondary actionable reliable data***—*scrutinized for practice or research secondary information obtained by communication or transportation from indirect sources*	Self-explanatory

Biography

Zbigniew J Gackowski has experience in industry, public administration, and universities. His teaching and research bridge the gap between Central European and US experience in Computer Information Systems (Warsaw Polytechnic, The University of Michigan [*Fulbright Research Scholarship*], Purdue University [Visiting Associate Professor], Baruch College [Visiting Professor], CSU, Stanislaus [Visiting and Tenured Professor], and the University of Melbourne [Visiting Professor]). His research has received much recognition. While in Poland, he published more than 120 items, among them 4 books and 6 papers in refereed journals and 12 papers presented across Europe, the United States, the Middle East, and South America. While in the USA, he taught at three USA universities, and wrote 32 research papers that were published in the proceedings of ASIS, ACM, WDSI, *Information Systems Educators Conference*, *The Informing Science Institute*, and the *International Conference on Information Quality* at MIT, 4 book chapters, and 1 scholarly book. He is a member of ACM, a charter member of the *Association for Information Systems* and a founding member and honorary fellow of *the Institute of Informing Science.*