Appendix

Knowledge, Information, and Knowledge Systems: Explaining the Conceptual Confusion

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Introduction

The following discusses human knowledge as a personal cognitive process. It challenges the information-knowledge progression of conventional thinking and serves to not only underscore that KM is a complex management technique but also an evolving field.

What is Knowledge?

Knowledge is a mental or cognitive state or phenomenon in which an individual has mastered a description of reality, a concept, or slices thereof. There is no knowledge but that which exists in the mind. The essence of the word “knowledge” is to “know something with familiarity gained through experience or association” as defined
in the dictionary. Hence, experiences or associations are phenomena of cognition, which occur in the mind.

Does this focused definition of knowledge necessarily prescribe the doom of knowledge systems in organizations? Not in the least. There is ample room and compelling reasons for knowledge systems to exist. The purpose of this chapter is to clarify the confusion that seems to pervade the literature as to what constitutes knowledge and how it relates to information.

The assertion that knowledge, as we define it, exists only as a cognitive phenomenon has been previously addressed by those who considered the existence of “tacit” knowledge. Michael Polanyi coined this term and advanced the argument that there are two types of knowledge: (1) “tacit,” which is knowledge contained in the person’s mind, and (2) “explicit,” which is knowledge that people externalize, share, and diffuse. Ikujiro Nonaka and his colleagues extended this typology of knowledge. They revealed the method used by successful Japanese companies to facilitate the sharing of knowledge by their members, thus turning “tacit” knowledge into “explicit” knowledge.

In this literature, both types of knowledge are considered as equal aspects of the phenomenon of knowing. The difference between them seems to be the locus of the knowledge. Tacit means it is embedded in the cognitive or mental enclosure and explicit means that the knowledge has already been diffused outside the individual’s mind.

Here knowledge is defined solely as a phenomenon of the mind. Explicit, shared, or diffused knowledge is not true knowledge. Whatever the entity that floats in databases, information systems, or knowledge systems, it is not knowledge but the externalization of the processes of the human mind, which are the only constituent components of knowledge.

Human beings who live in societies must share what they know with others. The motives for this are survival, competitive pressures, and the need to grow and to add to our stock of skills, competencies, and capabilities. Add to these our need to cooperate to achieve complex tasks, and the result is the plethora of social, economic, organizational, and psychological reasons for the drive to share what we know and to tap the knowledge of others.

To do so, we devised means of communication, both nonverbal and languages. As philosophers such as Ludwig Wittgenstein and linguists such as Noam Chomsky have suggested, language allows us to exchange our description and understanding of reality—albeit in an imperfect mode. We are able to create linguistic artifacts, such as intellectual nuggets, which are statements about reality, as we know it and as we are able to share and to externalize it. Polanyi had even suggested that “tacit” knowledge is that knowledge which individuals are yet unable to externalize. But the issue is not the matter of where such sharing will occur, nor that all tacit knowledge may at some point become explicit. The issue is that, as individuals, we
are bound by our ability to express our knowledge, to translate what we know into “shareable” quantities, and to externalize it via the communicative and linguistic tools we possess. Barring direct access by others to the crevices of our mind and a direct reading of our cognitive thoughts, we are limited in our ability to externalize what we know.

Externalized knowledge is not knowledge. It is a limited translation or, in graphic terms, a fuzzy picture of whatever knowledge we were able to share via the tools of human communication and language. What exists outside the mind is in the form of a collection of linguistic artifacts. These are “intellectual nuggets,” which may be propositions, statements, formulae, symbols, or any other manifestation of human communication tools and devices.

This picture or projection of our reality (as we know it) is what we share and communicate to others. All such “explicit” projection of what we know is not only an incomplete and, to an extent, biased imprint of what we know, but it also is exposed to the tribulations of the shortcomings and barriers embedded in human communication.

What is Information?

What is this externalized form of what we know? As faulty and “non-knowledge” as it may be, this is a projection or representation of the reality as we are able to provide to others. Human interaction and our innate ability to communicate conjure to create a standardized mode of expressing this reality.

Once externalized, this description of reality (intellectual nuggets) loses its cognitive characteristics and its personalized format, which is the essence of knowledge. What is left is a collection of nuggets, standardized to a point where all who are versed in the “key” to deciphering this description are able to access and to absorb and comprehend its content.

Perhaps the term “information” is appropriate to describe and to identify this collection of externalized nuggets. The distinction made here is therefore not between “tacit” and “explicit” forms of knowledge, but between “knowledge” and a radically different form of description of reality, accessible to all, and residing outside the mind.

This distinction is not just a matter of semantic trifling. Rather, there are substantive differences between knowledge and what we may call “information.” In addition to the different location of its existence, information is a “processed” description of reality, presented in a standardized form. Once acquired, interpreted, “read,” or deciphered, this “information” is not knowledge—it remains the externalized projection of what we know.
For example, I know that upon my study of an organization, it is faltering and on a verge of collapse. I compose a report in which I detail this conclusion and how I arrived at it, my methodology, and my initial assumptions. This report contains intellectual nuggets, which are opinions, lessons, findings, conclusions, and descriptions of the organization and my exploration of its existence and its workings. The report is not knowledge. It contains “information” about the organization. The reader of the report does not know that the organization is on the brink of collapse, not because my conclusion is subjective, but because the projective “information” provided in my report needs to be absorbed by the mind of the reader and undergo the processes of generation of knowledge.

Here lies the crux of the differentiation between knowledge and information. As a cognitive phenomenon, knowledge is created when sensorial inputs are processed and clustered in the mind. Such nuggets are absorbed through the five senses and clustered as a cognitive phenomenon, thus generating knowledge. In a popular version, this would be equivalent to not “knowing” until one walks in another’s shoes. Creating knowledge through sensorial inputs is to experience the reality about which we generate knowledge.

### Challenging the Information-Knowledge Progression

The act of obtaining and absorbing information about the phenomenon is far from experiencing it via the clustering of sensorial inputs. Conventional thinking suggests that we have a progression: from data, to information, to knowledge, and to wisdom. Such a progression, in my view, is a conceptual and ontological fallacy.

The information-to-knowledge progression conveys the erroneous conception of how we can transform information into knowledge. To agree with this notion one must have an adequate theory that will explain how information is processed into knowledge. Such a theory is yet to be devised. A feeble excuse for the lack of such a theory is sometimes advanced on the grounds that the mental processes where information is transformed are the realm of consciousness and we are yet to unlock this amazing human ability.

However, if we approach this phenomenon with knowledge creation as the starting point, all that is needed is to establish whether the clustering in the mind is based on underlying concepts, as argued by some epistemologists, and what are the criteria for clustering and sensemaking. The creation of knowledge as a mental process is still a marvel to be unlocked, but there is no requirement in this approach to add a theory that attempts to explain how information is transformed within these cognitive processes.
What are Knowledge Systems?

When people externalize what they know, they do so within informal surroundings and they also do so within organizational boundaries. From times immemorial, humans externalized what they know to their kinfolk and to the members of their hunting parties. They raised their young and mentored them in the skills needed for survival and in understanding their environment.

As formal organizations emerged, there also arises the need to gather, to assemble, and to store the externalized knowledge of those who possess such knowledge. Initially, it consisted of a raw collection of skills (how to plow, sow, build bridges, ignite a fire, and make tools). Later, this need has evolved to more complex notions of why nature behaves as it does (why the seasons of the year, the flooding of the rivers, the frailty of the human existence, and the birth and death of living organisms).

Organizations thus became harbingers of the knowledge of their members, and a healthy trading began in such collections. In many instances, a ban was declared over revealing certain skills and competencies. The Philistines had such a ban on ways and means of forging weapons—a technology they possessed and kept as secretive as possible. Over the millennia of human civilization, organizations accumulated records of externalized knowledge (“information”) for the purposes of conducting operations and for their performance and survival.

As harbingers of these records, organizations do not “know.” They are repositories of whatever their past members were good enough to deposit and leave behind. Such records, containing a variety of topics of information, were used for training, operations, competition, and growth. Some of the information in these records was lost because of the unreadable form in which it was produced or stored, or other attributes of poor communication. Nonetheless, organizations became the key harbingers of whatever was shared by individuals after they departed the world of the living and could not themselves share their knowledge.

Knowledge systems and knowledge-based anything in the organization are therefore a misnomer. What is stored in organizational records is “information,” since knowledge is solely defined as the cognitive activity in the individual’s mind. However, the information stored in these records is the product of the attempts of countless individuals to externalize what they know. Hence the connection to the notion of knowledge.

In the final decade of the 20th century, we forcefully discovered the role that knowledge and its organizational systems play in the working, performance, success, and survival of the organization and its members. The notion of “knowledge workers” appeared and management scholars, such as the late Peter Drucker, emphasized their importance in the changing face of the global economy. What prompted this rush to identify and to be so laudably concerned with “knowledge-workers?”
As I suggested in my book *Creating Value with Science and Technology*, during the second half of the twentieth century there were three complementary phenomena. Massive investments by many nations, particularly the United States in publicly funded science and technology, complemented dramatic improvements in the education process. In much of the world, countries have invested in elementary and higher education to extents never before dreamed by previous governments. University education has become a popular rather than an elitist experience. Thirdly, dramatic improvements in sea and air transportation and the lowering of tariffs and several commercial treaties, plus the relative liberalization of economies, which previously had in place prohibitively defensive tariffs, have all contributed to the globalization of trade.

When the relative advantages of land, capital, and standardized workforce began to diminish or disappear, skills, competencies, and “knowledge” have emerged as crude yet powerful substitutes to the national economic toolkit. Because of the inherent difficulties in sharing and diffusing knowledge, the emphasis on this new element of economic power is gaining forceful momentum in both business and academic circles.

In global terms, as the literature on technology transfer has shown in its conclusive findings, the simple transfer and diffusion of “what we know” from country to country in a given area is highly insufficient to train a generation of “knowledgeable” people. Direct contact and mentoring are necessary so that which is shared by those who know may be absorbed by those who don’t know to some degree of adequate use.

Within this trend of the focus on and the veneration of knowledge, organizations are increasingly creating and restructuring their “knowledge systems.” These are collections of records deposited by individual members, past and present, who had knowledge about a topic, a given area, or an answer to a specific query. As they indulge in developing and using these systems, organizations are also becoming painfully aware of at least three problems. First, whatever they accumulate in their “knowledge systems” is only a fraction of what their members actually know. Secondly, members are very reluctant to share what they know and to deposit what they know in these systems. Thirdly, unlike libraries and traditional information systems, “knowledge systems” are a different type of repository. If a member of the organization needs to know how many people are employed by a competing company, she can find this item in a traditional information system, library, or depository. If, however, the member wishes to know what are the comparative advantages of the competing company in the commercialization of nanotechnology, such “knowledge” is not readily available nor is it accessible in the organization’s systems. “Knowledge systems” are excruciatingly difficult to structure, manage, maintain, and utilize.
Why the Confusion?

If, as proposed here, all that is available in systems, records, and any medium outside the human mind is, at best, information—not knowledge—then we have some level of confusion between the concepts of information and knowledge. The issue, therefore, is not how to better and more fully extract “tacit” knowledge from organizational members. Rather, the issue is how to reconcile the coexistence of information (as the externalized mode of what we know) and knowledge (as the cognitive processes in the mind).

These two very distinct phenomena (information and knowledge) seem to not only coexist but also have some interaction, via the knower and the user of the externalized content. However we choose to name these phenomena, we have mental processes on the one hand and a collection of the externalized reflection or projection of these processes on the other. They are somehow connected, they are related, and they interact in the activities of organizational members.

We have therefore a gap between what we know, and the volumes of collected material from many individuals. This material is viewed as the externalization of what these other individuals had chosen to share and to deposit in the repository. The gap is conceptual: how do we transform one into the other? How do we make the interaction a successful event, when knowledge and information available in repositories are such different phenomena?

Consider a mundane example of a pedestrian skill. I gain access to a repository of information about tying the laces of shoes. I am exposed to text, graphics, and movies about how laces are tied. With all this information absorbed, I still do not know how to tie the laces of my shoes. I need to see the laces, touch them, try, fail, try again, and finally complete the cognitive process in my mind where the result is that I now know how to tie the laces of my shoes. Having access to the information about the skill does not make knowledge of the skill, nor of more complex forms of knowledge such as abstract notions and conceptual views of reality.

Explaining the Gap:
A Theory and Some Applications

To explain the gap between the phenomena of “knowledge” and its external projection as “information” we need a theory of the “interaction” between the two phenomena. This theory would attempt to explain: (1) how we externalize what we know in the form of intellectual nuggets, (This means how we translate our cognitive processes into communicative artifacts so that we may share our mental capacities with others),
and (2) how we input “information” or the externalized communication artifacts and process them in our mind, as we do with clustering of sensorial inputs to create the mental capabilities we call knowledge.

The first question this theory would attempt to explain has been formidably addressed in studies of human communication, semantics, linguistics, and semiotics. The second question is the crucial task of this “theory of interaction.” It deals with the difficult objective of explaining how we create knowledge not from the “raw material” of sensorial inputs, but from the assembly of regurgitated items of whatever others have externalized and communicated outside their minds. How do we input, process, and convert this material into “knowledge?”

There are cognitive, philosophical, and biological aspects to this theory. The mental processes in this case would perhaps be different from those that command the clustering of sensorial inputs. Consider, for instance, the biological function of generating energy in the body. Energy can be generated by digesting food, extracting its nutritional components, and transforming them into energy in the cells. This process is similar to the creation of knowledge from the mental “digestion” of sensorial inputs. Conversely, if we inject energy-producing agents directly into the cell, the process of generating energy will be quite different.

The philosophical aspect of this theory intersects with the problem of induction. Sir Karl Popper argued that, with his conjectural knowledge, he had solved the problem of induction by offering a good solution to David Hume’s logical and psychological queries and to Bertrand Russell’s struggle with this issue.

Hume’s approach to induction was focused on the unique role of experience in shaping human reasoning. He argued that the generation of “general laws” or “expectations of regularities in nature” is a mental process based on our prior experiences. As we experience regularities in natural or other phenomena, we therefore project them to expectations and general laws (induction from the particular to the general). But Hume also suggested that humans associate ideas to create cognitive generalizations of phenomena in their surroundings—in the absence of experience. Hume justified such human attribution as a result of faith.

Popper combined what he described as Hume’s logical and psychological problems of induction, and offered his solution. He proposed “conjectural knowledge” by which all universal laws or theories are conjectural and empirical explorations of these generalizations can be refuted but their “truth” cannot be established empirically.

The conjecture solution proposed by Popper greatly contributed to the philosophy of science and to scientific methodology. Donald Campbell relied on Popper’s philosophical constructs when advancing his “evolutionary epistemology.” But such advances in philosophy and methodology have not contributed to clarifying the gap between the sensorial impacts we gather from our world and the formation of knowledge as mental-cognitive processes.
Popper addressed this issue in his description of the “three worlds” of our perception of reality. The first world is the physical, the second the mental, and the third consists of ideas or thoughts. He believed that such entities of the “third world” are human discoveries and do exist outside the mind and apart from the physical world.

Although this is an elegant attempt to offer a solution to externalized knowledge, the ontological autonomy with which Popper endows human ideas and human conceptualization of reality is at best an egregious explanation. Human knowledge is more complex than ideas and universal laws. It contains skills, competencies, and capability to link, connect, assemble, and cluster disparate inputs. The externalization of, say, the theory of numbers (to use Popper’s example) as a “man-made” conception of a certain reality does not make it ontologically independent from the mind which created such notions. The theory of numbers or the description of the evolution of biological systems or business corporations is not knowledge. Only when this “third-world” (in Popper’s terminology) is combined with the human mind (the “second world”) do we have knowledge. Ontologically such notions exist in records, documents, tombs of ancient kings, or supercomputers—but they are, for the purpose of knowledge, as “alive” or “knowing” as the paper, stone, or silicon chip in which they exist.

All this is different from what Popper termed the “bucket” vs. the “searchlight” approaches to knowledge, and the creation of scientific knowledge. The “bucket” approach argues that observations (experiences) precede hypotheses. In his approach to the methodology of scientific hypotheses, Popper suggested the “searchlight” approach, in which hypotheses precede observations and are thus tested by empirical observations. This methodological procedure for scientific exploration represents a focused view of how one should go about studying the world outside the mind. However, we go about it, the inputs to the human mind remain within the confines of the senses, which are then clustered to form higher-order knowledge such as concepts and theories. On the other side, the externalized form of such knowledge is re-absorbed by the human mind in a reverse process by which, I suggest, the externalized knowledge is “decomposed” into sensorial inputs and reassembled in the mind.

In summary, I suggest that the only possible process of cognition (and knowledge creation) is the mental process by which the neurons in the human brain cluster sensorial inputs. The belief (expressed by many philosophers and cognition scientists) that humans have the mental ability to produce, input, and process ideas, concepts, and theories is false. The process is as follows (Figure 1):

We are currently in the very preliminary stages of uncovering the process of (A) above—how sensorial inputs are clustered. Recent findings suggest that fewer neurons than we had believed are involved in clustering sensorial inputs such as images (vision) for the creation of knowledge about famous people’s faces stored in our
memory. We are beginning to gain insights into the efficiency of our brain, but we are still far from uncovering the processes described in (A) and (B) in Figure 1.

**Some Implications**

The view expressed here (that knowledge is narrowly defined with the knower, and all externalized forms are not knowledge) has some applications in the design of information and knowledge systems. If, as we are now discovering, our mental processes are very efficient and we need very few indicators, metrics, or sensorial inputs to create very complex concepts, then the implication for knowledge and information systems is a call for efficient and very economical content in the design. As I had suggested in my book, *Knowledge and Knowledge Systems: Learning from the Marvels of the Mind*, a small number of sensorial inputs is sufficient to form complex mental notions. In addition, the cumulative impact of previously processed sensorial inputs and deposits in our mental memory contribute to an even more efficient, and certainly more effective processing of sensorial inputs to create knowledge in the form of complex notions, concepts, and theories.

Another implication is in the reassessment of the key concerns in the design and management of organizational knowledge systems. Currently we are mainly focused on the issues of tapping tacit knowledge, combining it with “explicit” knowledge, and learning by being embedded in external networks. A reassessment would change the problem from tapping tacit knowledge to designing a knowledge system in which the content deposited by organizational members will be in a form amenable to processing by other members or users of the system (per knowledge process B previously shown).
Finally, a key implication relates to the basket of incentives the organization provides its members to share their knowledge and to use its knowledge system. These incentives should be reformulated to fit the searching and processing behavior of the members. People do not search for externalized knowledge by assembling bits and pieces of information. Rather, their searching mode is focused on a topic, such as “What do we know about ____?” The reformulated incentives should compensate behavior that produces “quality,” not “quantity.” Members should not be compensated for the amount of use or deposits they perform with respect to the knowledge system in their organization. Rather, incentives should emphasize the content and its rate or power of absorption by other members of whatever members deposit in the knowledge system.

**Conclusion**

To know is the most laudable and the most painful of human capabilities. Much of our effort in organizations seems to focus on sharing, preserving, and diffusing what we know. The recent emergence of the nations of the “knowledge economy” and “knowledge workers” has helped to establish a disciplinary area of “knowledge management,” beyond the realm of the management of information systems.

In this chapter, I have proposed a view of human knowledge as a personal cognitive process. Whatever we are able to externalize and share with others is but a collection of “information” which now should be absorbed and digested by other people to create knowledge in their minds. Knowledge cannot be externalized in the same form or power of its existence in the mind. This view would dictate some reassessment of the design and taxonomy of knowledge systems in organizations, and the type of incentives we give organizational members to use these systems.