KNOWLEDGE – AN OPERATIONAL DEFINITION

A KNOWLEDGE BRIEF

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1 SITUATION

Today, computer technology and the Internet give us unprecedented control over information. We can create, store, retrieve, analyze, and disseminate large amounts of information with great ease. Those who exercise this control effectively will experience an unprecedented opportunity to create valuable knowledge in their fields of activity. And those who pursue this opportunity will gain an unprecedented advantage over those who don't.

2 PROBLEM

So, how do you manage large volumes of information to best effect? How do you structure information to facilitate the extraction of knowledge through associative methods and scientific analysis? Finally, how do you get this knowledge to the point of greatest need in a timely and cost-effective manner?

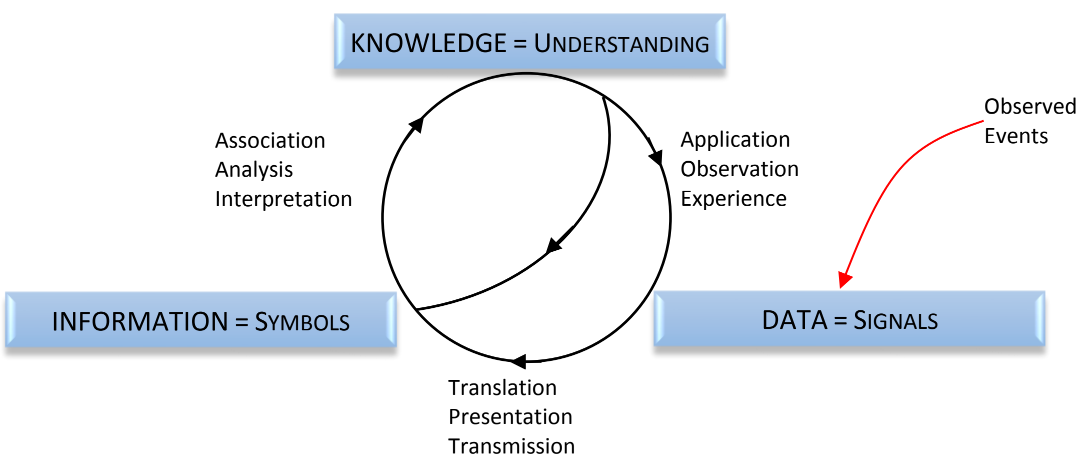
3 SOLUTION

Effective knowledge management requires an understanding of what knowledge is and the principles that determine how it is created. This technical brief presents a concise overview of what constitutes knowledge and its formation.

4 AN OVERVIEW OF KNOWLEDGE AND KNOWLEDGE CREATION

Knowledge represents the highest state of our awareness of the universe. This awareness began with our observation of and reflexive response to physical signals in the environment. It progressed to our translating these signals into symbolic representations that could be stored, manipulated, and passed down to the benefit of future generations. Eventually, the association of these symbols into complex schema led to a better understanding of the world around us. This progression has led to creation of intellectual tools (language and logic) that have allowed us to solve many of our problems and build the complex civilizations that we live in today. As a corollary, acquisition of understanding has led to the development of ever more powerful and intelligent means of observing signals and creating symbols that feed forward into an exponential growth in the very understanding we seek.

CYBERNETIC RELATIONSHIP BETWEEN SIGNALS, SYMBOLS, AND UNDERSTANDING



5 DATA, INFORMATION, AND KNOWLEDGE – OPERATIONAL DEFINITIONS

Computer technology has greatly leveraged the cycle of signal observation symbol formation and understanding. However, this has led to a new problem. In the past a person could gain a good grasp of man's understanding of the world through the reading of a judiciously chosen library. Today a single individual can never hope to read through all the stored information on a single subject let alone master all that we know about it. To manage this valuable resource to the effective solution of our problems we need to gain access to and apply this understanding in a timely and effective manner. As a foundation to achievement of this goal we need to define a highly organized system of data capture information storage, and knowledge formation.

DATA: [Ink on Paper / Electrons on Ferromagnetic Media] is a set of signals in the form of energy that can be instantiated into a physical form for storage, retrieval, manipulation, and conversion back into energy for transmission.

Data may be transmitted in many different forms such as light, electricity, sound, and temperature. These data may be stored as memories or instantiated as physical states on various types of media. The classical example is ink imprinted onto paper. Ink on paper allows us to store a sequence of hand motions – writing – or automated physical movements – printing – as signals that can be retrieved, viewed, read and shown to others. The modern counterpart is the ferromagnetic material applied to computer disks. This material allows us to use computers to translate hand motions – typing – and many other signals into electromagnetic pulses for storage on a disk. These data may then be retrieved into random access memory gates for manipulation by software programs, projected as electrons onto video monitors for viewing, and transmitted as electrical impulses via communication devices.

INFORMATION: [What, Where, When, Who, and How Much,] is data translated through programmatic logic into symbols that are grouped into sets that describe the state of a plurality of observable objects and actions (events).

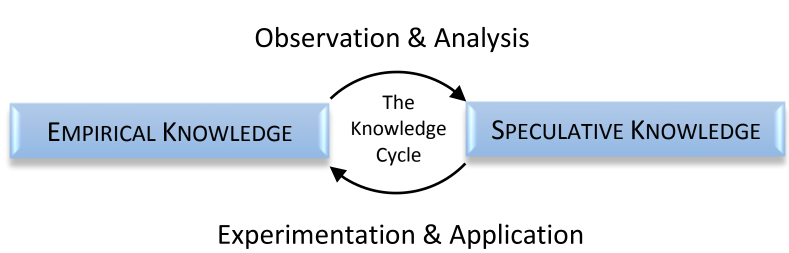
Informational symbol sets provide representations of the observed (nonfiction, photographic) speculated (scientific/religious) and imagined (fiction/music/art) world around us. For example, ink on paper allows us to see individual alphanumeric characters that are assembled into words, phrases, and blocks of text that might describe the color, shape, size, weight, and speed of a car. Characters may also be organized into tabular structures for mathematical manipulation and charting while music symbols may be rendered into a concert for our hearing pleasure. The modern computer has greatly increased our capacity to create and work with symbols so that we can now make drawings, animations, photographic images, video clips, and music with great ease.

KNOWLEDGE: [How and Why] is created through association of informational symbol sets into taxonomies, chronologies, and logical relationships between objects and actions. These sets describe a plurality of event – outcome pairs that define two types of knowledge: mechanisms (how) and reasons (why).

- **Empirical or Tacit Knowledge** [the how of an event] also known as rules of thumb through applied knowledge. This knowledge is based on repeated observations that allow the creation of rules by which the state of objects can be predicted from known actions.

- **Speculative or Theoretical Knowledge** [the why of an event] is based on the formulation and testing of hypotheses as to the cause behind the mechanisms that effect the change of state.

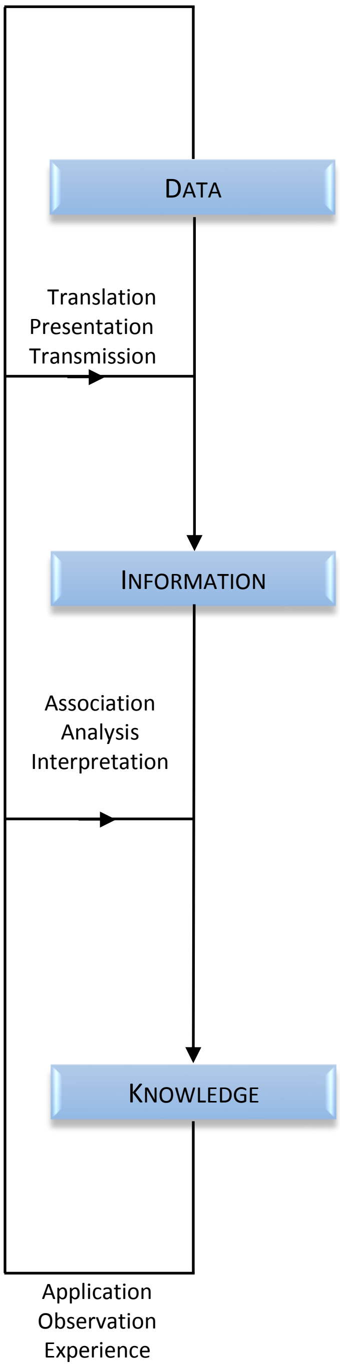
Empirical knowledge allows experienced individuals to keep an activity running smoothly by responding to known events using a set of rules. Speculative knowledge provides a means of generalizing this response to unexpected events by providing a means of determining their cause. In turn, this assures the development of responses that help prevent future events or mitigate their effects with a high degree of certainty. In addition, speculative knowledge provides a means of designing and implementing new activities with a high degree of confidence in their success. Once applied, speculative knowledge often leads to the development of additional empirical knowledge through new observations and more effective analysis of information gained through them.



6 THE PROCESS OF KNOWLEDGE FORMATION

As noted above, the transformation of data signals into knowledge is effected through programmatic logic. This logic uses a variety of rules that have been developed over time to create language as well as inductive and deductive logic. For this reason, there is no definitive boundary between what constitutes data, information, and knowledge. However, it is useful to make this distinction for defining an effective knowledge management system.

THE TRANSFORMATION OF DATA INTO INFORMATION AND INFORMATION INTO KNOWLEDGE



THE DATA STREAM – A SET OF BINARY DIGITS [BITS] ACTING AS PRIMARY SYMBOLS

[010000110100000101010010] → Bit stream (digital symbols)

Electromagnetic signals imprinted on the hard drive surface are sensed and used to open and close random-access memory gates. The gate states are interpreted by the CPU as a set of primary symbols called binary digits [**BITS**] that stand for 1 and 0 respectively.

THE DATA SET – A SET OF BIT SETS [BYTES] ACTING AS SECONDARY SYMBOLS

[01000001] → a (a character)

Sets of one or more bits are interpreted by the CPU as representing one of several secondary symbols including characters, numbers, dates, time, Boolean states (true or false), etc. Classically these are 8 (a byte), 16 (word*), 32 (double word), and 64-bit sets.

THE SYMBOL SET – A SET OF BYTES [WORDS] ACTING AS TERTIARY SYMBOLS

[c, a, r] → car (an object)

Sets of one or more bytes are interpreted by the CPU as representing one of several tertiary symbols including words, punctuation, as well as numeric and logical operators. These are used to describe the properties of objects and their methods of actions.

THE DATA SET – A SET OF WORDS [PHRASES] DESCRIBING A SINGLE EVENT

[01000001] → a (a character)

Sets of one or more bits are interpreted by the CPU as representing one of several secondary symbols including characters, numbers, dates, time, Boolean states (true or false), etc. Classically these are 8 (a byte), 16 (word*), 32 (double word), and 64-bit sets.

THE PHRASE SET – A SET OF PHRASES [TEXT BLOCK] DESCRIBING RELATED EVENTS

[Phrase$_1$, Phrase$_2$,…Phrase$_N$] → text block (such as a paragraph)

Sets of one or more phrases are used to describe complex relationships within and between sets of objects and actions that define basic axioms of knowledge.

THE TEXT SET – A SET OF TEXT BLOCKS [DOCUMENT] STORING RELATED KNOWLEDGE

[Paragraph$_1$, Paragraph$_2$,…Paragraph$_N$] → document (a book)

Sets of one or more text blocks are used to relate axioms into speculative and tacit knowledge for application to real world problems. (plans, policies, procedures, guidelines)

THE DOCUMENT SET – A SET OF DOCUMENTS [LIBRARY] STORING GENERAL KNOWLEDGE

[Book$_1$, Book$_2$,…Book$_N$] → Library(a public library, business library, etc.)

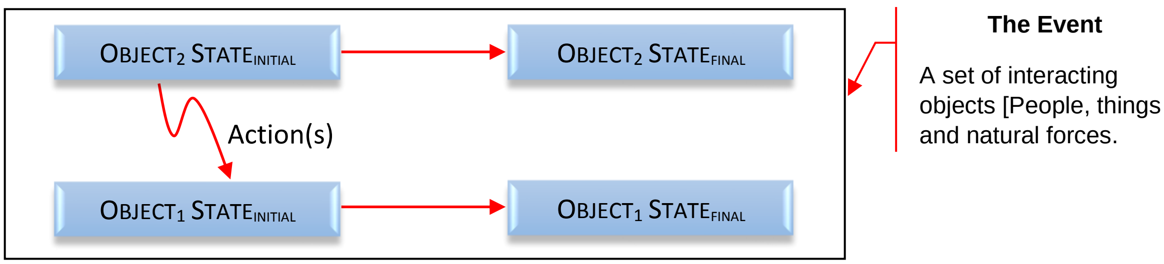
Sets of one or more documents are grouped together to provide an easily accessible fund of knowledge for effectively identifying, understanding and solving problems.

*A computer word as opposed to a spoken word.

7 APPLICATION OF KNOWLEDGE FORMATION PROCESS – OPERATIONAL OVERVIEW

A better understanding of the data capture, information storage, and knowledge formation can be gained through examination of a real-world example. Operationally, during an event we may observe signals. Later, these are translated into informational symbols that describe the event. Analysis of the information is carried out to gain an understanding of how and why an event occurred and caused an outcome. This knowledge may then be used to solve problems (applied knowledge) and create rules (empirical knowledge) through analysis of additional observations.

AN EVENT – A GENERALIZED SCHEMA



KNOWLEDGE FORMATION THROUGH ANALYSIS OF EVENTS – AN OPERATIONAL EXAMPLE

For example, object$_1$ above might be a car and object$_2$ another car. The first car is in an initial state – new condition with two occupants traveling 55 miles per hour along a road. The second car is in an initial state – five years old with three occupants traveling 45 miles per hour along the same road. At some point in time the second car hits the first car. This leads to an outcome – possibly observed – of both cars being damaged and their occupants being injured.

POLICE DEPARTMENT: Members of the police force may question witnesses, observe the appearance of the cars, examine the road surface, and test the drivers for evidence of drinking (data). This data is usually written onto a form (information) for later use by a district attorney. In addition, lawyers, insurance companies, and other agencies might access this information for additional analysis and action (knowledge formation and application).

INSURANCE COMPANIES: The accident information will be analyzed and compared to large accident infobases to determine what type of settlement will be made to the insurance holders to repair the damage to their cars. The settlement is often based on well-defined criteria – empirical knowledge – defined using statistical analysis.

GOVERNMENT AGENCIES: Data collected from this accident and many others are collated into infobases for future analysis to determine allocation of government resources and dissemination to private organizations.

PRIVATE ORGANIZATIONS: Accident information is often analyzed to determine mechanisms underlying the events observed. In turn, this may lead to discovery of root causes such as design deficiencies and structural defects in one or both cars, problems with driver experience and behavior, or road and weather conditions. Creation of this new speculative knowledge leads to the development of ***potentially*** valuable solutions that, when applied, ***may*** prevent these events or mitigate their effects. The results in the past have been the introduction of seat belts, better breaks, air bags, better driver education, and safer roads to name a few. This has ***often*** lead to fewer accidents and less severe injury to passengers.

Be warned, knowledge is not necessarily valid. You must test before widespread application.

8 CONCLUSION

An understanding of modern knowledge formation places a powerful problem-solving tool in our hands. On the way to achieving this goal we will need to examine document management concepts because this will provide the technical underpinning of any knowledge management system we choose to design and implement.

Want to know more? Contact me at gusackm@comcast.net

See our website: www.manxenterprises.com