

Information on Information

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Abstract

Information has its own features. An attribute is a characteristic that describes a feature. Attributes can be thought of as questions that are asked about the feature. Information also has its own qualities, some of which describe features that are very specific to information. Valuing information is also an inherently difficult task because of the unique features of information that distinguish it from other material resources.

These features are being addressed in this paper. Knowledge about these intricacies of information is necessary if an information worker and their organizations need to increase their information productivity.

Introduction

When talking about information, we intuitively know that information is not the same as traditional, tangible, physical resources, such as ore, lumber, machines, equipment, land, minerals, or gems. These material resources are considered limited, which contributes to a value system for exchange of resources. They can be depleted and diminished. A truck can be in only one place at a time and can be used for one activity at a time. More than one person, or organization, cannot hold these tangible resources at one time. Information has its own characteristics (Table 1).

Table 1. Examples of Information Characteristics

You never know the full value of information until you have completely consumed it.
When you teach, you exchange information. At the end of the lecture both the teacher and the students know more.
If you have information, you will never lose it by transmitting it. Legal protection is not applicable, because you have to reveal some parts of information in order to use it.
The consumption of information is different than that of other resources, since information is not lost when given to others.
If someone is given an idea, both the giver and receiver have the idea.
Information does not diminish when consumed; on the contrary, wide use of information generally leads to an overall increase in its amount. The same item of information may be used by, and have a different value to, an arbitrarily large number of users.

Based on a number of leading authors (Bawden, 2001; Case, 2002; Eaton & Bawden, 1991; Meadow & Yuan, 1997), the next sections describe the qualities of information, the characteristics of information, and the value of information.

The qualitative aspects of information are not in scope for this paper, because it is difficult to determine what constitutes good information. Yet many people make assessments about the “goodness of information”: relevant, timely, complete, or detailed.

Also, it is not the intention to cover all distinct attributes of information. Most academics and practitioners acknowledge that we still have a long way to go to understand all the intricacies of information as a concept.

Qualities of Information

Qualities describe features that are related to information but are not specific, unique, or closely related to information. Information possesses certain unique, even paradoxical, qualities.

Table 2. Examples of Information Qualities

Although information is instantiated in physical objects, information itself is intangible, a collection of 'abstract objects'.
Information is human. It exists only through human perception and assessments.
Unlike other resources, information is self-multiplicative; its exchange does not imply either loss or simple redistribution.
Information is expandable, increasing with use. The free flow of information maximizes its use.
Information is compressible, able to be summarized, and integrated.
Information can substitute for other resources, e.g. replacing physical resources, or transport links. Information may save money by substituting its use with other resources.
Information is transportable virtually instantaneously. Information is easily transportable by using applications of new information technologies.
Information is diffusive, tending to leak from the straightjacket of security and control, and the more it leaks the more there is.

Some of these qualities, however, are directly related to the notion one takes when describing the phenomenon information (see IIIP Issue Paper, Information Identified, 5 January 2009). The next enumeration serves as a guideline in understanding the qualities of information.

Accessibility

Accessibility not only refers to the physical access to information, but it also applies to knowing what information is available. The latter refers to the intellectual accessibility of information (am I able to use it?). Knowledge about the availability of information means knowing how to use what is available - for instance knowing how to use search agents, abstracts, and indexes. This is also the case of knowing who knows what. Evidence from recent research shows that people turn to other people for information, not primarily to data bases, the Internet, or traditional repositories like file cabinets. The value of verbal sources of information can be largely explained by the fact that people regard personal sources of information to be very reliable. If the other person is perceived as an authoritative and dependable information source, trust is very high. Many personal sources are readily accessible as part of personal networks.

Access alone does not add value to information. However, because personal sources are very information rich, they often provide additional cues to the information accessed, a smile, the tone of voice, or extra information not sought for by the information requestor.

Context

Information and knowledge take context into account, which means the context of the user and his mind. Often people do not realize the importance of the context the receiver places in the information: e.g., is the language including the semantics understood, is the receiver's background properly taken into account, are situational factors addressed. The term situation is regularly used as a term related to context. One can say that information without context has no meaning. For information to be relevant, one needs to understand not only the *what*, the content, but also the *why*, the context. Context also refers to timing issues and even the physical space in which the information is distributed.

Conversion

Often, information is not used in the original form offered by the sender. The person receiving it adds his own information to suit a particular situation or a specific circumstance. Some information can be used together with other chunks of information to form a new information package for a particular purpose. In this way, more value can be added to the appropriateness of information.

At the same time, this can also be a risk. Much information is sent electronically today. Assessments about the reliability of the source need to be taken into account to inform the recipient that the information was not changed. Often, however, this is done to bring the content level to the level of understanding of potential recipients.

Culture

A feature that is not inherent to information is the cultural environment in which the information is expressed. It has a strong impact on the usefulness of information. Most information is culture specific and related to the language that is used to represent information.

Intentionally

Resources like oil or gems have no intention whatsoever; they just are where they are. In daily life, a sender produces a message with the intention of informing a reader. But sometimes there is no intention. The natural world has information that is not communicated with a purpose in mind. Think for instance about the clouds: if you are not the local weatherman, why bother about these clouds?

Interdependency

Information often forms part of technology. In fact, information technology, IT, is a very common acronym. Without its information component, technology has little value as a resource. But it works also the other way around. Information is closely connected to the technology that carries the message. In fact, information is also often confused with the representation of information that nowadays is technologically oriented.

Life Cycle

Just as any other resource, information has a life cycle: definition of requirements, collection, transmission, processing, storage, dissemination, use, and disposal. There is, however, one major difference. Information may have multiple life cycles: ideas come into, go out of, and finally come back into, fashion. Information can be re-used, because it is not depleted with use.

New technologies are sometimes responsible for these new life cycles. Music, once recorded on a LP record, then the same songs on a CD, now iPods or the like, and per song downloadable or played interactively through the internet. However, most information can't be isolated or structured like music or books. For most classes of information the 'life-cycle' idea is an oversimplification. One of the main reasons is the extremely variable demand for information. Moreover, some information may be out-of-

date only temporarily, until a new request or new insights provide a fresh look on old information. The oil crisis in 2005 made small oil fields regaining new attention, partly due to the expected duration of high prices, but also because inefficient wells could be made profitable. Information about these wells became relevant again.

Medium

The medium that is used to represent the information plays an important role. Equally important is the presentation and format of the information that is being used. Some formats are more appropriate than others for the presentation of particular information. People differ in the way they acquire and analyze information. The three leading information preferences are:

- *Visual*. About 70% of all people prefer to receive information by seeing images, concepts, schemes and so forth.
- *Kinesthetic or haptic*. This is the preference for some 20% of all people. They learn and acquire information mainly through experience, hold onto, movement, experimenting, etc.
- *Auditive*. For 10% of all people, the preferred style for receiving information is hearing through sound, such as music and the spoken word.

Our sensory functions can be addressed in many different ways. We may hear information on a one-to-one basis, or in a group of people, or in a public speech; we may hear it privately from someone in another location through a telephone or a two-way radio; we may hear it through a public medium such as broadcast radio, or pre-recorded audio-tape. Some media may be partly visual, like a public speech. Other media are heavily dependent on visual impact, most obviously television, video and cinema, and, of course, the display screen of a computer. A particular piece of information can be transmitted by any or all of these methods, although some are more effective than others in particular circumstances. The choice of medium is critical in ensuring that the message it conveys reaches its intended recipient and can be effectively exploited when it is received.

Sound, however, is still in its infancy. The revolution in graphics greatly improved the way people worked with computers and other technology. The revolution in sound may well do the same thing. With all the visual data thrown at us every day, we are in danger of missing the information that really matters.

Once information is represented on a certain medium, it is immediately shut off from those who do not have a preference for that medium, or simply cannot use that medium. It is easy to recognize that the visually impaired encounter problems with reading newspapers. People with an aptitude for listening in general find it hard responding effectively using e-mails. They rather talk with someone directly instead of putting their ideas and reaction into bits of information.

Physicality

We can distinguish between information and its physical form, the representation of information (e.g., a document, a book, the sound waves of human speech, or a natural object that embodies some kind of data). This implies that information can have a physical form, but it is not a prerequisite. Yet thoughts and ideas also have a physical dimension: the electric impulses of a human nervous system.

Scarcity

The value of information can be reduced or eliminated by making it scarce to competitors or other potential users. In reality, information is not freely available. Scarcity of information is likely to be at the heart of most efforts to obtain an advantage over competitors.

Specificity

This refers to the depth of coverage or the degree of detail of the information in a message.

Truth

One could argue that information must be true in order to be real information. In that case, we need another name if information is false, such as misinformation. But information can also be almost true, or incomplete, inaccurate, or even deliberately false. In the right context and with the right interpretation level, the receiver can access the truthfulness of the information. Therefore, truth in this respect is the degree of confidence that the user places in information acquired.

Uncertainty

One of the main reasons people look for information is its potential to reduce uncertainty about events in the real world. Information received from other people may possess some uncertainty to you, as you do not know if they completely understand what information you are looking for. Typically they add or delete some information in the communication process.

In 1948 information was already defined as the reduction of uncertainty. Uncertainty here means the probable amount of information available. The less information is available, the greater the uncertainty. Decreasing uncertainty requires gaining more information, but increasing information may not always resolve uncertainty. Moreover, sometimes it is not possible to reduce uncertainty completely. The information that might reduce uncertainty is also an issue of uncertainty and is often as critical as the information itself. Take for example the stock market or the weather for tomorrow. How much information do you need to predict if the value of stock rises or falls? Because the stock is part of the stock market, you might need more information than is available in a given time to make your prediction.

Attributes of Information

An attribute is defined as a characteristic or recognizable quality of an object, such as size, color, material, shape, or age, which is used to describe, analyze, or characterize an artifact. An attribute is a characteristic that describes a feature. Attributes can be thought of as questions asked about the feature.

Many categorizations exist on the attributes of information (e.g., Oppenheim *et al.*, 2003; Rowley, 1998). Some authors include attributes such as: expansion, compression, substitutability, and the ability to share in their taxonomy. The intangibility of information is also often emphasized. Others describe attributes such as quality, currency, accuracy, and comprehensiveness as significant. Some feel that information should be seen as something tangible, physical and concrete, while other viewpoints emphasize the intangibility of information. Due to the different and often conflicting views of the information concept, the attributes of information have not yet been uniquely identified. The most salient attributes are described next in alphabetical order.

Ambiguity

Information is always potentially ambiguous. We are required to interpret it within a context to identify an exact meaning. It is precisely for these reasons that the importance of the message-receiver's mind be emphasized in my definition of information (see Issue Paper IIIP, Information Identified, 5 January 2009).

Amount

Compared to most other resources, more information doesn't necessarily mean better information. Sometimes it is even hard to assess the quantity of information that is needed for decision-making. Which has more information, a telephone directory or a large newspaper? How much information do you need when asking a question? When asking a question do you give directions to the respondent in terms of the amount of information that you expect in an answer?

Clarity

Most information needs a context and an interpretation from the user. Hence, this is clearly an attribute that will vary with the individual reader.

Consumption

Information is not lost when it is given to others. It also does not diminish when it is consumed. Sharing information can even lead to an increased value for both sender and receiver.

Dynamics

Eaton and Bawden (1991) mention that information cannot be regarded as a static resource to be accumulated and stored within the confines of a static system. Information is a dynamic force for change in the systems within which it operates and must be viewed within an organization as a formative organizational entity, rather than as an accumulated stockpile of facts. It adds value to an organization through encouraging innovation and change without being tangible.

Inappropriability

Information is inappropriable because an individual who has information can never lose it by transmitting it. Information can be owned, but that ownership is rarely exclusive. In other words, if I have information and I give it to you, then both you and I then have use of the information. Information can, therefore, not enter into traditional economic exchange because it became the possession of both buyer and seller. Information is thus said to be 'leaky', because when it is transferred it may go not only from seller to buyer but also to third parties. They may be in the vicinity and acquire the information solely through, for example, overhearing it or viewing it from afar.

Indeterminacy

A person who records (or sends) information has no absolute guarantee of (a) *who* exactly is going to receive it, and (b) *how* they are going to interpret it. This indeterminacy arises from the fact that information usually takes the form of a coded representation of entities in the real world that must be interpreted.

Individuality

Information comes in many different forms, and is expressed in many different ways. The same information can be represented on different media, addressing the recipient's different senses. Information can take on many values in the context of an individual situation.

Knowledge

Information affects our state of knowledge regarding something (possibly providing justification for a belief). It should be emphasized that this state of knowledge is continuous and dynamic, it existed before the information arrived, and may change rapidly after it is received. Knowledge is information read, heard or seen once it is understood.

Multiplicative Quality

Information can be used to create more information, or to make better decisions that cause actions, which generate more information, and so on. This is called the self-multiplicative quality of information. Exchange of information does not necessarily involve redistribution, loss, or consumption.

Redundancy

The communication of information always has an element of redundancy (i.e. non-essential information), primarily to resolve problems of ambiguity and indeterminacy. However, this apparent redundancy may prove to have value in some situations. Badenoch *et al.* (1994) give an example of the bar-code scanners in supermarkets that are usually considered to be advantageous because they speed up the check-out queues. In fact, they have been shown to be, in some cases, slower than manual typing of prices. Where they gain their true value is in the (apparently redundant) information they generate, which can be used for other purposes. Thus, although the (bar-coding) information is designed for one specific task, its usage extends far beyond.

Supply

The supply of information relates to the economic aspects of information. Because we have an infinite supply of information, traditional theories of supply and demand dictate that the more scarce a resource, the higher the demand. As demand becomes greater for a scarce resource its value increases. With information, it is our limited time to digest and interpret the information that is significant. The oversupply of information and our limited time to use all the information means that our decision-making is often based on subjective opinions rather than objective data.

Usage

One of the most important attributes of information relates to its use. Information can be shared or consumed more than once and does not necessarily decrease with use.

Information can be used again and again for many different purposes. It is not comparable to natural resources such as oil or water. Of course, information may become out of date, it may even become obsolete. However, the possibility always remains that it can be put to a new use.

Value of Information

Information is defined as 'any difference that makes a difference to a conscious, human mind'. Therefore, the value of information cannot be determined in advance, because a human being has to actively assess the real value. In order to have value, information has to be transformed by human cognitive processes into human knowledge, without which no products of tangible value can be produced or exchanged.

Valuing information is an inherently difficult task because of the unique features of information distinguishing it from other material resources (Table 3).

Table 3. Information Valuing Issues

Information is not depleted by use.
Information is non-rival.
Information has no inherent value in itself; its value lies in its use.
You cannot easily exclude individuals from the benefits of using information.
The exchange of information does not imply either loss or simple redistribution.
Before information is consumed, it is difficult for consumers to determine an exact value about the utility of consumption.
To estimate the value of information, consumers use branding, word-of-mouth, and signaling as clues.
Information has no scarcity value.
Just as you would rather receive information from a trustworthy source, information goods need to have good branding and reputation.
The value of information depends on context and use.
Information only has real value when you own the intellectual rights, like a book or a piece of music. A paradox arises, for example, when people enjoy an artist's music while the artist earns money and retains control over the rights of the information.
Information is costly to produce and cheap to reproduce.
Information goods are often priced according to customer value, not according to the actual production costs.
Most information goods are experience goods: the consumers must experience it to value it.
Production of an information good involves high fixed cost and low variable costs.
Most of the fixed costs of producing information are sunk costs, costs that are not recoverable if production is halted.
There are no natural limits for additional copies of information.
If information is hoarded for the exclusive use of a limited number of people, it can actually fail to achieve its full potential value for those who hoard it. If, however, information is exchanged and traded, the value resulting from its use increases for all parties to the transactions.
Paradoxically, the more people receive and use information, the more this will lead to an overall increase of its value.

Information is not like food or energy of which everybody needs a bare minimum (a ration of sorts) in order to survive. Information has value only when a recipient has some need for it and the capacity to process it. The issue is how much money someone is prepared, directly or indirectly, to pay to acquire the information; that is ultimately the measure of its value. What users are seeking is the subset of the information that best meets their needs. Up to the point at which the subset is optimized, each additional piece of information increases the value of all information that has already been accumulated. Even beyond that point, there may continue to be some accumulation of value, although at a lesser rate, until the point is reached at which there is so much information that it is no longer possible to effectively use it. This is the point of information overload, an increasingly common phenomenon.

As Macdonald (2000) notes, all demand for information is expressed in some degree of ignorance. Were there no ignorance, there would be no need for information, and presumably no demand. This is a little different from the situation in other markets. In these, buyers are certainly not fully knowledgeable about what is for sale in that they cannot have perfect information about all goods, but ignorance is not actually a prerequisite of demand. Moreover, buyers can reduce their ignorance, and hence their uncertainty, by discovering more about the goods for sale. At the florist, for instance, the buyer can see and smell the good to better assess their value to him.

To be sure, not all potential buyers display the same information-gathering behavior. A car buyer will arrange for a thorough mechanical inspection of a car; some will kick its tyres. The point is that a buyer - even a tyre-kicker - can acquire information about a car, and about most other goods, in order to express demand. This is not the case with information itself. Not only is it difficult to gather further information about the information for sale, but the good itself must be kept under wraps. Only the seller really knows what he has for sale, and yet the seller may not disclose what this is.

Problems in Valuing Information

Several problems can be identified in valuing information. First, what constitutes information will differ according to the purpose of the individual concerned. What is of vital interest to one may be of no interest or value to another.

Second, the lack of a clear definition of information makes it difficult, if not impossible, to develop appropriate criteria for valuing information.

Third, information is intangible and it needs to be transformed to knowledge inside human minds before it can be applied. If we talk about the information representations, it first has to be read, seen, heard or otherwise sensed before the brain can make knowledge out of it. Traditional accounting is not equipped to look at the multiple uses of content, or to trace the processes of adding value once it is transformed into human knowledge and applied.

Fourth, information as a resource doesn't follow the laws of physics: it is diffuse, compressible, extendable, it can be shared and consumed more than once, it does not decrease with use, and it can be a substitute for other resources.

Finally, there is also no metric we can use to compare the value of a good decision to a bad one. How do we know that a project has taken twice as long as it should have for lack of access to information? Information workers rarely turn out measurable products, and each project is slightly different from the one before. If they can't find the information on which to base their output, they may have to submit poor quality work to meet a deadline.

The Real Value

The valuation of information will never be an easy task. The value of information is not intrinsic to the information itself; it depends on its suitability and availability. While it is impossible to assign an absolute value to any given piece of information, it is clear that the individual user can assign such a value. This may be economic, but it may equally be social or cultural.

The valuation of information is often based on the cost of acquiring information. This is not a satisfactory solution, however, since quantifying such costs of information is not a straightforward matter. Information that costs little to acquire may be very valuable in the right circumstances, while information that costs a great deal to collect may prove useless. Therefore, the cost of acquiring information is often not related to its value.

Feather (2004) identifies a number of ways in which the value of information can be defined:

- The *exchange value*: how much is someone willing to pay in the market for the information.
- The *apparent value*: this encompasses not only the exchange value but also the investment that the user of information is willing to make in terms of energy and time, and the user's opportunity costs.
- The *value in use*: the actual value of the information when put to use by an individual in a specific situation. The value is determined entirely in a situational context and cannot be known until the use has occurred, when one can measure the benefit of the use.

Fundamental to a discussion of the value of information is the assertion that the value of information is tied to individuals, cultures, or organizations and thereby to an identity, role, or orientation related to those aspects. An essential characteristic of information is that it has no value except when in use. People make use of the information they receive for their own benefit. Information is combined with existing information the person already has and is put to work.

Valuing information is probably asking the wrong question. We maintain meticulous records on a wide variety of costs. But information costs are primarily labor costs. Technology is only a means to acquire and distribute information. Unless we have a better understanding of the cost and value of information, it will be very hard to deal with the dynamic nature of information and its ability to change value in a particular situation.

Conclusion

This paper has shown a number of theoretical aspects of information. An understanding of these matters is important before describing any measure that would be beneficial to a more productive information behavior of a person or an organization.

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The techniques for measuring performance today, from factory floors to the delivery of services to the outcomes of innovation, often fall short because they do not consider the value of new technology or provide meaningful indicators to determine tradeoffs among multiple investments. The Institute for Innovation & Information Productivity was formed in 2006 to break through outmoded, industrial-age biases and redefine knowledge economy measurements for individuals, teams, firms and nations. The IIIP develops new measurements and best practices to better understand the factors affecting business and organizational performance, studies the impact of technology, and encourages a global dialogue on improving operational results.

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