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Valuing Information in an Interactive Environment

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Herbert R. Brinberg
Parnassus Associates International
New York, New York

Thomas E. Pinelli
NASA Langley Research Center
Hampton, Virginia

Rebecca O. Barclay
Electronic Information Age, Inc.
Portsmouth, Virginia

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Department of Defense

INDIANA UNIVERSITY

VALUING INFORMATION IN AN INTERACTIVE ENVIRONMENT[1]

Herbert R. Brinberg[2], Thomas E. Pinelli[3], and Rebecca O. Barclay[4]

ABSTRACT

Considerable effort has been devoted over the past 30 years to developing methods and means of assessing the value of information. Two approaches — value in exchange and value in use — dominate; however, neither approach enjoys much practical application because valuation schema for decision-making is missing. The approaches fail to measure objectively the real costs of acquiring information and the real benefits that information will yield. Moreover, these approaches collectively fail to provide economic justification to build and/or continue to support an information product or service. In addition, the impact of Cyberspace adds a new dimension to the problem. A new paradigm is required to make economic sense in this revolutionary information environment. In previous work, the authors explored the various approaches to measuring the value of information and concluded that, in large measure, these methods were unworkable concepts and constructs. Instead, they proposed several axioms for valuing information. Most particularly they concluded that the "value of information cannot be measured in the absence of a specific task, objective, or goal." This paper builds on those axioms and describes under which circumstances information can be measured in objective and actionable terms. This paper also proposes a methodology for undertaking such measures and validating the results.

INTRODUCTION

The literature is replete with studies of, and theoretical speculation about, the value of information. And yet, we are no further along in developing a general theory of the economics of information — much less a methodology for valuing information — than we were years ago. The literature in the field is extensive and a comprehensive bibliography of the significant contributions to the subject is appended to this study for those brave souls who would wade through the forest of ideas, speculation, observations, calculations, and theorizing in hopes of emerging into the light of discovery.

But, thus far there is no information equivalent to the Theory of Relativity that would encapsulate in one brief equation the universal truths in the many faceted aspects of information. Perhaps, there is an equivalent to Fermat's Last Theorem flowing from such concepts as cost/benefit, or the value in use/value in exchange dilemma, and one day, as with the ultimate solution last year of this puzzle, a valid equation will be forthcoming. Alas, time may have already passed for that hope to be realized. The conquering of Cyberspace presents an irreversible paradigm shift that shatters expectations that economics and information science, separately or in tandem, will provide a universally applicable formula for measuring the value of information. Indeed, even before this "sea-change" in technology, scholars and observers in the field had become

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[1]Presented at the International Congress on the Economics of Information, May 18-20, 1995, Lyon, France.

[2]Parnassus Associates International, New York, NY, USA.
[3]NASA Langley Research Center, Hampton, VA, USA.
[4]Electronic Information Age, Inc., Portsmouth, VA, USA.

resigned to the improbability of such a formulation. Repo (1990), in his excellent review of the various theories of value stated, "It seems obvious that there is not a single theory available which fully explains the value of information. It does not even seem probable that one can develop such a theory easily." In their recent paper, Parker and Houghton (1994) underscore Repo's conclusions.

WHY MEASURE THE VALUE OF INFORMATION?

Why then are we so intent on finding a construct for measuring the value of information? One can postulate four driving forces:

(1) The philosophical perspective that seeks to define how information in general or specific chunks of information improve society through education and better citizenship, fuel the process by which innovation takes place, and provide the mechanism for markets to function and scarce resources to be allocated in order to enhance the economic well-being of the state.

(2) The theoretical investigations that constantly search for an inclusive explanation for how the various forces — market and cognitive — interact to create value in information.

(3) The operational approach that attempts to quantify (in money terms) the costs and returns of information in order to make a decision to buy or invest in the information content and/or technology.

(4) The evaluation process to determine whether an existing information service (e.g., a library or information center) should be preserved, enhanced or eliminated.

We believe the principal reason to continue the search for a meaningful measure of the value of information is to provide a more objective basis for decisions concerning the desirability of acquiring or investing in specific information content, conduits, technologies or services. We shall propose later in this paper whether, when and how, in the light of the increasing convergence and connectivity, such measurements can be made, and why most attempts at measuring are futile.

WHAT IS VALUE ANYWAY?

The answer to that question depends on whom you ask. To some it is the warm fuzzy feeling derived from increased knowledge or the reduction of uncertainty. To others it is the enhanced confidence in a prospective decision. In the marketplace value is the price a buyer pays to get information and conversely the price the seller gets to supply the information. To the investor it is the difference between the cost of acquiring the information or building the system and the returns derived from its use. To the ultimate user, value is the benefits derived in the form of improved decisions or the solution of a problem.

Value in Exchange

Two approaches to valuation have dominated the literature of information economics — value in exchange and value in use — and both are being radically altered, if not made obsolete, in a Cyberspace world. Value in exchange draws on economic theory. Economists equate market price with value. They assume the existence of many buyers and sellers with perfect knowledge of the marketplace, trading relatively homogeneous products. They further assume both demand and supply curves are relatively flexible so that the price will shift with the needs and wants of buyers, on the one hand, and the costs and availability of supplies on the other. From this perspective, value is established each time an exchange takes place. But this value is short lived owing to the constant shifting along the demand and supply curves as well as the shifting of the curves themselves. Nevertheless, economists view value as the price established in an exchange in a free market. Information is considered to be a commodity subject to such market forces.

But price equates with value only to the extent that each party believes he or she satisfied a need at the time of the exchange — the seller (hopefully) to create a margin over and above costs and the buyer to generate a benefit over and above the price. Any longer term value derived from this exchange is ignored by price except as it subjectively drives the bids and asks of the buyer and seller. Ignored too are the shifting values of a commodity as tastes, needs, or interests change. Examples abound - such as the price (value) of a classic car which exceeds by far its original purchase price — even after extensive use. Thus, price is a snapshot of value at a point of time rather than a panoramic view.

But we quibble! More important to our thesis is the failure, despite many treatises, to ascribe exchange value to information. The reasons have been well articulated, and often, in the various expositions of the "unique" characteristics of information. But, with digital technology detaching the content from the physical plane, the commodity analogy self-destructs. When information was captured in physical form, viz. a book, newsletter, etc., the content was committed to a material surface that could be identified, handled, and transferred. A price could be established for the conveyance which embodied the ideas, data, analysis, etc. In other words, the book was sold, not the content. In Cyberspace, the content is captured in digital signals of ones and zeros, and liberated from its substrates.

In this new paradigm, there is a "first copy" cost to the information provider but unlike the physical world of print, subsequent "copies" do not involve the high cost of printing, paper and binding which in the world of publishing establishes its price, hence value. The digitized patterns of electronic signals incur no further copy costs and the value added along the value chain is the distribution — the medium becomes the message.

In Cyberspace the law of supply and demand no longer holds. The supply curve is compressed into a single digital source while the demand curve is exploded into a universe of potential buyers. These buyers or users, individually or collectively, in isolation or concurrently, have access to multiple sources at any time, in any place. The price they pay — the market

value — is a combination of fees, usage charges, and communications costs. Because of the different skill sets of users, the ultimate price to each will vary, and often times, the actual price is not known until after the fact.

More significantly, the evolution of wide-spread interactivity, most notably the explosion of the Internet, is permanently changing the relationships between information providers and information users in two ways. First, instead of a one-time sale of an information product or service, information providers and users increasingly are entering into a relationship where the information becomes a flow rather than a burst of energy. The data base has no physical characteristics or bundles. The sender and receiver of the information share terminology, interest, language, even technology. Initially, the information may be offered (and accepted) without charge so that the digital spigot may be opened to sustain the subsequent stream of information. Does the absence of payment invalidate the value? How does one place a value on this ongoing relationship? And how does one then value the information that derives from it as the stream is tapped? Second, the ability of the user to draw a chunk of information from one source, acquire a tidbit of information form another, a sliver from a third, etc., converts that user into a compiler or integrator of information, fashioning a new body of knowledge. In that role the user becomes the author. Information becomes user driven rather than publisher or author driven.

An analogy can be drawn from the jigsaw puzzle. It has meaning, hence value, when all the pieces are put in place. The absence of even one piece undermines, perhaps even destroys, the integrity of the whole. What is the value then of each piece of the puzzle, and is the last (and perhaps missing) piece the most valuable of all? The realities of Cyberspace doom the economists' paradigm of value in exchange. Certainly, a price will be paid for chunks of information, even for access that will allow the acquisition of minuscule splinters of information. But that will hardly allow one to establish the true value until its raw materials are crafted into a useable application. And one cannot place a value on the evolving relationships.

Value in Use - A Contextual Measure

The rejection of value in exchange as a construct for valuing information, the evolution of the user as a dominant factor in the creation and application of information in an increasingly interactive environment, and the recognition that the use of the information may be temporal lead us to examine use as an operational measure of information's value. The underpinning of this construct is that the value of information is determined by the context of its use. As Taylor (1982) described it, value is not intrinsic in information: it is in the message and the message is given value by someone who uses it. Because information is not appropriable, any chunk of information conceptually can be used simultaneously by many users. The interactive environment extends and accentuates this property.

But each use of a given chunk of information is unique, each user of that same chunk of information is unique, and the specific application and intended result from each use is unique. Accordingly, the same information can have widely differing values in use. Given this, how can one measure the unique value created in each context? Information science has opted for cost-

benefit as the over arching technique of such measurement. This is not surprising since value is usually construed as the positive difference between the benefit (return) and the cost. And, the greater the positive difference between the two, the greater the presumed value. But therein lies the rub — how to measure costs and benefits. Are costs the prices paid for the goods, labor or services (i.e., the prices paid along the continuum of the value chain) embodied in the information itself? Do costs include the opportunities foregone when a particular course of action is followed? Are costs those that are imputed by the involvement of resources in the use of the information? Are the costs direct and marginal or fixed and allocated?

And what about benefits (or returns)? Are they revenues derived from the sale of the information? Are they the incremental "profits" earned from the enhanced productivity, new products or improved market share resulting from the integration and application of information? Are they the fruits of the application of new knowledge to discovery? Or are they the sum of actual and imputed savings in both time and money?

Compounding these difficulties are two concerns that are heightened by the increasing interactive access and use of the information:

(1) The accretion of use values that follow from the accession of new bits and chunks of information which are added to the existing information stock of an organization.

(2) The ability with new technology to roam, browse and/or "surf" a myriad of digital - essentially on-line databases to unearth — even discover — pieces of information that one never knew existed, that fill gaps in the current knowledge base, that open up new avenues of investigation or identify unexpected or unforeseen problems.

Glazer (1993; 1991) referred to the first phenomenon as the "information intensity continuum," that information expands in use and value as it is enriched over time. Rather than decay, the stock of information is revitalized and the possibilities for meaningful applications grow exponentially. This turns information into a life form, to borrow a concept from John Perry Barlow's (1994) Taxonomy of Information. It adapts, it mutates, it persists and it grows. Its value is ever changing, generated by each succeeding "use."

With the ability to roam the on-line networks and surf the Internet, the user gives value to parcels or bits of information by activating them — retrieving them from their repository and internalizing them for possible action. At the time of access, "value" is absent (except for the price that may be paid for that access). When applied to a problem, a decision, or an operation, it assumes a meaningful use value. In other words, the vendor is present to each customer who captures the value added in his or her individual use. Both instances reinforce a fundamental axiom that information is more valuable when it is familiar and widely available than when it is scarce; however, exclusivity generally enhances value.

In the final analysis, valuing is the result of measurement, and the validity of any system of measurement is in its real life applicability — to decision making, problem solving or

productivity. The flaw in most cost-benefit analysis applied to value in use is the tendency to reduce the equation to money terms even when valid money measures are not available. When imputation or "dollar equivalences" are employed, when the time cannot be factored in, the end result is questionable if not inoperable.

MEASURING INFORMATION IN THE CONTEXT OF USE

How then to measure? In a previous paper, Brinberg and Pinelli (1993) presented several axioms to guide attempts to measure the value of information. The principal axiom, reinforced by subsequent investigations, is that the value of information cannot be measured in the absence of a specific task, objective, or goal. The value of information, therefore, is valid only in context, and since each context is unique, the solution is to limit the measurement to those situations in which the context is clearly defined.

In the beginning, the context of information and information technologies was clear cut, mainly to "automate" existing processes or, in the jargon of the industrial age, to replace people with machines. The measurement in such "simplistic" applications likewise was clear cut and relatively straightforward: relate the cost of acquiring the information and its supporting system to the savings in personnel. The resulting value of the information investment naturally followed.

But even these applications ignored all the other "benefits" that could not be measured directly, such as improved quality, freed-up time to undertake more challenging tasks, or better communications. Not did it measure some of the costs, such as employee morale or shattered loyalties as layoffs were implemented. As information has become more extensive and actionable and information technologies more complex and powerful, the investment's objectives and results cannot be reduced to traditional accounting conventions such as return on investment, net present value, or just plain profits. They may not even be translatable into monetary terms.

We can demonstrate a number of issues. How to measure the value of the information system designed to share information and thereby improve the overall effectiveness of the organization? Specifically, how will that shared information technology speed up the development process? Or how to measure the results of an investment in an information system to improve customer service and responsiveness to customers' needs? How to measure the value of the data base that provides ongoing marketing information to position a product or to seek new customers?

The inability to reduce the value of information in these examples to monetary terms does not foreclose us from establishing values nonetheless. The alternative measures are not financial ones; rather they are operational indicators of performance that can be used to assess the overall impact of an investment in information in a specific context. Peter Keene (1991) termed these operational indicators "anchor measures," and we suggest that this term is appropriate to generalize the seeming incoherent approach to measuring the effectiveness of information and its supporting technology. These indicators establish the expected value in the context of the

application, and the results can be quantified. Most important, they eschew the absolute requirement that a dollar-based equation must yield returns over costs.

As Keene states, "The appropriateness of the anchor measure is a management judgment. No measure is 'correct.' The choice guides investment and represents a statement about how to judge the impact of I[nformation] T[echnology]." He further indicates that "anchor measures may not be readily translatable into quantitative financial figures such as return on investment," and adds that, if employed, most such financial figures would penalize information investments since the investment in year 1, for example, and the increase in the asset base in years 2, 3, and possibly beyond, may not yield a revenue stream until year 7 or later.

To underscore the interrelationship between the anchor measure and the objective of the information, Keene described a retail bank with two seemingly opposite strategies. In the first strategy, the bank employs information to reduce costs. The appropriate anchor measure for the bank would be the annual cost of serving a customer or the costs per transaction. However, these measures would not be appropriate anchors if the second, opposite strategy were to increase market share to grow revenue. Then, the anchor measure might be revenue or product per customer.

CONCLUDING REMARKS

Our investigation indicates that value in exchange is inappropriate and value in use is limited as formulas for measuring the value of information. We have determined that the value of information can be measured only in the context of its specific application. These conclusions are reinforced by the emergence and coming dominance of interactivity in the acquisition and use of information, especially where the user is becoming the driver in creating value-added in information resources.

We reviewed cost-benefit algorithms as a technique for measuring the value in use of information, but we concluded that the shortcomings of monetary terms as a common denominator precluded its direct applications in many, if not most, of the unique situations that characterize information in use.

The concept of anchor measures is recommended because it ties measuring the value of the information directly to its specific purposes and goals. Having set these parameters up front, the measurement of success (value in use) becomes practical and straightforward. Anchor measures define the critical success factors for the information investment and, at the same time, they define the criteria for success in objective and measurable terms.

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