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Applied Information Economics: A New Method for Quantifying IT Value

An Executive Overview

Critical Reviews For Applied Information Economics:

"AIE's unique strengths are its processes for clarifying and quantifying 'unmeasureable' benefits, costs and risks and their presentation in a probabilistic model based on a range of estimates (versus single-point estimates). Thus, it structures an investment decision in economic terms with defined levels of risk/return."
The Gartner Group

"AIE represents a rigorous, quantitative approach to improving IT investment decision making…..this investment will return multiples by enabling much better decision making. Giga recommends that IT executives learn more about AIE and begin to adopt its tools and methodologies, especially for large IT projects."
Giga Information Group

"AIE-like methods must become the standard way to make (IT) investment decisions."
Forrester Research, Inc.

"The theory of Applied Information Economics is right on target. People that don't use these methods will be missing a lot of opportunities."
Dr. Marshall Van Alstyne, MIT Sloan School of Business

Synopsis

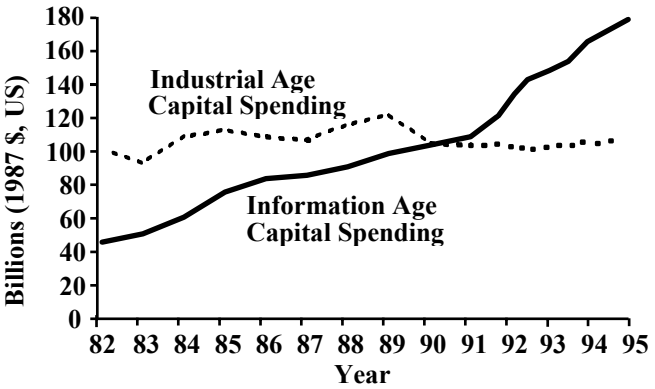
Applied Information Economics (AIE) is a powerful new method for quantifying the value of IT investments. This overview document of AIE is targeted toward executives who make decisions about approving IT projects. The issues covered are the nature of the current IT decision problem, how AIE solves them and how AIE is different from other methods.

I. The Risks & Opportunities for IT Decision-makers

Making "economically rational" decisions about information technology (IT) investments is becoming both more important and more difficult. The hope of dramatic productivity gains from IT investments seems to increase as the power of computing increases. One indicator of this faith in IT is the growing "portfolio" of information systems investments in virtually every company. For many companies it is the largest of all investment portfolios.

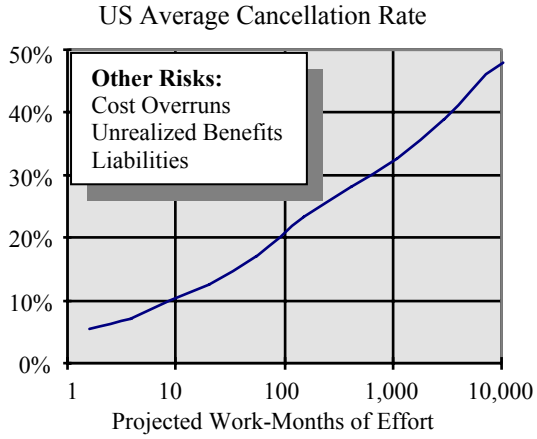
"If [the economy] is still 'capitalist,' it is now dominated by 'information capitalism.'" Peter Drucker (Ref. 4)

Yet, this growth in IT investments and the power of computing has not been matched by a growth in successful techniques for finding the right combination of IT investments. This is a real predicament because the difference between the "right" decision and the "wrong" decision is dramatic.



There are cases of companies realizing fantastic returns on investment of 50% or more from IT investments. (Ref. 3) Companies that have received these kinds of returns have turned information systems into strategic advantages by leveraging IT into new levels of customer service, enhanced quality control and reduced administrative costs.

However, for every success story there is a story of runaway development costs, cancellations after a huge investment, practically unmanageable maintenance, or unrealized expectations. For example, the risk of project cancellation (usually resulting in the loss of most of the investment up to cancellation) is often over 5% but sometimes over 40%.



It has been reported that in the worst-case scenarios a bad IT investment does more damage than just the loss of the direct investment. There are cases where dysfunctional IT systems have interfered with the business operations and cause the loss of customers and revenue. The Denver Airport is a well-known example of this. (Ref. 5)

Given the extremes of the risks and benefits of IT investments, it is easy to see how critical it is to tell the difference between the "right" investment decision and the "wrong" one. A rational and systematic analysis of the expected costs and benefits is essential. However, even with extreme differences in returns on IT investments, most decision makers find it difficult to determine which investments will be a phenomenal success and which will be a crippling failure. The decision-maker is confronted with many seemingly abstract and intractable questions.

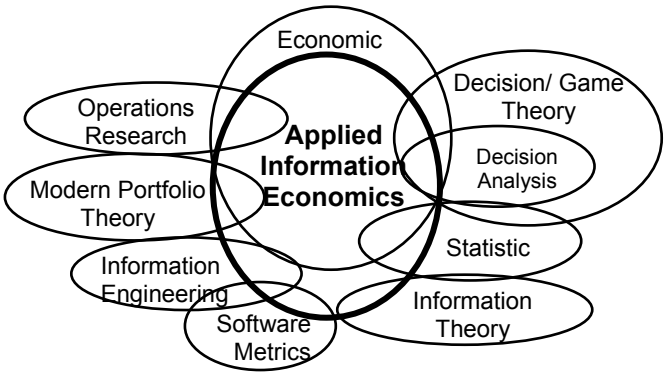
- How do I estimate the value of information or an information system (including "intangible" benefits)?
- How do I deal with the apparently extreme uncertainties in the estimates of IT costs and benefits?
- How do I know whether one IT investment is "better" than another investment (IT or otherwise)?
- How do I know when to stop analyzing, accept some risk, and make a decision?

II. The Solution: Applied Information Economics

Definition: Applied Information Economics (AIE) is the practical application of mathematical models and scientific measurements to solve problems in information systems investments.

AIE is a unique methodology to rigorously apply a specialized economic theory to the problems confronting the executive in charge of the "IT portfolio."

AIE is a synthesis of techniques from a variety of scientific and mathematical fields. *The tools of economics, financial theory, and statistics are all major contributors to AIE.* But in addition to these more familiar fields AIE includes *Decision Theory* - the formulation of decisions into a mathematical framework - *and Information Theory* - the mathematical modeling of transmitting and receiving information. It is important to emphasize, however, that even though AIE is a theoretically well-founded set of techniques, it is a very practical approach. Every proper application of AIE keeps the bottom line squarely in mind. All output from the AIE project is in support of specific practical business objectives.



The powerful techniques of AIE clarify, measure, and provide optimal recommendations for a variety of situations. AIE applies across the enterprise to solve some of its most perplexing problems, including the following:

- Using mathematical models to improve cost/benefit analysis (CBA) for better decisions at all levels of IT
- Developing financially-based quality assurance measurements to insure that the implementation of IT decisions are effective
- Developing a strategic plan for information systems based on identifying the best opportunities for economic contribution by information systems

How AIE Works

Some of the basic techniques that make AIE a powerful set of tools are "unit of measure" definitions, calculation methods for the value of information, methods for modeling uncertainty in estimates, and treating the IT investment as a type of investment portfolio. These methods are part of a fully documented formal procedure.

"Unit of Measure" Definitions

Most IT investment arguments include some costs or benefits which are treated as "intangibles" or factors that cannot be measured. Some common examples include "Strategic Alignment," "Customer Satisfaction" or "Employee Empowerment." In most of these cases, the factors only seem to be immeasurable because they are ambiguously defined. AIE removes this type of ambiguity by focusing on definitions that can be express in units of measure.

For example, an argument for a new Project Management System may claim that, among other things, it increases "employee empowerment." Does this mean that certain types of decisions can be made better and faster because the information to make decisions is available to more people? If so, how frequently do situations arise that require such decisions and what is the economic impact of a timely decisions which is more likely to be correct? Does "employee empowerment" mean that management overhead per employee is reduced because less supervision is required? Does it mean that employee turnover is reduced (along with recruiting and training costs)? Does is mean all of the above?

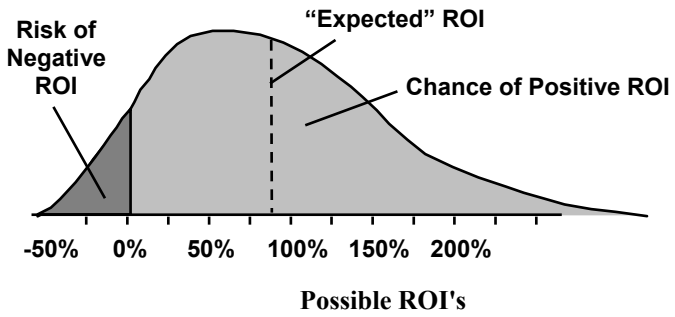
"Anything can measured in a way which is superior to not measuring it at all" Gilb's Law (Ref. 16)

All "Intangibles" Have Unit of Measure Definitions

"Customer Satisfaction" could be:
- Percentage of customers that repeat business
- Number of complaints received per month
- The cost of fixing defects after sale

"Employee Empowerment" could be:
- Decreased employees/year (turnover)
- Decreased supervisory overhead
- Decreased time to make certain decisions

Example of a Probability Distribution for the ROI on an IT Investment



Analyzing Uncertainty Systematically

All investments have a measurable amount of uncertainty or risk. In fact, rational investment decisions must always take both the risk and return of a given project into account. The ability to quantify the risk of a given IT investment, and compare its risk/return with other non-IT investments, is one of the many things that set AIE apart.

AIE quantifies uncertainties with ranges of values and probabilities. In reality, there is uncertainty about any number that we would apply to just about any cost/benefit variable. Instead of choosing some arbitrary number of high precision, AIE focuses on determining the range of possible values for a given variable and ascribing probabilities to them. It is almost never the case that we will need exact numbers before we can make an economically rational decision. The decision is whether the expected return is enough to justify taking the predetermined and quantified risk.

The ranges of values assigned to variables in a decision model can be used to determine a "probability distribution" of the net benefit of a particular IT investment. AIE uses the "Monte Carlo" method - the generating of thousands of random scenarios on a computer (also used in statistics, actuarial science and game theory) - to develop a graph of the likelihood of each possible net benefit.

Since part of this graph will usually show that there is some chance of losing the investment or not making the desired return, the risk of the investment can be quantified and assessed against its expected return.

The Calculation Of The Economic Value of Information

Contrary to popular belief, the value of information can be calculated as a dollar value. Although the term "information" is often used in an ambiguous manner, an unambiguous unit of measure has been defined which can be used in an economic value calculation. This mathematical procedure can be paraphrased as follows:

1. Information Reduces Uncertainty
2. Less Uncertainty Improves Decisions
3. Better Decisions Result In More Effective Actions
4. Effective Actions Improve Profit

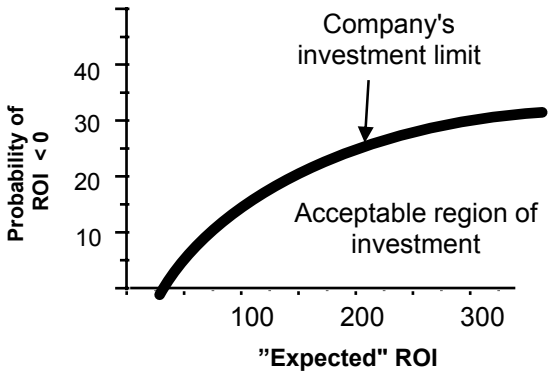
These four steps can be stated in unambiguous mathematical terms. The mathematical model for this has been around since the late 1940's. From this the "elusive" value of information can be determined precisely.

IT Investments as an Investment Portfolio

AIE uses the methods of Modern Portfolio Theory and treats the set of IT investments in a firm as another type of investment portfolio. Each investment is analyzed on a risk/return basis for its contribution to the portfolio.

By using techniques from Modern Portfolio Theory, we can determine whether the uncertainties inherent in a given IT investment decision are acceptable given the risk/return position for the firm.

Example Risk/Return Profile



III. What Is Different About Applied Information Economics?

The methods and the result of AIE are distinctly different form any predecessor. The methods discussed previously are very effective and would be new to almost any IT decision-making committee.

Previous attempts to improve the ability of firms to invest in IT more effectively could be put into two categories: traditional CBA and Weighted Scoring Methods.

Traditional Cost Benefit Analysis

For firms that were making no attempt whatsoever to quantify the value of information systems, traditional cost benefit analysis (CBA) was a great improvement. the decision criteria used by CBA includes Net Present Value (NPV), Return on Investment (ROI), Economic Value Added (EVA) and a few others.

Since CBA spoke the language of budgets and finance, it was usually understood by the individuals tasked with making budget decisions. Furthermore, the basic principles it attempts to apply (NPV, ROI, etc.) are sound financial tools.

Unfortunately, CBA is often put together by IT staff and is not always reviewed by finance or accounting advisors. Sometimes this leads to simple errors in the application of financial concepts that can led to erroneous investment decisions.

An equally significant and more common problem is that CBA, as it is usually employed, depends on point estimates (exact numbers instead of ranges) for every relevant factor in the costs and benefits of an information system. The point estimates could not usually be specifically justified by some methods of measurement but were entirely based on the judgment of individuals. Sometimes, the only attempt to differentiate between numbers of different level of uncertainty is an ambiguous "hard" vs. "soft" distinction. Often a benefit that was identified as "soft" would be left out of the calculation altogether. This tended to systematically ignore some of the largest benefits of information systems. Consequently, the result of most CBA's is a number that cannot be meaningfully compared to alternative uses of the budget.

Weighted Scoring Methods

There are several recent attempts to improve IT investment decisions by using various forms of weighted scoring methods. (Ref. 10, 11, 12, 13) These methods ask IT investment decision makers to rate a proposed project in categories such as "strategic Alignment," "Organizational Risk," etc.

Most of these methods have between 4 and 12 categories of evaluation but some have over a hundred. The proposed project is typically given a score of 0 to 5 in each of these categories. The scores in each of these categories is then multiplied by a weighting factor which is meant to account for the relative importance of each of the scored categorized. The weighting factors are usually standardized for a given company so that all projects are evaluated by comparable criteria. The adjusted scores are then totaled to give an overall score for the proposed project.

Sometimes these methods are misleadingly referred to as information economics methods and are represented as objective, structured or formal. It is important to note that these methods are not based on any kind of formal, accepted economic model and that they cannot truly be called economics at all. The total score that is generated for a proposed system has no meaning in financial terms. The definitions of the different scores in a category and the weight of a category are not tied to any scientific approach either theoretical or empirical. It is actually nothing more than another entirely subjective evaluation process. Many users of these methods claim they see a benefit but there is no demonstrated measurable value to this process. (Ref. 9, 14)

A report by Barbara McNurlin demonstrates this point. (Ref. 14) Ms. McNurlin analyzed 25 different benefit estimation techniques including various weighted scoring methods. She characterizes those methods, none of which she classified as based in theory, as "useless."

Paul Gray, a book reviewer for the Journal of Information Systems Management, may have summed it up best. He reviewed a book titled, "Information Economics: Linking Business Performance to Information Technology," one of the definitive books of a popular type of weighted scoring method. (Ref. 13) He wrote: "Don't be put off by the word 'economics' in the title: the only textbook economics discussed is in an appendix on cost curves." (Ref. 15) Meant as an accolade it also sums up the key weakness of the approach: there are no economics in this version of information economics.

Summary Comparison of Methods

	Traditional Cost/ Benefit Analysis	Weighted Scoring Methods	Applied Information Economics
Basic Financial Tools	NPV, ROI, EVA (sound financial tools)	Not specifically included or altogether ignored; produces a "score"; not comparable to financial data	NPV, ROI, EVA (sound financial tools
Analyzing "Intangibles"	Usually ignored because only "hard" benefits are given numbers	Attempts to evaluate without removing ambiguity, adds further ambiguity with subjective scoring	Focuses on removing the ambiguity of the identified intangible with "unit of measure" definitions
Uncertainty In The Estimates	Uses point estimates, ignores differences in level of uncertainty except for ambiguous "hard/soft" distinctions	No specific methods are discussed. Subjective scoring methods actually may add uncertainty	Employs sound mathematical methods already used in actuarial science, statistics and financial management theory
Information Gathering Methods	Systematic methods employed - but rarely; usually depends on individual judgment	Almost no focus on real measurement techniques of any kind	Scientific information gathering. Also calculates the EIQ, to gather information just sufficient for a given decision
Overall Assessment	Better than nothing; has sound financial methods	Creates an illusion of objectivity and quantifying benefits; has demonstrated no measurable improvement in decisions	The only method which provides scientifically and economically valid recommendations

Conclusion

Applied Information Economics has distinct advantages over other methods for assessing the value of information systems investments. It is the only method that has specific tools to deal with the uncertainty, intangibility, and ambiguity typical of IT investments in a way which is financially meaningful. As the power of information systems increase, as the influence of information technology on economic prosperity grows, it will be even more critical that we develop and utilize rational business methods in the analysis on IT investments. **Applied Information Economics is and will continue to be at the forefront of methods to keep business prosperous in the growing information economy.**

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