Starting out on a voyage of discovery

In the first of a series of articles, Paul A. Strassmann reviews the origins and development of information economics

I learned about the difference between information technology and information economics rummaging through the library stacks of Templeton College in 1975[1]. My eagerness to understand the economics of information, as seen from a corporate finance standpoint, was precipitated after I was excused from completing my annual budget review with the executive committee of Xerox. I was sent to find an explanation for the measurable benefits obtained by Xerox from all of its IT spending. As I was proposing an IT expense equal to 4.3% of Xerox revenues, the executive committee also wished to know the ratio that would indicate they were not overspending on this activity.

I chose to spend an extended holiday in Oxford in one of the most convenient business libraries to search for a rigorous method that would explain our steadily rising IT budget as the company was declining in profitability. In my position as the Xerox CIO I had become accustomed to rationalising the merits of individual projects by calculating the benefits of added spending in terms of standard capital investment return on assets (ROAs).

Suddenly, this would not be acceptable. Instead of limiting my budget pleas to explaining the payoffs from only newly requested funds (consistently earning a customary 20% increase in the annual IT budget), I had to quickly gain an understanding of how the firm's moneymaking machinery was affected by large injections of information technologies into its management processes.

The trouble with the books on economics was their bias

In the 1970s there was no available technique that would help me justify total IT spending for a decentralised global firm[2] and the conventional investment evaluation methods being applied would not answer the question of whether the firm's total IT spending was in any way related to profits or to any other measure of performance. The various methods then available to obtain money for computerisation were at best clever manipulations of subjective (and biased) opinions originating in vendor's marketing departments or within consulting firms seeking business with yet another unverifiable formula to promote their services.

Browsing through an accumulation of texts on industrial economics, industrial engineering, economics and economic analysis did not produce much that was useful. The references in industrial economics were concerned with analyses of payoffs from investments in tangible assets such as machinery or labour-displacement automation of clerical personnel.

Although the share of IT costs in the 1970s allocated to hardware could be as high as 30%, the forecasts of declining prices of electronics suggested that a correlation of IT with corporate profits could not be revealed by anything that worked for the justification of machinery in factories. The capital cost component of IT budgets was sufficiently small to be completely dwarfed by labour and capital costs that could be only indirectly related to corporate profits.

The trouble with the books on economics was their bias towards viewing a corporation as an agent reacting to the marketplace through pricing actions. Economists were not interested in the internal working of corporations and did not even collect data about the internal allocations of costs. Furthermore, standard economics textbooks did not even recognise "information" as a factor of production. Economics was dedicated to the traditional views that only land, labour and capital mattered.

The professional journals in economics and econometrics were filled with pages of erudite mathematical theories and speculations unsupported by any real-world data. Again, I could not find anything I could present to a sophisticated

corporate financial investment review committee.

In the 1970s there was an enormous outpouring of euphoric texts generated by social researchers. Using data from small opinion surveys, they often came up with contradictory speculations. The polls included projections of enormous savings by the respondents, such as 1,000% returns on investment.

Such claims were not only useless, but also misleading[3] and set unrealistic expectations. In the end, I had to confront directly the challenge of how to measure the total impact of IT on Xerox in terms that our financial investment review committee would find plausible[4]. Any acceptable metrics would have to be consistent with the way accounts were kept, how executive bonuses were calculated and what definitions would be used in reporting operating results after the investments were completed. The source of the data would have to be amenable to derivation from accounting records or from any source that could be independently verified.

It happened that the scope of my job as global CIO in Xerox had been recently enlarged to include worldwide corporate systems administration. This gave me a charter to examine the managerial, administrative and clerical costs for 70 operating units in different countries. I was already collecting financial data about the scope of each operation, including revenues, profits, overhead costs, capital investments and headcounts to supplement what I already knew about IT expenditures.

To judge the contribution of IT in a particular unit one had to consider that only those people who were included under direct operating expenses could take advantage of IT. Most of the operations were purchasing their inputs from external sources. The suppliers had already included IT in their prices along with labour costs, profits and capital depreciation.

When the full set of financial and operating statistics were assembled they were an eye-opener. The facts revealed not homogeneity but enormous variety. Formerly I could examine Xerox only through the narrow perspective of IT. Obtaining complete data about diverse operations selling identical products, for identical uses and competing against identical competitors, would confirm the generally held assumption that IT could be viewed as a standardised tool performing standard tasks in a reasonably homogeneous environment.

The IT costs in Japan were astronomical

Each of the worldwide units displayed an unexpected range in any of the ratios I originally assumed to be comparable. Identifying which operating units were superior or inferior as compared with an assumed standard of excellence (e.g. the US) proved to have no merit regardless which ratio we picked.

Units with manufacturing facilities had different ratios of IT per capita than operations that were merely marketing and distribution affiliates. High-wage countries had a lower ratio of IT to revenues than low-wage countries. The IT costs in Japan were astronomical, but their clerical costs per 1,000 copy machines installed were only a fraction of US expenditures. There was no correlation whatsoever between profits and IT spending. Depending on local conditions – which included culture, government regulations, involvement of unions and the capabilities of local management – the profit ratios of different operating units appeared as uncorrelated scatter diagrams[5].

Three months later I demonstrated to the finance committee that the relationship between IT and profits was not a matter of analysing cost or ROA ratios. How IT was applied was a reflection of the unique characteristics of a particular operation. Whether IT contributed to profits had to be examined in the context of how an operating unit's management proposed to change their operations in order to enhance the chances for success of their proposed plans. The "right" level of spending would be then found by comparing the profit impacts, without making any changes in IT spending, with the expected consequences of added IT investments.

I recommended that while the evaluation of the contributions of IT would remain an annual budget exercise (in the autumn), such an exercise would be taking place only after IT roles, goals and missions would become lined up with the roles, goals and missions examined during the long-range planning cycle (usually early in the spring). In this way IT would be included as an integral element of the long-range profit plan. The potential contributions of IT would become visible as marginal gains in profitability: as marketing, product, logistics and financial resource plans become integrated into a coherent set of proposed actions.

I could not propose the application of the cybernetic view of "requisite variety" as a general principle of information economics solely on

the basis of Xerox data. In 1981 I convinced the Strategic Planning Institute of Cambridge, Massachusetts to include in its exhaustive research questionnaire a request for detailed data about IT spending for over 300 corporations[6]. The data confirmed that corporations from diverse sectors of the economy as well as from different countries exhibited as widely diverging ratios of costs and IT spending as was observed within Xerox.

This brought me to the formulation of the first four "laws" of information economics:

- IT spending and profitability are unrelated.
- IT spending reflects a firm's unique characteristics.
- Cybernetics (the Law of Requisite Variety) applies to IT.
- The utility of systems is reflected in transactions.

In Table 1, these "laws" are brought into a contemporary perspective by looking at the ratios of purchases to sales for a wide range of firms. This is a sample taken from much larger research findings using 2002 financial data, which shows ratios for well-known firms in different sectors of the economy.

TABLE 1: External transactions are larger than internal transactions

Company Name		Sales $Millions	Purchases $Millions	Purchases/ Sales	Direct Costs/Sales	Profit/ Sales
ROYAL DUTCH/SHELL	Netherlands	$179,431	$149,365	83.2%	11.5%	5.2%
DEUTSCHE BANK	Germany	$57,816	$33,769	58.4%	40.9%	0.7%
VOLKSWAGEN	Germany	$98,708	$72,107	73.1%	24.2%	2.7%
FRANCE TELECOM	France	$48,892	$22,878	46.8%	97.7%	-44.5%
CITICORP	USA	$65,874	$28,314	43.0%	40.8%	16.3%
JOHNSON & JOHNSON	USA	$36,298	$16,508	45.5%	36.3%	18.2%
GLAXOSMITHKLINE	UK	$34,261	$14,407	42.0%	39.0%	18.5%
UNILEVER	UK	$50,611	$34,354	67.9%	27.7%	4.4%
SIEMENS	Germany	$82,999	$49,440	59.6%	37.3%	3.1%
GENERAL MOTORS	USA	$184,214	$143,030	77.6%	21.4%	0.9%
DAIMLERCHRYSLER	Germany	$156,838	$113,049	72.1%	24.7%	3.3%
NÉSTLE	Switzerland	$64,455	$44,468	69.0%	22.5%	8.5%

If the ratios of purchases/sales (e.g. external transactions) are larger than the direct costs/sales ratios (e.g. internal transactions) then the contributions of IT will have to be planned and evaluated by different methods. Table 1 illustrates a small sample of the diversity in the ways in which firms can deploy resources. An examination of a much larger database extracted from year 2002 financial statement (1,287 listed companies) shows that widely divergent variety is not an attribute of either economic sector or of geographic location.

An ineffective pharmaceutical firm in Germany will analytically look like an ineffective steel firm in the US. Therefore, comparing ratios within an economic sector or within a particular country will be always futile. Regardless of the number of surveys collected to come up with ratio-based indicators (such as IT as a percentage of revenue) the results can be only of statistical interest. Applying such ratios for budgeting or evaluating IT violates the law of requisite variety which views information as a unique solution to a firm's cybernetic feedback control system.

Financial reports do not distinguish between internal and external transactions

As long as the focus of IT was almost entirely on internal transactions and concerned with arresting the growth in administrative costs the justification of IT projects for cost-cutting was manageable within the scope of annual or bi-annual budget exercises whenever that was applied to routing paperwork or clerical automation. As soon as the reach of IT extended to activities that affected customers, such as in sales, marketing, maintenance services and quality control, the inward-looking and case-by-case methods of capital asset budgeting to calculate industrial age ROAs and return on investment lost their relevance.

When IT reached out to deal with external costs, the simple methods for analysing payoffs from investments lost all utility. The rise in global trade and the increasing dependency on purchases altered the roles of IT from purely tactical to strategic, such as in lowering the costs of the sources of supply. Evaluating the information economics of "strategic" options became much harder to quantify. The planning horizon for restructuring external transaction became also much longer than for internal transactions, perhaps as much as seven to 10 years ahead.

It was the difference between conventional, cost-saving, project-by-project justification and the quantification of enterprise-level impacts that would explain the prevailing difficulties in answering the question of what share of internal or externally applied IT was or was not contributing to corporate profits.

Financial reports do not distinguish between internal and external transactions except in cases where firms set up 'trading subsidiaries' that act as suppliers, or by outsourcing internal functions to obtain a full visibility of whether the prices are competitive. This is why outsourcing or organisational separation of IT services has now become the favoured means for claiming improved IT efficiencies[7]. Under such circumstances the only way to measure the consequences of a shift in resources is to examine the ratio of aggregate transaction costs (reported as sales, general and administrative expense) to the costs of goods sold.

Table 2 shows transaction cost ratios for firms in Table (see p17)[8]. It shows that while the range in transaction costs is relatively small, the range in the profit ratio is 6,490% and in the cost of goods ratio is 2,603%. Such high variability even in a small sample confirms that unique combinations of external and internal costs can result in an enormous difference in profits. If one considers including other inputs to a firm, such purchasing, taxes, depreciation or asset costs, one should not be surprised to observe the enormous variety in how firms can assemble resources to come up with an institution that can survive competitive adversity.

A corporation is like a living organism. We know that all creatures are assembled from identical materials. Yet, the differences in beings – even in the case of identical twins – can be enormous and cannot be understood except by comparison. If we wish to understand the worth of information as measured by transaction costs and if we wish to understand how transaction costs are affected by IT, this can be done best by an examination of how firms competing in the same marketplace earn either superior or inferior profits. This leads us to the fifth "law" of information economics: comparison of competitive gains reveals the value of information ■

TABLE 2: There is no correlation between transaction costs and profitability

Company Name	Profit/Sales	Costs of Goods $Millions	Transaction Costs $Millions	Transaction Costs/ Costs of Goods
ROYAL DUTCH/SHELL	5.2%	$142,760	$13.018	9%
DEUTSCHE BANK	0.7%	$32,174	$13,504	42%
VOLKSWAGEN	2.7%	$72,193	$13,873	19%
FRANCE TELECOM	-44.5%	$19.667	$13.948	71%
CITICORP	16.3%	$25.074	$14,145	56%
JOHNSON & JOHNSON	18.2%	$8,785	$16,173	184%
GLAXOSMITHKLINE	18.5%	$5,484	$16,874	308%
UNILEVER	4.4%	$23,794	$17,908	75%
SIEMENS	3.1%	$56,372	$19,935	35%
GENERAL MOTORS	0.9%	$140,406	$23,624	17%
DAIMLERCHRYSLER	3.3%	$112,880	$25,504	23%
NÉSTLE	8.5%	$25,873	$28,699	111%

FOOTNOTES

[1] Chapter 1, The Business Value of Computers, *The Information Economics Press,* 1990.

[2] The exception was the frequently imitated manual from IBM which stated that the value of IT could be calculated as the cost of additional clerks needed to complete all work in a timely manner in case computers ceased to function for an extended period.

[3] Years later the $400 billion+ expenditures for fixing an event that did not happen – the Y2K frenzy – was precipitated by two opinion surveys from leading IT advisory firms.

[4] The Squandered Computer, *The Information Economics Press,* 1997.

[5] It was then that I formulated a hypothesis that Ashby's Law of Requisite Variety – with origins in cybernetics and not in financial analysis – could be better applied to understanding the diversity in Xerox IT spending.

[6] Chapters 6 and 7, The Business Value of Computers.

[7] Strassmann, P.A., Managing the Costs of Information, *Harvard Business Review,* September 1976. http://www.strassmann.com/pubs/iej/2003-09.php and http://www.strassmann.com/pubs/cw/synergy.shtml

[8] I have been tracking transaction cost ratios for a large sample of global firms for more than 20 years showing that despite large investments in IT to allegedly reduce transaction costs they have not been reduced. Illustrative examples of findings using such data can be seen in http://www.strassmann.com/pubs/iej/2003-09.php and in http://www.strassmann.com/pubs/cw/synergy.shtml. If one includes taxes as an enforced transaction cost for conducting business my analyses would have shown a steady increase in transaction costs.

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