Technology Economics

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Those of the Star Trek generation may think of "space" as the final frontier. Those with a natural science focus may focus on the fact that although 70% of the Earth's surface is water, only 10% of that has been explored in detail – and that is yet another frontier.

In the world of economics – global, national, and even company-level –there is an unexplored component that touches all of us, impacts the businesses we are part of, and changes the way we interact and communicate with each other – it is technology.

Although technology spending is at a level of approximately 5% of revenue and 7% of operating expense across all sectors worldwide and is as high as 10-12% of Net Revenue and 16%-18% of Non Interest Expense for the world's most technology intense financial services institutions, its dynamics – the interaction of technology investment and the creation of value – are uncharted, haven't been calibrated, and are misunderstood.

Perhaps this is not a surprise because technology has only a relatively short history in the world of business. Its history is a mere 50 or so years which pales against the 2,300 year history of the study of economics since Aristotle pondered the creation of wealth for individuals or even the 230+ years since Adam Smith's Wealth of Nations.

However it can be hypothesized that those companies that can understand the workings of Technology Economics and master and take charge of their own internal Technology Economy microclimates today – before such learnings are documented and taught in the standard business school curricula – will be in the best position to leverage technology for competitive advantage.

At the most macro of analytic levels, the global technology economy is HUGE. As a reference point of initial calibration, 2009 global technology spending is approximately $4.2 trillion dollars. This is the equivalent of $701 for each person on the planet or the equivalent of one personal computer per year for every inhabitant of the planet (or perhaps 3.5 iPhones!).

If the $4.2 trillion dollars of technology spending was treated as a GDP, it would rank only behind the United States, Japan, and China (in 2008 terms) as the 4th largest economy of the 186 tracked by the World Bank.

The Technology Economies of the world's nations are more than just "significant". In the United States, Total Technology Spending is equivalent to $3500 per citizen and $5600 per worker; in Switzerland it is higher at $5100 per citizen and $6700 per worker; In Zimbabwe and Bangladesh it is closer to $20-$40 – a contrast not surprising but quite revealing all at once.

The Technology Economy is not static. It is quite fluid and dynamic. The flows of the technology trade circle the globe like the ocean's currents. Today's "balance of Tech-trade" is equally illuminating. For every $1 of technology services spending ("imports") flowing into the US, $.87 flows out; for India for every $1 in, $8.86 flows out; for China $1.70 flows out.

In addition, the Technology Economy is changing fast. India's technology investment per worker will grow 77% by 2011, the Ukraine by 95%, Brazil by 60%, China by 55%, and the US which started "ahead of the pack", a mere 10%.

The Technology Economy rate of change itself is changing. Worldwide technology spending from 1980 to 1990 was $800B while from 1990 to 2000 (another 10 years) it was $3200B (or $3.2T). With 2009 spending estimated at $4.2T, this one year will be the equivalent of the last 20 years of the previous century.

Despite the enormity, growth, and flux of the Technology Economy, surveying the current economic models of markets, consumer spending, and capital investment, one is challenged to find "technology" explicitly mentioned. Analyst literature is replete with data that shows the impact of GDP changes and economic change on technology spending. But there is little that shows the other side of the "linkage" – what is the impact of changes in technology investment on the performance on companies, nations, and the global economy.

This reverse interaction should be no surprise. Earnings announcements from premier technology firms such as Cisco, Dell, IBM, HP, and Tata drive market changes. Even data on flat panel TV, videogame, and mobile phone purchases have moved the market in the past year but have a minor role is such traditional measures as the consumer price index. And clearly one of the greatest market shift phenomena of our time – the burst of the dotcom bubble – occurred at the heart of the Technology Economy.

Today's economic measures are rooted in the industrial age and offer no "transparency" or visibility into technology. In some sense they are relics of the past industrial and agricultural ages.

In fact, the old economic measures have failed us. They don't provide us with the data or insights we need to get the full economic picture. Unfortunately, at the same time, the total

picture of the "right" economic measures hasn't fully evolved. It is possible nevertheless to get some insights into the next generation of measures by observing some economic patterns.

For example, by charting the change in US non-farm productivity versus the technology "eras" of the past 50 years one will find that non-farm productivity increased 16% during the mainframe era, 25% during the client server era, 70% during the initial PC era, and more than 150% during the current era of pervasive computing (all figures are indexed to 1960 national productivity).

During the same period, the correlation between change in US non-farm productivity and the change in technology investment shows an R-squared of .98. Though the form of the interactions aren't well known, there is clearly evidence of the impact of technology investment on business performance, as made visible by the change in productivity.

Similar changes are evident in observations relating to the change in a nation's investment in technology per worker. During this same period of 50 years we have seen radical changes in the key players in the global economy with the rise of India, and China and BRIC in general. However, visibility into leading indicators such as the as the rate of change of technology investment per worker are not apparent. They are missed or ignored by our regularly reported global economic measures.

As a further example of the weaknesses of current indicators and predictors of economic change in the face of the Technology Economy, consider the Conference Board's Leading Index of Economic Indicators. It relies on of industrial age data and has virtually no explicit technology content. If one performs an experiment and recasts this indicator in Technology Economy terms and replaces industrial age data with appropriate technology focused data (e.g. technology unemployment versus general unemployment), its predictive power is improved.

Similarly, daily market indicators like the DJIA, S&P, VIX, and Russell 2000 do not differentiate between technology intensive and non technology intensive companies – those that fully leverage technology – and those that do not. Initial research show that a "Technology Leaders Index" indicates that those companies that have learned to leverage technology – those that are fully IT savvy in the words of Peter Weil of MIT's CISR - have been outperforming others in a range of market conditions as gauged by stability, shareholder value, and resiliency.

Moving away from the world of markets to the world of "people" there are measures such as the UN's Human Development Index that gauge quality of life. Early results indicate that technology investment at a national level correlates well with longer term changes in the HDI.

In short, the key indicators that are used the gauge and predict the strength of economies, global trade, the performance of companies, and even human quality of life virtually ignore

the impact of the fourth largest economy on the planet – the Technology Economy. Far worse is that current measurement practices obfuscate its multidimensional impact and role.

Unfortunately the aforementioned weaknesses in the economic models and measures of the past are reflected in the way companies measure and manage their internal technology.

At the top of the "charts" for IT financial measurement and benchmarking are the most popular measures of spending – IT spending as a percent of revenue and IT spending as a percent of operating expense.

These measures represent relative spending on IT as compared to the moving landscape of business volatility. Over the past 18 months, the average Fortune 500 company has endured revenue decreases averaging perhaps 19%, and with a focus on maintaining profitability they have reduced operating expense by perhaps 26%. How can these commonly used IT measures be understood against such a moving backdrop.

And in a steady state business mode (pretty rare in the current economy), what is "goodness"? Should both measures be low?

In fact, in more normal times it is the pattern of movement of these measures that is more revealing than any single point in time value. For a healthy company, IT spending as a percent of revenue will likely decrease over time as IT costs to protect existing revenue are optimized. At the same time, IT investments to grow new revenue streams (as justified by business plans), reduce cost, avoid cost, and manage risk should be a larger component of operating expense as automation plays a larger role in a company's workings. "Health" therefore takes the form of IT spending versus revenue decreasing (albeit there are investment cycle impacts) while IT spending versus operating expense should increase to an asymptotic optimized level. Unfortunately, conventional business management wisdom today typically seeks to drive both low simultaneously under the banner of cost cutting.

The entire suite of today's most common IT measures (IT spending as a percent of revenue, IT spending as a percent of operating expense, IT spending per employee, IT cost per server, desktop, etc.) are focused on the wrong side of the technology "equation"
They are focused on the inputs and the commodities of a company's technology economy and not the outcome or outputs. Plus they don't offer any transparency in business terms. Furthermore none of them show any "motion". They are not leading indicators. In fact they are generally lagging indicators and that can be as dangerous as driving using only your rear view mirror.

More dangerous is the fact these measures propagate the notion that IT is an expense. Business reflexes have had 2700 years to evolve since the first occurrence of money in trade (coinage was introduced in 700B.C. by the Lydians). The simple most primal business reflex is to cut expense in the face of revenue strain. And if IT is labeled as an expense, it is destined to be "cut". This is a natural response if there is no visibility or understanding of

Technology Economics at the company level. IT is perhaps the most leverage-able component of a company's expense base and this reflex dilutes the value of IT to a company in perhaps it time of most critical need.

A concise example of this reflex is illustrated by what might be called the "Spend into the Skid" dynamic. A $50B bank with $35B in Non Interest Expense with $5B in IT spend could bring its pre-tax earnings per share up from $4.29 (assuming 3.5B shares of stock outstanding) to $4.57 by cutting IT expense 20%. But if it made the right investments and upped IT spend by $1B and in turn could decrease operating expense by 20%, EPS could shoot up to $7.07

However this example is misleading in that a "takeaway" should not be that IT spending should soar ever upward. In the earlier discussion of Fortune 500 revenue and expense reduction (-19% and 26% respectively) another IT/Technology Economy phenomenon has been observed. Those companies desiring to reduce IT spending radically in concert with revenue/expense compression have been able to do so to a maximum level of -16% in a one year period.

There are a few lessons that are evident. The basic one is that it appears that IT expense isn't as compressible as other business expenses. The history of IT has resulted in a high fixed cost economic model. This is not a surprise because most of IT history has been in "up markets". The other lesson reinforces an earlier observation that the reflex action of most companies is to cut IT costs under revenue pressure. Clearly with a better understanding of Technology Economics, business management would realize that perhaps a downturn is the best time to invest in IT by making surgically precise investments to obtain operating leverage.

There is yet another even more critical issue for today's IT measures. The issue is how to illuminate the connection between technology investment and outcome. This is key to enabling a balanced view of value transparency side by side with expense transparency.

Yet another experiment is the measurement of IT intensity, which has been developed to simultaneously consider the expense aspect of IT in the context of revenue and operating expense. The measures is a scaled value computed as the hypotenuse of the right triangle formed by IT spending as a percent of revenue and IT spending as a percent of operating expense. There is a high correlation (perhaps just a pattern) between the behavior of pre-tax margin and this measures. Initial findings show a frontier of performance that correlates to levels of IT optimal investment. The performance frontier varies by industry but enable detection of above and below optimal spending levels and also is an indicator of IT investment portfolio performance – how well a company is selecting IT investments which impact business performance in the short and long term. Essentially IT intensity correlates well with IT investment yield while illustrating the dynamic of under or over investment in IT. Plus in the context of the performance frontier, this model also illustrates that cutting IT investment can potentially limit the outcome to levels below that of those competitors at the

optimum. Likewise it illustrates the performance penalty for over-investment. IT intensity, while useful, is perhaps at too high a level to enable full IT value transparency.

Historically there have been some attempts to envelope IT investment in a business focused framework. In the early 2000's META Group introduced a taxonomy which classified IT investment into categories of Run the Business, Grow the Business, and Transform the Business spending (this was an outgrowth of the work of this author and Dale Kutnick, the founder of META Group). While this structure has provided companies with some fundamental transparency it didn't go far enough to expose the outcome potential of IT.

IT investment has at minimum has five dimensions of impact. A fuller portfolio profile would include classifying investment based on the outcomes of Growing Revenue, Protecting Revenue, Reducing Cost in the short term, Avoiding Cost in the long term, and Managing Risk. Furthermore the mechanisms by which these outcomes are attained fall into the realm of key IT competitive levers – the use of IT to increase operational efficiency and effectiveness, the use of IT to enable product leadership and differentiation, and the impact of IT on customer intimacy/relationship [the Treacy/Wiersema model at work].

There are additional measures that help connect the "dots" of IT in business that are needed to further complete the balance of value and expense transparency. These are measures that offer bi-directional transparency to the business audiences that will use the measures that cascade from a business focused view to the innards of IT in a cohesive manner.

A particularly interesting and revealing measure is "IT cost of goods" For example the IT cost of the average US newspaper is $.41 per copy; the IT cost per day per hospital bed is $65 per day (and that with 947,000 beds in the US that is $20B per year – the size of the government health IT stimulus); the IT cost per hotel bed per day is $2.50; the IT cost per US car is $323, the IT cost per megawatt hour is $2.63.

The dynamics of IT cost of goods is also relatively unexplored. As more and more technology finds its way into products and the IT systems to support customers and products this cost will rise. And as it rises, an understanding of the business outcome is essential. An increase in IT cost of goods should have a pre-defined and understood set of outcomes – reduction in total goods to costs to increase margin; increase in product differentiation which may drive up market share but not necessarily increase margin per unit; increase in client stickiness which may help maintain market share; or any other such variation.

Of course not everything can be viewed in the context of IT cost of goods but it surely is illustrative of a new form of transparency.

With the aforementioned examples and evidence of technology economics and associated ideas at work and selected measures as a backdrop, let's return to the bigger picture of charting this large, unexplored, and uncharted space.

First, in macro Technology Economics terms there is wide variation in technology intensity by sector. The financial services sector is more than four times as intense by this measure as construction and engineering. Second to financial services is media followed by expected others such as telecommunications. This doesn't mean technology doesn't play a role at the lower end of the technology intensity spectrum. It just means its role is different in relation to how companies invest and make money and as they transform. In financial services for example, it can be argued that technology is the product or the product is manifested in technology. This is quite different than in construction and engineering in which technology is critical but is not the final product itself.

Similarly, processing requirements of different sectors show equally large variation. In financial services, the average large scale global institution requires 1.07 Mainframe MIPS and .49 Servers for every one million dollars in revenue it generates while in retail organizations the processing load for one million dollars in revenue is about .33 mainframe MIPS and .14 servers.

Another newly charted dynamic has to do with scale economics. There are powerful relationships especially in the area of IT infrastructure. There are scale shifts inherent in the current economy with M&A and industry consolidation that have downstream impacts on IT that in turn directly tie to IT scale and flow into IT cost of goods. Imagine the impact on IT cost of goods when one company competes with another that has twice the infrastructure scale.

For example, two years ago the largest global banks had perhaps 100,000 mainframe MIPS and 40,000 servers. As a consequence of industry consolidation, the largest now exceed 210,000 mainframe MIPS and 80,000 servers. The resultant infrastructure unit costs are 40% lower than those at the average industry scale.

At the same time, with Moore's Law at work, and clearly a moving marketplace underneath it all, there is no room for complacency. IT commodities such as mainframe MIPS, servers, and storage are showing annual unit cost decreases of -17%, -8%, and -12% respectively. This phenomenon itself will change the economics of most companies to keep pace and be competitive.

As such, in the context of Technology Economics, it is time for cross company/organization sharing and scavenging of technology resources in the form of Technology Commons to provide access to scale economics for all companies. These can be created by establishing Technology "corridors" – like Open Space and Green Corridors in the environment – to enable large scale sharing. Technology Commons should be the basis of leveraging global

technology capacity for the "basics" of technology related services – from simple consumables such as connectivity, desktop services, and email to processing power grids to data storage commons. In fact without much of a stretch it is easy to envision the Internet, Google's "cloud" and various offerings from Amazon, Yahoo, and others as "the new Commons".

A recent article in The Economist entitled "Commons Sense" really sets the context for such thinking…. "In 1968 Garrett Hardin, a professor of biology, published an article in the journal Science that was to have a profound impact on the social sciences, including economics. In it, he explained "The Tragedy of the Commons". "Picture a pasture open to all," he wrote. A herdsman grazing his animals on the land will have an incentive "to add another animal to his herd. And another; and another…But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy." Each herdsman captures all the benefit from an extra animal but the cost of overgrazing is borne by all."

Fast forward 40 years and perhaps we could conceive of an article entitled "The Tragedy of the Shared Infrastructure". Paralleling the issue of overgrazing is the implementation of "poison pill" SLAs (service level agreements) – SLAs which benefit a single user/line of business/stakeholder but drive the cost of the entire set of shared services higher to a level of cost that must be "borne by all" but supply value only to a few. Imagine however that you can unravel this phenomena and build a true technology Commons – a Greenfield commons of the basic services within a company or across companies that provide the core services needed at a basic level that serves common needs and is not polluted (economically or otherwise) by the needs of special interests. There would be no cost of "overgrazing," rather there would be only economies of scale and service.

In this basic Commons or a set of Commons, the most fundamental of IT services identified before could reside - connectivity, virtual desktop support, email, etc. Of course this could be extended to the more power consuming services of computing (the cloud) and storage – clearly this could be implemented at the application/business system level too. Software as a Service is a clear instance of the new Commons model too.

There will always be special interest groups with needs not served by the Commons. For example, the financial services industry has specialized email needs that are not met by the Gmails of the world. But suppose Gmail-like services were in the lowest common denominator Commons then a next level Commons could be built upon it with the special needs satisfied without polluting the cost structure of the basics. Using this model, it is clear that an organization with highly specialized needs would in fact be "uncommon" and that their needs could only be met by having a service implemented and used solely by them.

The implications of the Commons model are twofold – in implementation and governance.

First, in terms of truly Greenfield IT implementation, most organizations today would benefit from rethinking their shared services strategy (infrastructure and applications and perhaps

business processes) and devolve to a true Commons model with the removal of the overgrazed service level requirements that lead to enhanced economics of sharing and scale. At the same time, above the basic Commons, most organizations (and the planet) would benefit from collaboration that would result in Commons meeting more specialized but shareable needs.

Secondly, in terms of governance, The Economist puts this into perspective – "In "Governing the Commons", which was published in 1990, Elinor Ostrom of Indiana University described the rules needed to keep a commons going. She showed that there are almost always elaborate conventions over who can use resources and when. What you take out of a commons has to be proportional to what you put in. Usage has to be compatible with the commons' underlying health (ie, you cannot just keep grazing your animals regardless). Everyone has to have some say in the rules. And people usually pay more attention to monitoring abuses and to conflict resolution than to sanctions and punishment"

Commons governance is becoming moderately well understood and has a far longer history than that of IT. The principles are transferrable. History has shown us "Though there were failures, too, it seemed as if good management could stave off the tragedy. Before he died, Hardin admitted he should have called his article "The Tragedy of the Unmanaged Commons"

In summary, the beauty of all this is that the foundational concepts currently exist– there is a "science" of Commons; Commons have a long history; Commons governance is understood to some degree; the new Commons is in its infancy; Commons are a useful construct to think about many problems.

In our technology economy, the "Commons" sense is simply common sense. It meets the needs of a new technology economics for organizations under financial stress with also a new need to buffer their operations in a world with high volatility. It meets the needs of a world with scarce resources in which a major and increasing source of waste is the under-utilization of growing technology resources.

Even with the "commons", there is yet another key dynamic which can't be ignored. It is a blend of the dynamics of scale and Moore's Law. It is the interaction of demand and unit cost which in turn results in total cost.

Some of the past arguments herein speak to the dynamics of scale and the resultant decrease in unit cost. However seeking favorable unit cost by driving scale up is dangerous too. If a company misread this dynamic and have more scale than you need with a competitive unit cost, the product of the two is still too much total cost – which some call "Costco IT", and you must be wary of it. A company needs to manage demand as diligently as it manages cost and calibrates demand to business need to create a return on IT investment – the ever elusive ROIT.

However ROIT is not elusive if you establish a base of historical data from more "normal" times. For example, the change in technology investment during the period 2004 -2006 shows evidence in changing the course of business profitability such that for every $1.00 invested in technology during that period..an increase of $1.47 in business profitability. This ROIT is connected to real business outcomes – increased operational efficiency, product leadership, and customer interaction.

There are even more IT dynamics to consider. At the end of the last "normal" economic period – starting in 2007 - pressure was put on IT in virtually every company to cut costs as part of the reflexive action discussed earlier. At this point an additional dynamic of the Technology Economy came into play – the compressibility previously discussed. That compressibility is linked to the underlying cost pools that relate the staff compensation and other compensation costs.

Today personnel costs make up to 50% of total IT costs and as such most of the expense variability is in personnel. This in turn is evidenced by the first IT management reflex when faced with cost pressures – cut staff. The typical overall IT cost reduction "playbook" is to cut staff, renegotiate with vendors, stop refreshing technology, and to cut discretionary projects. Put the "pedal to the metal" and you might be able to get 30% compression and that is about the overall limit. However if a company changes its staffing model, use of its supply chain (using more of a Wal-Mart Category Captain approach to push costs outside the company), and also tap into the "commons"/ sourcing this could jump to 60% variability - a massive change.

And yet another caution: the degree of variably should be tuned to the nature of the business itself. Similar to the way consumers choose cellular phone plans with fixed cost minutes or "pay by the drink" usage, companies need to use well focused models to optimize their fixed versus variable cost IT economics.

While the preceding discussion has dealt with sizing, charting, calibrating, and exploring the dynamics of the Technology Economy, none of that will be of much value without some basic principles that allow an organization to "take charge" of it.

Doing so likely requires the adoption of a navigational discipline that is adaptive using a forensic model. At the highest level, this implies that organizations must chart their current position, calibrate against competitors and the marketplace, form fast hypotheses, and then take action - and continue to cycle the process.

To make this happen an organization needs a robust view of (and real time window into) its Technology Economy with a precise business focus. The management team needs to build in the right leading and lagging indicators internally and continually obtain market data feeds of what is going on in the "outside world".

In short taking charge means a variety of things:

- Transparency to "size" IT, keep it costs competitive and value competitive.
- Visibility to leverage the marketplace
- Competitiveness with the scale economics of biggest peers
- Agility in value and expense: managing yield and return

For most companies things are upside down in that they are victims of their technology economies. This needs to be turned around with a focus on

- Continuous optimization and not just cost cutting
- Leveraging new concepts such as the "Technology Commons" – a Nobel Prize winning concept that gives leverage and governance all at once. We are starting to see this in new technologies such as Cloud.
- Striving for economic agility tuned to the needs of business dynamics
- Making decisions based on an outcome model and not an input bias.

In essence it is about constant/continuous monitoring and navigating the company Technology Economy as aggressively and effectively from an outcome perspective.

Hopefully it is clear that on a global level, the Technology Economy is a major engine and determinant of the total economy - maybe it's like the El Niño of our weather systems as it isn't the largest component of the economy but it is a component with major and far reaching influence.

When the Technology Economy is viewed at a national level we can document its impact on reshaping the global distribution of wealth as evident with the rise of India, Brazil, and now China. In short, it is a critical component of national competitiveness.

With these realizations it is possible that in the near future we will see new indicators that replace the industrial age relics that are failing us badly; maybe a Technology Economic Index to replace the Leading Index of Economic Indicators, a Technology Leaders Index to replace the DJIA, a Technology Consumer Confidence Index or CPI.

There are lots of new options that are now in the form of experiments that may yield insights and high value results.

Finally, in the context of company performance it does appear that the companies that can fully leverage their own technology economies will be the new leaders. Historical evidence indicates this and new models predict such a future.

Advancing the use of Technology Economics in a company can only happen through balanced business and IT collaboration. Those companies that can harness their Technology Economy for operational leverage, product leadership, and making the customer/connection will be and are the new business leaders

Advancing the field of Technology Economics can only happen by capturing the insights and hypotheses from businesses, governments, and academics worldwide, and the stakes of success are extremely high. We are in the Technology Economy, and those that chart, calibrate, and make use of its principles first will have a substantial and sustaining impact in shaping the destinies of nations and the quality of life of the inhabitants of our planet well into the future. With a technology investment equivalent to $701 per inhabitant of our planet today (and rising exponentially) we have to master the dynamics of this new emerging economic nation and distribute its wealth wisely.