e-Business metrics applied to performance measurement of pilot projects

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Abstract

The application of technological innovation to business processes in the knowledge economy is seen as a key contributor to competitive advantage. Pilot projects are low-risk evaluation ventures initiated by management to determine the expected returns from future Internet-based e-business investments.

Since such trials impact multi-functionally across the enterprise a comprehensive strategy for the pilot should be carefully crafted before implementation while taking into account success measures that extend beyond the traditional project management returns of on brief, on budget and on time. Success is more than simply overcoming technical challenges. These measures should assist with the extrapolation of the pilot study to an eventual successful endeavour.

An important outcome of such a pilot project is the development of an appropriate value proposition for future Internet-based businesses. This requires the development and use of new measures.

This paper is based on a more comprehensive study into the role of electronic strategy development on business performance. It includes a review of the literature on metrics which are finding application in the field of electronic business. A case is made for the application of e-business metrics to pilot projects which should result in improved outcomes. Pilot studies are often precursors to new business ventures. More successful projects should ultimately result in better knowledge-economy based ventures.

1 INTRODUCTION

Managing business today in the highly volatile, competitive environment, challenges an executive to find new and innovative ways of creating competitive advantage. One of the reasons for the exponential growth of the Internet and the electronic enabling of businesses is to exploit the commercial advantages offered by new technologies. However, with the development of new business models, comes risk. While the “first to market” advantages are clear, less obvious are the concomitant risks of untried systems, technologies and business practices. It has therefore become common business practice to implement pilot studies for the evaluation or testing of new technologies, customer responses to new products or services and the creation of new business prototypes.

This paper has an intentional focus on the application of pilot studies in the Information Systems (IS) domain. Many of the points made could, however, find reasonable application in pilot studies conducted in other spheres of business activity.

A pilot study can be construed as one which serves as a provisional or speculative model for future experiment or business development. It permits the evaluation of processes, businesses or markets to be done in a controlled “laboratory scale” environment where variables may be closely managed, the trial measured and the impact established. The consequences of failure are contained.

There are several variants of pilot studies, depending on the rationale behind the project. There may be a need to test an emerging technology without examining business complexities (proof of concept), a need for the assessment of product acceptance (test-market), the evaluation of potential implications of a new business venture, or to test any other potential opportunity.

An effective trial is one that has been carefully designed, implemented and evaluated. This paper posits that the quality of pilot studies could be enhanced by a more careful application of evaluation metrics supported by the measurement of intangibles, both of which should be incorporated in the design of the test. A case is made for improving the quality of pilot project assessments, and the concomitant management decisions, through the application of measurement techniques that have evolved from the knowledge economy.

The formal study of pilot interventions appears to have received scant attention in the literature, possibly because such endeavours have been consigned to the realm of “best practice”.

It is the function of management to manage risk. Pilot studies are one way of doing so.

2 THE ROLE OF PILOT STUDIES IN THE MANAGEMENT OF RISK

2.1 Business risk

Risk is a factor or course of action involving uncertainty. A recent study (Schnitt, 1993:14) found that spending on Information Technology (IT) is the largest single item in the capital spending budget of US corporations. Spending on IT has risen even more steeply over the past few years as organisations became increasingly technology-dependent and consequently, more vulnerable to the risks of IT failure. The exponential growth of the Internet and its technologies has encouraged the, often rash, entry of business into the realm of electronic commerce. Driven by perceived first-to-market benefits, corporate investment in Internet-related technology has been stimulated to even higher levels. The risk of failure has increased proportionally. A well-formulated pilot study can impact positively on almost all areas of risk. The mastery of IT risk begins with its identification and leads to a deeper understanding the impact of risk on the business.

The IT environment (Bandyopadhyay *et al.*, 1999:438-439) has application, organisational and inter-organisational levels, each with its own associated risk element. Application risk, often the focus of pilot studies, is concerned with the possibility of technical or implementation failure of IT applications that originate from internal or external sources. It is interesting to note that an empirical study (Loch *et al.*, 1992:179-180) on computer security revealed that IS managers consider natural disasters and employee accidental actions to represent the greatest level of risk – apparently business risk was not a cause for concern. It is no surprise that for many years IT strategy was formulated almost entirely independently of the business’s strategy. Another study (Lightle and Sprohge, 1992:31-36) did raise business sustainability as an IT risk. It saw sustainability as impacting upon the competitive advantage of the enterprise – a strength acquired through the long-term deployment of applications. Historically, the benefits from effective IT applications enabled firms to outperform their rivals, but this window of advantage is today much smaller since competitors are readily able to replicate technology.

There exist several risk-reducing measures possible for management to take. Commissioning a pilot study is just one of them.

2.2 Pilot studies as a means of dealing with risk

Management need to deal with the risks associated with sustainability of competitive advantage through the long-term deployment of IT applications. In order to minimise this risk, either through a venture aimed at improving efficiencies, gaining competitive advantage or by growing revenues, management must first identify potential opportunities.

There are many ways of exploring an opportunity. These include immediate investment or acquisition. Commissioning a pilot study is the lower risk course of action often preferred by management. It has become apparent that trends in the business world are no longer linear, where it is possible to catch up. Failure to innovate is now seen as a major business risk. Innovation has become a competitive differentiator in the knowledge economy.

Successful enterprises will define innovation as a strategic objective. Innovation, as interpreted by the Product/Market Matrix (Anshoff, 1968:99) means new products into new markets that again result in management operating in the single highest arena of business risk. This emphasises the need for caution and again leads to ameliorating risk through effective pilot studies.

2.3 Applying metrics to pilot studies

At each of the discrete steps in any pilot project design there is a need for thoroughness. The processes of setting objectives, defining project scope and managing its implementation are beyond the ambit of this discussion where the focus is confined to performance measurement. New metrics and different approaches to viewing performance have been developed to assist with the valuation of electronic commerce (e-commerce) ventures. A discussion follows on the application of measures to performance evaluation of pilot studies.

E-commerce is an evolutionary process (Fellenstein and Wood, 2000) encompassing “the set of electronic, networked transactions, including those pre-transaction and post-transaction activities performed by buyers and sellers.” It is common practice for electronic businesses to make extensive use of special applications linking multiple enterprises and consumers. The resultant business processes differ markedly from the norm and traditional measures of performance proved inadequate. These measures fell short by virtue of their fixation on financial resources and their inability to fathom the impact of intangibles, or flexibility, on a business. Development of appropriate metrics arose

from the need of investors for objective valuation techniques that could be applied to these businesses. The impact of intangibles on business performance had to be taken more formally into account.

3 METRICS FOR THE INTANGIBLES IN A BUSINESS

Traditional financial measures of value or return have tended to focus on evaluating the firm's application of its financial resources. These tangible measures include Net Present Value, Internal Rate of Return and others. They do not measure the intangibles associated with the firm's offering. These have recently become of greater value due to the advent of the Internet and the knowledge economy. Such intangibles include market share, profitability, first-to-market benefits and others. The knowledge economy, by definition, requires more attention to the value contribution of these elements.

In a customer-centric model three core management activities closely link strategy with execution (Hax and Wilde, 2001:379-385). These processes, which are adaptive, consist of the firm's operational effectiveness - relating to its production and delivery of goods and services, its customer targeting processes – managing the customer interface, and its ability to innovate in the development of new products. The required metrics are applied at the aggregate level (having relevance to the overall, integrated business) and granular level where the fundamental performance drivers are measured.

Pilot studies are usually conducted at the granular or operational level. The metrics used here should relate to operational effectiveness ("dong the right things") and include such intangibles as defining the measures of system performance, analysing profit contribution by product, finding the cost drivers, using quality criteria, measuring product differentiation and defining the economic drivers of the firm's customers. Customer targeting metrics include profit by customer, market share trends, identifying channel costs, customer retention and identifying customer switching costs (Hax and Wilde, 2001:20-23).

Innovation, often the *raison d'être* for pilots, can be measured by the number of new products introduced, and in the pipeline, measuring the sales contribution from new products, research and development expenditure as a percentage of sales, the firm's involvement its customer's value chain and the ease with which competitors can imitate the enterprise's standards. Important here is how the rate of new technology introduction compares the firm with its competitors. Many such intangible measures can be applied to pilot studies.

Since the new metrics have grown from the inadequacies of the traditional measures, it is important to know what these measures are and where their limitations exist. Moreover it is often necessary in practice to apply some of these calculations for completeness or to measure purely financial returns.

4 TRADITIONAL MEASURES OF VALUE

Historically, measures of IT value were done by purely financial calculations relating to the value of an investment and its concomitant return. The calculations, especially when applied in times of high inflation, often incorporated factors that discounted the time value of money. These are simple measures, readily calculated and understood and, in the past, usually sufficed as a reasonable measure of valuation. Their popularity was undoubtedly as a result of the ease by which the data could be extracted and the calculations performed. Many of these measures are still in use today, often applied to businesses and pilot studies in combination with other measures. The most popular measure is the cost/benefit analysis.

4.1 Cost/benefit analysis (C/BA)

Benefits are the advantage, profit, or gain attained through an action. They are the investment's return. The benefit is what the investment enables a firm to accomplish or how its mission is enhanced. Focusing on improved outcomes rather than the technology is one of the best ways to ensure that the expenditure of any resource furthers the businesses mission.

Costs, here, refer to both the incurred expenses of an investment and its capitalised costs that are direct (materials, labour and other expenses having a direct bearing on the production of a specific product or service) or indirect (which include rent, utilities, insurance, indirect labour). Once all costs and benefits are identified and numerated they must be integrated meaningfully into the equation. The calculation of the cost-benefit analysis hinges on the quantification of all variables - some may be difficult to identify and monetise.

As with any financial tool, there are a few shortcomings of the C/BA that must be acknowledged and managed. Because the calculation hinges on the quantification of all variables, it can be tedious and at times impossible to successfully monetise every element to be factored into the analysis. Remaining objective when considering the elements to be factored into the analysis is a challenge since personal judgment must not cloud the decisions.

Costs and benefits as part of a pilot study, particularly if the intervention is bounded, are usually readily quantifiable. Where a pilot study is of short dura-

tion, the time value of money is not an issue. There are many financial metrics that employ discounted cash-flow techniques.

4.2 Other traditional financial measures

This paper does not purport to provide in-depth direction on these methods. For more insights into the various calculations the reader is advised to consult any one of the many readily available financial texts.

4.2.1 Net present value (NPV)

NPV is one of the most commonly used traditional tools for analysis. In practice other instruments such as those that follow are useful but do not provide as much insight. The metric recognises the time value of money by discounting monetary costs and benefits over a period of (usually) the project life. NPV permits purely financial comparisons that may have widely disparate cash flows. It permits objective evaluation of projects regardless of scale differences or the existence of capital rationing and can be used to compare independent or mutually exclusive projects.

For each period of the analysis, cash inflows (benefits) and cash outflows (costs) are totalled and summed to arrive at a net value. This net cash flow is then multiplied by an appropriate factor to arrive at the discounted cash flow (DCF) for each year. NPV is the total of these discounted cash flows over the period of analysis. For meaningful interpretation sound estimates of project costs and benefits, the selection of an appropriate discount rate and identification of the timing of cash receipts and payments are needed.

To determine how much an investment's return (or NPV) will change in response to a given change in an independent input variable with all other factors held constant sensitivity analysis is applied. This technique can be used on one variable at a time, or on a group of variables (sometimes referred to as scenario analysis). Typically, returns are more sensitive to changes in some variables than to changes in others. This technique can be applied to the results of pilot studies when the interaction between variables is known.

Expected Value Analysis involves the assignment of probability estimates to alternative outcomes and summing the products of the various outcomes.

4.2.2 Internal rate of return (IRR) or modified IRR (MIRR)

The internal rate of return is the discount rate that equates the present value of the expected future cash flows to the initial cost of the project. It is the NPV solved for a discount rate that causes NPV to equal zero. A favourable IRR is

one that ensures the benefits provided by an investment exceed the organisation's weighted average cost of capital.

The modified internal rate of return provides an IRR when expected negative cash flows occur after the initial period. This method requires the compounding of the future values of all positive cash flows to the last period of the project's cycle. All negative cash flows are discounted to the first period. The MIRR is the rate at which the present value of the negative cash flows equals the future value of the positive cash flows.

4.2.3 Return on investment (ROI)

ROI is a percentage that equals the total return for the timeframe of an analysis divided by initial and subsequent investments. ROI may be stated as either discounted or non-discounted.

4.2.4 Discounted payback period (DPP)

DPP, normally stated in years represents the length of time required for net revenues to recover the cost of the investment on a discounted basis. This metric has long been abandoned as the primary factor in valuation in favour of other methods fostering broader and longer-term views. It does provide a measure of project liquidity and can be of use as an indication of risk as a project whose return is realised rapidly is seen to present less risk than longer-term projects.

4.3 Special measures

The financial metrics discussed above are often encountered however there are others, less frequently encountered but nevertheless occasionally useful. More details of these calculations and examples of their application are available in the literature (Remez and White, 1999:30-33).

4.3.1 Savings investment ratio (SIR)

The SIR allows comparisons between profit savings potential of alternatives to determine whether the recurring savings of the proposed investment justify the costs. The ratio is derived by computing the present value of the savings produced by the investment relative to the costs of the status quo in each year of the analysis, totalling the discounted savings and dividing by the discounted investment costs.

The resulting ratio indicates the proportionate savings resulting from an alternative to the status quo to the investment required to implement the alternative. A SIR greater than unity indicates that the NPV of the savings attained by the new investment are equal to or greater than the NPV of the costs incurred

to implement the new investment. SIR can be used to compare multiple project returns after considering total costs and savings.

4.3.2 Benefit investment ratio (BIR)

The BIR of a project or investment is used in situations where the financial analysis scores of alternatives rank closely and an additional viewpoint is desired. It is derived by dividing the discounted benefits by the discounted costs and will always indicate the same accept/reject decision for independent projects.

4.3.3 Equivalent uniform annual cost (EUAC)

When the lives of alternative projects differ and are shorter than a minimum requirement time period, EUAC allows alternatives to be compared on a common basis of time. It can be helpful in evaluating specific alternative components of an IT system by converting each option into an equivalent hypothetical alternative with uniform recurring costs. Instruction on this method can be found in most financial texts.

4.4 Accounting for flexibility

The measures defined above are mostly financial in nature. They do not generally allow for intangibles, non-financial performance or business flexibility. Considering a pilot venture as being equivalent to the acquisition of an option is an evaluation process receiving more and more attention (Copeland, 2001:1). The increasing use of option pricing models to support IT investment decisions has also become more prominent in literature. Since traditional quantitative approaches, as discussed above, provide a partial picture the manager often faces the problem of valuing different investment opportunities provided by pilot studies

5 REAL OPTIONS IN PILOT STUDIES

5.1 The rationale for real options

NPV could suffice as a measure or performance for a project that remains relatively unchanged over time but it does not adequately deal with the elements of flexibility that need consideration when implementing a pilot project. Traditional NPV almost requires the explicit renunciation of flexibility.

A financial “option to purchase” is usually exercised when the cost of exercising the option (the “exercise price”) is lower than the current market price. The decision contains no uncertainty. The situation is similar for a real option on a commodity such as gold, or wheat. A business gives up its option when it makes an exercise decision or when it expires - which also effectively termi-

nates the flexibility created by the option. The decision to exercise an option will define whether the real options approach is better than some of the standard conventional discounted cash flow financial models discussed above. It has been shown (Taudes *et al.*, 2000:229-230) that if a firm is prone to bias at this stage, it may waste resources by investing (exercising options that appear to be failing) or by dropping options that could lead to an advantage.

The characteristics that distinguish real options from financial options are the degree of uncertainty remaining when the exercise decision must be made and the extent to which the assets created by establishing the option are initially integrated with other resources in the firm or kept isolated.

Real-options analysis embodies the value of flexibility to expand, extend, contract, abandon, or defer a project - a decision not well supported by a purely financial calculation.

5.2 NPV and real options

The application of real options analysis to the evaluation of pilot studies is often a superior process to NPV since NPV tends to undervalue a potential project. Real-options analysis adds value by making allowances for management action. The process offers the flexibility to expand, extend, contract, abandon, or defer a project in response to unforeseen events that drive the value of a project up or down through time.

NPV makes no provision for the value of flexibility in making future decisions that resolve uncertainty. Real-options analysis looks at the problem as a decision tree permitting, if necessary, the development of an NPV with the right to defer a project, stopping the deferral process when the NPV of the project - without the option to defer - exceeds the value of waiting.

5.3 Management decisions and real options

As pointed out earlier real options are the right, but not the obligation, to take an action in the future at a predetermined “price” at a predetermined time. When a real option is exercised the difference between the return of the project and the exercise price of the option is captured, thus if a project is more successful than expected, management can pay an “exercise price” to expand the project by making an additional expenditure.

Management can also extend the life of a project by paying an exercise price. If the project does worse than expected it can be scaled back or abandoned. In addition, it is not required that the initial investment be made immediately - it can be deferred.

The value of a real option is influenced by the value of the underlying project, the exercise price/investment cost, the volatility of the underlying project's value, time-to-maturity, risk-free interest rate and the cash flows.

Where economics could shut down a pilot project if the marginal cost exceeds the marginal revenue, real-options analysis provides a realistic answer: The operation should be shut down only when the expected losses from continuing to keep operations open is equal to or more than the fixed cost of shutting down.

Pilot studies can often contain well-disguised opportunities. By using a real-options approach management are better able to foresee events leading to more meaningful pilot studies and, ultimately, resulting in better investment decisions. Businesses can then be better equipped to revise critical decisions as the project progresses.

Several researchers have written on the use of option models in IT investment decisions, including (Dos Santos, 1991:74-77) who expounds on an exchange option model for valuing an IS project.

There are a few "proprietary" metrics offered by consulting groups that are applicable to measuring the performance of electronic businesses. They are given brief mention since if the pilot is large enough, these methods can be applied to measure the performance of such studies.

6 OTHER METHODS OF MEASUREMENT

6.1 Giga Group: Total economic impact

According to its vendors (Giga Information Group, 2000:1) the Total Economic Impact (TEI) methodology "is a holistic ROI approach that measures how a solution or initiative not only impacts on IT but also on the company's business units". It enables organisations to identify and maximise the overall value of technology investments and to communicate that value in business terms.

TEI has four components - benefits, costs, flexibility and risk. The benefits represent the value delivered to the business by the proposed project. Since IT is often a source of competitive advantage the value expectations sometimes exceed mere cost reduction. TEI captures the value proposition of the proposed project by measuring the benefits against the incurred costs. They propose that all benefits ascribed to TEI should be traceable to one or more critical success factors (CSFs), directly linked to higher-level business strat-

egy. If the proposed technology investment generates benefits that cannot be satisfactorily linked to a CSF, then it is not considered a benefit for the organisation in the model and is discarded. Benefits should only accrue to the business units. The TEI process begins with a discovery of potential benefit areas each with its specific capture date.

Costs in the form of labour, subcontractor or materials, represent the investment necessary to capture the value, or benefits, of the proposed project.

Flexibility represents investing in additional capacity that can, for some future additional investment, be turned into business benefit, such as an investment in an office suite application where the primary driver may be standardisation (to increase efficiency) or licensing (to decrease IT costs). The resulting scenarios facilitate the required management decisions with the final results being presented in tabular format facilitating comparisons.

This metric is useful and an example of its application to Network Appliance Inc., a US-based provider of enterprise network storage solutions is available (Giga Information Group, 2000:1).

6.2 Cap Gemini: The value creation index (VCI)

The VCI process as advocated by Cap Gemini (Kalafut and Low, 2001:1) views intangibles as the most significant differentiating factor between successful and unsuccessful IPOs. The VCI measures the impact of key intangible asset categories on a company's market value, innovation, quality, customer relations, management capabilities, alliances, technology, brand value, employee relations, environmental and community issues.

6.3 The Balanced Scorecard

In their book on the Balanced Scorecard (Kaplan and Norton, 1996) performance is measured by growth in customers, retention of talent and improved market share. The process has found extensive application in managing business performance. Its possible application to pilot studies, however, is considered to be beyond the scope of this paper.

6.4 Technical performance measurement systems

Business IS practices are no longer confined to intra-organisational islands of automation but have become open, collaborative, extended and web-centric systems which have thrust IT performance management into the spotlight. Management is realising that optimally performing solutions are part of the success drivers.

There are other measures of performance available specifically for web sites, that include, for example, application response time. These have become critical drivers of revenue, customer satisfaction and profitability. There are specific systems technologies (Netuitive Inc, 2002) and dedicated web-based performance measuring services available that combine real-time performance analysis with predictive insight allowing flexibility and permitting informed decisions to be made. Such systems facilitate the correlation between IT system and subsystem performance and key business performance metrics and are often the subject of pilot studies in their own right.

7 PILOT PROJECT METRICS – THE IMPLICATIONS FOR MANAGEMENT

Most of the metrics discussed in this paper are in use and can be readily applied to pilot studies to provide a more comprehensive picture to management. Simply asking whether a trial ended in success or failure is very limiting when by placing more emphasis on the project design and output measurement, results with more use can be delivered.

As companies access and deliver data in dramatically different ways, from vertical transactional systems accessed by generic reporting and query tools, to analytic environments that integrate data from across the enterprise to support consistent and near-real-time decision-making, more and more pilot studies will be undertaken.

As discussed in this paper some of the real benefits can be difficult to quantify using older methods of assessment. The use of traditional metrics to evaluate payback and return on investment, for example, of a data warehousing project show the bottom-line benefits associated with the costs of developing, deploying and maintaining a system but don't reveal the complete story. It has been shown how traditional ROI ignores intangibles such as improvements in the level of customer satisfaction or the faster time-to-market of new products and services. Traditional models do not measure competitively critical benefits such as better and faster decision-making, enhanced sales effectiveness, greater productivity and organisational flexibility to respond to rapidly changing markets. Flexibility can be catered for by viewing pilot studies as real options purchased by management for exercising in the future.

Constant innovation demands activities that elicit a steady stream of high-potential ideas. These must be developed, tested and implemented within the context of enterprise business and strategic direction – many of them through pilot studies. By codifying experience, judgment and insight into explicit form, knowledge becomes more broadly usable and access to the ideas and inno-

vations of others stimulates employees to broaden, extend and rethink their own tacit knowledge to create and innovate. Collaborative interaction and sharing of tacit knowledge adds judgment, experience and insight to ideas, thus grounding and validating them within the strategy and context of the enterprise.

8 CONCLUSION

IT risk management remains one of the important issues facing business executives and running a pilot study enables this risk to be assessed more objectively. As organisations become increasingly technology-dependent, they increase their vulnerability to risk and it behoves them to perform their risk analyses correctly, determine the risk level, and take measures accordingly.

The points made in this paper are designed to provide management with a view of all the major issues involved in the identification and analysis of risks and the role of carefully designed pilot studies as one of the many risk-reducing measures.

This paper should help organisations become more aware of their dependence on the reliable functioning of IT by identifying the potential threats from all external and internal sources. Without such awareness, firms would not be convinced about their susceptibility to these threats and the need for implementing risk-reducing measures for their continued operations and eventual survival.

Some managers may not have the innate ability to develop an overall business perspective. Those who do, and effectively deploy their talents by creating better tests, will develop the aggregate view and obtain improved insights delivered by better design and interpretation of pilot studies.

Managers should change their way of planning test ventures and be encouraged to take the logical steps of recognising the value of a well-crafted pilot study. They should understand how it impacts on reducing risk and, once the study is complete, see how it measures against all objectives, both financial and intangible, applying some of the metrics and techniques discussed above. They should not lose sight of the knowledge created.

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A business school is a university-level institution that confers degrees in business administration or management.Â In 1981 the current premises in Bellville has been acquired and five years later the department relocated to the Bellville Park Campus. In 1989 MBA student numbers reached 580. The name of the Department of Business Management and Administration changed to the Graduate School of Business (now the USB) in 1992.