

Journal of Information Technology Management

ISSN #1042-1319

A Publication of the Association of Management

JUSTIFYING INVESTMENTS IN IT

SASHA DEKLEVA
DEPAUL UNIVERSITY
sdekleva@depaul.edu

ABSTRACT

Traditional accounting techniques such as return on investment and net present value are often used when deciding investments in information technology. We examined both academic and trade literature to determine the utility of such techniques and to recognize alternatives. Findings reveal that this survey is needed and is important for information systems managers facing heightened scrutiny of IT projects.

Keywords: return on investment, information technology, cost and benefit analysis

INTRODUCTION

Various traditional accounting techniques have been used to calculate purely financial *Return on Investment* (ROI), including *Present Value*, *Net Present Value* (NPV) and *Internal Rate of Return*. More recently, however, organizations have begun to take non-financial benefits into account. Many practitioners, particularly those working in finance and accounting, still insist that every investment should be backed by verifiable ROI calculation. At the same time, the notion of intangible benefits that cannot easily be quantified is also quite prevalent. Some ask about the worth of investing in a firewall, for example, to prove that such decisions cannot be based on traditional ROI figures. In this paper, we attempt to answer the question whether ROI should, indeed, always be used to back decisions on information technology (IT) investments. We also identify alternative approaches and determine when they may be more appropriate.

ROI LIMITATIONS

A study of 130 senior executives from large companies that average \$230 million in annual IT spend-

ing, conducted by the Kellogg School of Management at Northwestern University in collaboration with the Society for Information Management and consulting firm DiamondCluster International, revealed that 51% of respondents have no process to evaluate IT investments against business strategy. Sixty-eight percent do not compare their IT projects' benefits to original targets, 74% do not track financial metrics after making an investment decision, and 80% said lack of financial skills makes quantifying IT benefits difficult [1]. Only 26% of executives say they track financial metrics after making an IT investment, but 63% would like to do so. Researchers found that senior IT executives simply do not know where to start, and that they lack the financial training necessary to make such analyses.

Similarly, all but three of the 30 companies studied between October 1999 and March 2000 funded at least one e-business initiative without a *Business Case* [2]. (The phrase *Business Case* is used here to describe a detailed presentation of investment benefits, including the ROI figures.) Senior managers simply allocated funding for initiatives perceived as strategic. At 16 companies, executives made a lump-sum allocation for company-wide infrastructure. Typically, they were responding to the perception that the company could not meet changing cus-

tomers demands or pursue new business opportunities without the proposed infrastructure.

Although Tiernan and Peppard [3] recognize that non-quantifiable benefits have always been a thorny issue in constructing investment proposals, they rather tentatively suggest that non-quantifiable benefits have to be translated into something that eventually has real monetary value. They resolve this “translation problem” by expecting that the relevant business functions consider whether or not they are likely to be able to secure the benefits from how they are planning to use the new IT service. These business functions will ultimately have to finance the projects to provide the IT services from which they expect to benefit.

Doherty [7] concurs by using examples of intangible benefits in a local government. They may include improved customer service, reduced wait times, increased public safety, decreased operational errors and attention to public health issues, all good, certainly, but rather difficult to quantify. In some cases, models or assumptions help translate the non-financial benefits into financial metrics so that traditional ROI calculations still can be used. Those models can be very complex, however, and analyses depend on the validity of the assumptions used to make them.

Lucas [4] further proposes that profits from investments in IT are often not evident and that some may construe these profits to be nonexistent. He states from the outset that not everything is measurable by ROI, such as customer satisfaction or the simplification of administrative work. He thus recognizes that for some applications companies cannot expect to obtain a measurable financial return from investing in IT, although they actually obtain it.

Varghese [5] puts it bluntly: “Basing IT priorities on ROI rankings is a fool’s game, a game in which the biggest liar wins.” He recognizes that ROI numbers do not ensure that technology initiatives will be in line with business strategy. Varghese further suggests that ROI figures should merely be used as a means to ensure that the planning is as comprehensive as possible and that the totality of impact has been considered.

McMahon [6] agrees, but focuses specifically on IT support in the human resources (HR) function. He disagrees with the suggestions that working to demonstrate positive ROI or developing a business case may be a waste of time. Preparing a business case or estimating ROI involve fundamental planning and business thinking, which should be parts of a basic business discipline. Secondly, such estimates represent the first step in expectation and change management. Thirdly, such analysis increases the understanding of the cost structure of HR and,

potentially, stimulates ideas for business process improvement. All in all, estimating ROI is a good business practice. He nevertheless asks: “Why spend a lot of time calculating ROI for payroll system?” McMahon suggests that for such system a positive ROI is difficult, or perhaps impossible, to demonstrate and introduces another acronym – KTLO, standing for *Keep the Lights On*. In other words, a company has to have it, although it may be outsourced. ROI in such cases is simply irrelevant.

The technology research company Gartner predicted that by 2005, leading-edge enterprises will rely on non-financial or synergistic measures as the primary decision factors in more than two-thirds of IT investment decisions, and presented 10 such measures [8]:

- Better, faster product design
- Better products
- New revenue through new products, customers and channels
- Improved customer service
- Increased employee effectiveness
- Increased process effectiveness
- Increased brand value and reputation
- Creation of other intellectual assets
- Connectedness and
- Asset utilization

The implication is that conventional financial measures could not be used to assess the value of IT investments resulting in these improvements. As has been said, “Not everything that can be measured has value, and not everything that has value can be measured.”

Although far from conclusive, the research, observations and reports above are representative of writings by both practitioners and academics. We read that managers often base their IT investment decisions on instinct and that even when ROI or a similar financial justification is considered, its shortcomings are clear and recognized. In the following sections, we discuss a number of proposals that go beyond the simple ROI calculation to justify IT investments.

BEYOND ROI

Hoechst, a venerable German chemical company and now part of the new Aventis, uses a non-financial *Scoring Model* where projects are rated based on five criteria: probability of technical success, commercial success, reward, business strategy fit, and strategic leverage [9].

Corporations such as Motorola, Philips and Lucent have used *Technology Roadmapping* to make plans for technology needs that will arise along with product

development. Groenveld [10] describes a roadmap process developed at Philips Electronics aimed at better integration of business and technology strategy. Roadmapping not only contributes to integration, but is also used to define technology strategy by displaying the interaction between business processes and technologies over time. The main benefit of technology roadmapping is that it provides information to make better decisions for technology investment. A generic technology roadmap has spatial and temporal dimensions. Different interdependent programs and projects show in the spatial dimension at a given point of time.

IBM developed its own version of a roadmap called the *Component Business Model*. It uses the model internally and in consulting. For example, IBM Business Consulting Services applied it in helping the Bank of America link its business and technology objectives [11]. The model mapped the bank's technology to its business objectives, identified priorities for transformation and helped create the new supporting IT architecture..

In addition to roadmaps and IBM's variation, Shimonski [12] described a known risk assessment model used for investment decisions regarding a system's security. A modified version is briefly described here.

Evaluators develop a list of all possible risks affecting the IT infrastructure and systems in general, unless the risk focuses on only a single piece of equipment. In any case, the list would likely include many security threats. For each of these, they then need to determine the likelihood of each risk occurring within a year, which Shimonski calls the *Annualized Rate of Occurrence* (ARO). Evaluators then estimate the total cost of each threat if it happened, and call it the *Single Cost of Threat* (SCT). To protect the company from all threats under consideration, planners need to budget for the possibility that they will happen. This budget allocation can be called the *Annual Loss Expectancy* (ALE) and can be calculated using the following formula:

$$ALE = \sum_{j=1}^n SCT_j \cdot ARO_j$$

Subscript j in the formula identifies each of the n possible threats.

Banking provides yet another possibility. Chen and Zhu [13] also realized that the link between IT investment and firm performance is indirect. They used an example from the banking industry where IT helps to increase the customers' deposits. Profits are later generated by investing the deposits. Traditional efficiency models can only measure efficiency of a specific stage even when a process has two stages. They developed the *Efficiency Model* for a two-stage production process linked by inter-

mediate measures. They illustrated their model using a set of firms in the banking industry with indirect impact of IT on performance. They identified the efficient frontier of two principal value-added stages related to IT investment and profit generation, and highlighted those firms that can be further analyzed for best practice benchmarking.

In their seminal paper that introduced the concept of the *Balanced Scorecard*, Kaplan and Norton [14] stated that executives understand that traditional financial accounting measures like ROI and *Earning per Share* can give misleading signals for continuous improvement and innovation. They also suggested that the traditional financial performance measures worked well for the industrial era, but that they are out of step with the skills and competencies companies are trying to master today.

Describing practices used by the U.S. government, Nguyen [15] reports that traditional ROI analysis only captures a part of the picture, since it measures only tangible direct costs and tangible direct benefits, measurements which he finds almost always inadequate. The benefits in government organizations are largely non-financial. Nguyen presents a framework called *Value Measuring Methodology*, a technique including but extending beyond the ROI calculation, and based on a weighting and scoring system to compare alternatives within the context of government's business goals. He describes a six-step procedure to derive the *Business Case* using five major criteria: constituent benefits, social benefits, internal financial benefits, internal non-financial benefits, and strategic organizational benefits. Using sub-categories, the method assigns each of them a particular weight and a score to calculate the total weighted score for the project, which enables comparison with other projects competing for funding.

Recognizing that not all IT investments are identical, some researchers see justification possibilities in the nature and goals of the investment itself.

Ross and Beath [2] introduced a concept of four IT investment types and called them Process improvement, Experiments, Renewal, and Transformation. Process improvements focus on operational outcomes of existing business processes. Companies need a steady stream of business and technology experiments to learn about the capabilities and limitations of new technologies. Renewal investments replace old shared technologies with newer, more powerful or more cost-effective ones. Transformation, on the other hand, intentionally changes a company's infrastructure in ways that not only enable, but usually demand process change. They concluded that using *Business Cases* to justify IT investments may be appropriate for Renewal and Process improvement investment types. For Transformation and Experiments, however, they pro-

posed that simple executive (or business area) funds allocation is needed. They also believe that effective IT transformation starts with understanding IT costs and applying principles of *Activity-Based Costing* (ABC). Researchers note that although quantitative tools such as *Decision-Tree Analysis* or *Real-Options Analysis* can assist decision making, ultimately most companies rely on competitive analysis and executive instinct.

Peacock and Tanniru [16] also divided IT investments into four types, but in different categories along two dimensions: Application of IT (distinguishing general from focused) and Measurement Complexity (categorized as low or high). They then applied the accounting concept *Activity Based Costing* (ABC) to the problem of justifying IT investments. The basic idea behind this approach is to compare business performance before and after the IT investment by analyzing investment's impact on business activities and performance. While limiting ABC's applicability mainly to the cell in focused Application of IT and low Measuring Complexity quadrant, they suggested that the very effort to study the IT's impact on various activities may transform cases fitting in general Application of IT and low Measurement Complexity or focused Application of IT and high Measurement Complexity quadrants into cases where ABC proves to be useful. The researchers recognized that the measurement and analysis costs may be substantial and that ABC approach may not be appropriate for every investment decision. The ABC is not really useful for justifying IT investments characterized as general Application of IT and high in Measurement Complexity, such as investments in IT infrastructure. The costs in such cases are often viewed as overhead, and either expensed or allocated to various entities using an *a priori* criteria.

Practitioners Rau and Bye [17] make a different take on IT valuation. They first define four IT value dimensions: Expense Containment, Process Improvement, Customer Advantage, and Talent Leverage. They then divide each of them into its three major subcomponents: Capital and Operating Expense, People, and Innovation, the later two an obvious extension of common focus. Measuring the capital and annual operating expenses is driven by accounting rules. Measuring the other two subcomponents of IT value, suggest the authors, moves the discussion beyond the well-worn path of valuing tangible assets into the gray area of valuing intangibles. They propose a number of financial ratios to measure the value of IT staff including *Return on Assets*, *Return on Capital Expended*, *Human Capital Return on Investment*, *Human Capital Value Added*, and *Human Economic Value Added*. They recognize that the third subcomponent of IT value—innovation—is the least tangible and the most

challenging to measure and compare it with such intangibles as brand equity and social responsibility. Yet, to the extent that IT innovation can be linked to specific business outcomes, measures and value metrics can be established. In a case of a customer relationship management application, for example, such measures could be *Revenue Increases per Customer*, *Marginal Revenue Productivity*, *Cross-Selling Value*, or *Cost of Sales Trends* over time. They thus conclude that valuing IT need not be guesswork. Using these metrics, they say, CEOs and CFOs can assess the value that is being generated by their IT organizations with greater precision and with much more relevance to business outcomes and enterprise value than in the past.

Kumar [18] actually focuses on the valuation of IT infrastructure, perhaps the most difficult IT investments to justify. He presents an extensive literature review and reiterates that traditional financial evaluation techniques, such as NPV, undervalue IT infrastructure investments since they do not carefully consider relatively intangible benefits such as flexibility. His framework recognizes the value of IT infrastructure flexibility, meaning that highly flexible infrastructure is usually more expensive, but may prove of higher value in changing business conditions. The value of IT infrastructure in Kumar's framework also depends on its use in an organizational context. His mathematical model presents an approach to understanding and assessing the value of IT infrastructure investments and is based on the *Asset Valuation* literature in finance.

While speaking about investments in IT infrastructure, it may be interesting to mention as an aside that such investments have been found to correlate with increases in investing companies' stock values. Dehning et al. [19] found positive, abnormal returns to announcements of IT investments by firms making transformative IT investments, and more generally with a firm's membership in industry groups with transforming IT strategic roles. Transformative IT investments are those where IT not only automates existing procedures or improves information flows either upstream or downstream along the organizational structure, but also facilitates the transformation of business and industry processes and relationships. Along the same line, some industries, such as financial services, are recognized to be information intensive, while others, for example construction, are less so. The researchers used experts to categorize various industries into segments depending on the role IT plays in each of them – automating, informing, or transforming. As mentioned, they found abnormal returns to announcements of IT investments by firms belonging to industries where IT is playing transformational role. In other words, financial

markets recognize the value (or at least the potential of adding value) of IT investment announcements and produce abnormal movements in the investing firm's stock price in firms or industries where IT plays transformational role.

Another technique used to maximize the business value from IT investments is known as the *IT Portfolio Management* (ITPM). It means managing IT as a portfolio of assets similar to a financial portfolio and striving to improve the performance of the portfolio by balancing risk and return [20]. Broader in scope than other techniques discussed so far, ITPM includes evaluation of planned investments comprising all direct and indirect IT projects and assets, including infrastructure, outsourcing contracts, and software licenses. Part of the ITPM may be the use of the *Balanced Scorecard* approach that captures various dimensions of business value, risk and ability to succeed. In a Fortune 500 consumer packaged-goods company, six criteria related to the 2002 strategic objectives were weighed: financial return, consumer focus, supply-chain business benefit, technology efficiency, knowledge advantage and work-life balance.

Bardhan et al. [21] have extended the portfolio approach by including the effect of project interdependencies and again applying *Real Options* for prioritization of IT investments. They recognize that an IT infrastructure project may have a negative NPV when evaluated on a stand-alone basis, but the project nonetheless can provide an option to launch future value-added services for application development. Unless the option value of this flexibility is taken into consideration, companies will not be able to accurately represent the strategic business value, or justify, strategic investments in IT. Using real data from a large U.S.-based energy utility firm, Bardhan et al. developed a *Nested Real Options Model* that extends prior research by incorporating the impact of project interdependencies for project valuation and prioritization. They used a *Value Net* approach to estimate project benefits based on interactions between the company, its customers, and its partners. A *Value Net* is a map that links a firm to various player segments: customers, competitors, suppliers and partners. Their model improves the understanding of project interdependencies and provides insights into the business value of IT infrastructure projects, thereby enabling the managerial flexibility to launch future projects.

Although the concept called the *Total Cost of Ownership* received a lot of attention recently, a new model proposed by Luftman and Muller [22] introduces instead the *Total Value of Ownership* (TVO). They find the former focused too much on costs rather than on value—costs of development, hardware, networking, software, and support. They identified three techniques to

help a company assess and maximize its TVO: *Portfolio Management*, *Governance Process*, and *Real Options*. Since we already touched on the other two, we will now introduce only the *Governance Process*, which requires that IT and business executives meet regularly to assess projects. The three-step process begins by identifying the company's overall business objectives. Business changes required to attain these objectives are identified next. They may include work process changes, transformation of business functions, or evaluation of new business models. Finally, the IT required to facilitate these transformations is identified. One has to notice that this three-step sequence is rather conventional: as the evolution of IT may influence the overall business objectives, the procedure would likely be more involved and iterative than the authors suggest.

Referring to a number of previous studies, Lee [23] recognizes that while some organizations failed to garner promised benefits from IT investment, others have been successful and that successful IT investment cases indicate that business process design issues should be addressed when IT investment decisions are made. Lee integrates IT evaluation with business process design and suggests a four-phase IT evaluation methodology:

1. Strategic analysis
2. Business process redesign
3. IT configuration
4. Performance evaluation

Lee also presents a simple *Mathematical Model* and a *Simulation Approach* to reasonably estimate organizational benefits of business process-integrated IT investments. Lee also recognizes two broad categories of performance evaluation: financial and non-financial, where the latter consists of two major dimensions: operational and strategic. While the operational dimensions are typically quantifiable (e.g., cycle time, defect rates, and end-user satisfaction), the strategic dimensions are mostly not (e.g., product development capability). He then focuses on the financial evaluation and discusses methodologies to transform strategic and operational performance into financial performance. In addition, Lee builds a simulation model to evaluate the impact of delivery time on repurchase decisions and empirically validates it. Lee observed that the benefits of IT investment used to reduce purchase cycle time are greater over time and that the *Discount Rate* should be chosen carefully, since a high rate severely penalizes future cash inflow.

The Certified Management Accountants Canada and the American Institute of Certified Public Accountants recently published a comprehensive Management Accounting Guideline [24] to provide a model and a selection of measures for evaluating IT performance in both

for-profit and not-for-profit organizations, to help CIOs better justify and evaluate their initiative and to aid CEOs and CFOs in making resource allocation decisions. The Guideline's objectives are, among others:

- To provide a general model of key factors for the evaluation of organizational success in IT integration
- To define each of the key factors and their interdependencies
- To provide specific measures of IT performance
- To provide examples of how to assign monetary values to non-financial IT benefits and how to calculate the IT payoffs

The metrics can be used during the planning stage for IT project justification prior to its start as well as

a performance measurement for evaluation after the project's completion. The proposed *IT Contribution Model*, shown on Figure 1, is consistent with other measurement frameworks such as the *Balanced Scorecard* and *Shareholder Value Analysis*. The Model broadly views IT projects as business change projects with IT components, rather than solely IT projects, so that change management constitutes an important part of IT projects. The business value is thus most important and should be clearly stated. This position leads to the assignments of accountabilities. IT managers are accountable for the IT infrastructure, applications, and technical support, while accountability for business results is shared with the relevant business managers.

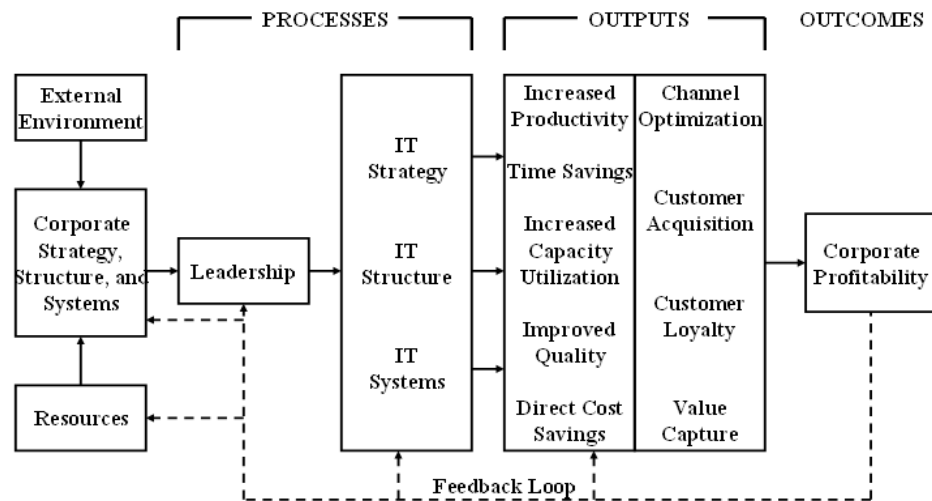


Figure 1: IT Contribution Model

The developers of the IT Contribution Model suggest that by using it, managers can implement a performance measurement system to more effectively evaluate the outcome of IT investments, which can lead to dramatic improvements in decision making, corporate resource allocations, and performance. Since the Model is rather new, we do not have yet have any empirical studies to support these claims, but the model is very detailed and one would expect it to be a welcome and useful guide.

ADVANCED FINANCIAL MODELS

Au and Kauffman [25] extend the considerations to the marketplace, or the company's ecosystem, recognizing the network effect, which makes the value of IT

investment dependent on whether other companies—either the competitors or participants in the company's value chain—also implement the same technology. For example, when a bank considers implementing a debit card payment system, it benefits if other banks as well as merchants also decide to implement such a system. In another study, Kauffman et al. [26] found that due to the network effect, a company's technology adoption decision-making was influenced by the expected size of the shared network. Au and Kauffman also show the importance of expectations—in addition to the network effect—in the development of theories of technology adoption. In developing their model, they discuss the *Rational Expectations Hypothesis* and *Adaptive Learning* as explanatory theories, which have been previously used for interest-rate

policy formation, financial market forecasting and money-market trading, manufacturing industry investments for the production of durable goods, and policies in labor market wage setting.

Using *Game Theory*, a number of researchers modeled IT investment decision as a game where actions taken by one rational player influence the responses of the others and their future decisions [27]. For example, Zhu and Weyant [28] are interested in interdependencies of IT investment decisions among competing companies. They find decision dynamics more complicated, yet more interesting, in cases of information asymmetry across firms. This means that some companies know more than others about the costs and benefits involved in implementing certain technology. The existence of information asymmetry may have significant effects on IT adoption decisions. The researchers studied this effect in an oligopolistic industry environment. To better understand these issues, they built a mathematical model where asymmetric information arises from the future performance of the new technology. They used *Game Theory* as their analytical tool to examine strategic responses of two competing firms and focused on a two-stage adoption game between two competing firms. The two firms first invest in the infrastructure to build the capability, and then exploit that capability in the second stage. Since the better-informed firm learns less from the other firm's actions, it often chooses to move first. The less-informed firm may prefer to be a follower. The researchers demonstrated that information asymmetry leads to different incentives and strategic behaviors in the IT adoption game, as they call it. Quite surprisingly, their model shows that ordinary market uncertainty may actually induce firms to act more aggressively under certain conditions. Their model also demonstrates how information asymmetry on costs would change the strategic behavior of both competitors, which leads to a startling but interesting result: having better information could actually hurt a firm.

CONCLUSIONS

Our overview of the IT investment justification literature, which is by no means exhaustive, enables us to nevertheless answer the main question motivating this study. Very few analysts or researchers support the notion that ROI or similar measures are sufficient and should always be used to justify IT investments. Virtually all feel that such measures are inadequate, since they do not include all secondary benefits from such investments. Despite the common notion that IT *per se* does not bring measurable returns, real benefits do indeed come from

improved business operations. But even measuring business performance is not always sufficient. For example, strategic investments in improved IT infrastructure may prove to be appropriate only in the long run, as they may offer the flexibility required to respond to changing business conditions.

Researchers have demonstrated that other factors, often external, may impact IT investment decisions. Examples are competitive situations in the market and familiarity with the technology. At the other extreme, managers just know that a particular system is required to simply stay in business. In such cases, it is considered an obligatory business expense requiring no justification at all.

REFERENCES

- [1] Chabrow, E. "IT staffs lack financial chops for project analysis," *Information Week*, No. 932, March 24, 2003, p. 20.
- [2] Ross, J.W. and Breath, C.M. "Beyond the Business Case: New Approaches to IT Investment," *MIT Sloan Management Review*, Winter 2002, pp. 51 – 59.
- [3] Tiernan, C. and Peppard, J. "Information Technology: Of Value or a Vulture?" *European Management Journal*, Vol. 22, No. 6, Dec. 2004, pp. 609-623.
- [4] Lucas, H.C., Jr. *Information Technology and the Productivity Paradox: Assessing the Value of Investing in IT*, Oxford University Press, New York, 1999.
- [5] Varghese, J. "ROI is not a Formula, it is a Responsibility," *Journal of Business Strategy*, Vol. 24, No. 3, May/June 2003, pp. 21-23.
- [6] McMahan, E. "What Technology ROI Looks Like and Where to Find It?" *Canadian HR Reporter*, Vol. 17, No. 2, Jan. 26, 2004, pp.7, 9.
- [7] Doherty, M. "Mapping ROI," *American City & County*, Vol. 120, No. 2, February 2005, pp. 32 – 34.
- [8] Harris, K. and Casonato, R. "Where Is the Value on Investments in IT?" Gartner Research report SPA-17-2345, July 16, 2002.
- [9] Cooper, R.G. *Portfolio Management for New Products*, Reading, MA: Perseus, 1998.
- [10] Groenveld, P. "Roadmapping Integrates Business and Technology," *Research Technology Management*, Vol. 40, No. 5, Sep./Oct. 1997, pp. 48-55.
- [11] IBM, online: www-1.ibm.com/services/ondemand/business/bank_of_america.html; accessed August 18, 2005.

- [12] Shimonski, R.J. "Risk Assessment and Threat Identification," *WindowsSecurity.com*, online: www.windowsecurity.com/articles/Risk_Assessment_and_Threat_Identification.html, 2002; accessed August 7, 2005.
- [13] Chen, Y. and Zhu, J. "Measuring Information Technology's Indirect Impact on Firm Performance," *Information Technology & Management*, Vol. 5, No. 1-2, 2004, pp. 9 – 22.
- [14] Kaplan, R.S. and Norton, D.P. "The Balanced Scorecard," *Harvard Business Review*, Vol. 70, No. 1, Jan/Feb 1992, pp. 71-79.
- [15] Nguyen, H.T. "Beyond ROI: A New Framework for Measuring the Value of Technology Investments," *Government Finance Review*, Vol. 20, No. 6, Dec. 2004, pp. 30-35.
- [16] Peacock, E. and Tanniru, M. "Activity-based justification of IT investments," *Information & Management*, Vol. 42, No. 3, Mar. 2005, pp. 415 – 424.
- [17] Rau, S.E. and Bye, B.S. "Are You Getting Value From Your IT?" *Journal of Business Strategy*, Vol. 24, No. 3, May/June 2003, pp. 16-20.
- [18] Kumar, R.L. "A Framework for Assessing the Business Value of Information Technology Infrastructures," *Journal of Management Information Systems*, Vol. 21, No. 2, 2004, pp. 11-32.
- [19] Dehning, B., Richardson, V.J. and Zmud, R.W. "The Value Relevance of Announcements of Transformational Information Technology Investments," *MIS Quarterly*, Vol. 27, No. 4, December 2003, pp. 637-656.
- [20] Jeffery, M. and Leliveld, I. "Best Practices in IT Portfolio Management," *MIT Sloan Management Review*, Spring 2004, pp. 41 – 49.
- [21] Bardhan, I., Bagchi, S. and Sougstad, R. "Prioritizing a Portfolio of Information Technology Investment Projects," *Journal of management Information Systems*, Vol. 21, No. 2, Fall 2004, pp. 33-60.
- [22] Luftman, J. and Muller, H. "Total Value of Ownership: A New Model," *Optimize*, Vol. 4, No. 7, July 2005, pp. 51-54.
- [23] Lee, I. "Evaluating business process-integrated information technology investments," *Business Process Management Journal*, Vol. 10, No. 2, 2004, pp. 214-233.
- [24] Epstein, M.J. and Rejc, A. *Evaluating Performance in Information Technology*, CMA Canada and AICPA: Management Accounting Guideline, 2005.
- [25] Au, Y.A. and Kauffman, R.J. "What Do You Know? Rational Expectations in Information Technology Adoption and Investment," *Journal of Management Information Systems*, Vol. 20, No. 2, 2003, pp. 49-76.
- [26] Kauffman, R.J., McAndrews, J. and Wang, Y. "Opening the 'black box' of network externalities in network adoption," *Information Systems Research*, Vol. 11, No. 1, March 2000, pp. 61-82.
- [27] Demirhan, D. "Factors Affecting Investment in IT: A Critical Review," *Journal of Information Technology Theory & Application*, Vol. 6, No. 4, 2004, pp. 1-13.
- [28] Zhu, K. and Weyant, J.P. "Strategic Decisions of New Technology Adoption under Asymmetric Information: A Game-Theoretic Model," *Decision Sciences*, Vol. 34, No. 4, Fall 2003, pp. 643-675.

AUTHOR BIOGRAPHY

Sasha Dekleva is Associate Professor of Information Systems at DePaul University. He is the author of 2 books and over 70 articles. His articles appeared in journals such as *MIS Quarterly*, *Information Systems Research*, *Communications of the ACM*, *Information & Management*, and many others. His work focuses on the management of information technology. He is currently studying mobile business.