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Detecting irregularities

Does your credit card company call you after you make a transaction that is out of line with your usual activity? How does the company decide which transactions are irregular?

Statistical process control traditionally has been used to ensure that manufactured parts conform to specifications and to detect shifts in the underlying processes. Just as SPC can be used to detect shifts in a manufacturing process, similar methods can be used for business activity monitoring to detect irregular patterns of transactions or information flow that may be indicators of fraud or terrorist activity.

The challenges in these contexts are threefold. First, thousands or even millions of data streams have to be monitored and analyzed simultaneously. Second, shifts may not exhibit the relatively stable or predictable patterns that are usually seen in manufacturing settings, and historical data may be limited. Third, real-time detection of irregular patterns is needed to enable the rapid response that is often necessary to mitigate the damage.

In “A Statistical Process Control Approach to Business Process Monitoring,” professor Wei Jiang of Stevens Institute of Technology, Tom Au, Ph.D., of AT&T, and professor Kwok-Leung Tsui of the Georgia Institute of Technology propose a unified framework for modeling customer activity profiles. The method accommodates trends, change points, and frequent outliers. The proposed methods are shown to be effective for activity monitoring and detection of fraud in the telecommunications industry.

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The current issue of The Engineering Economist (Vol. 52, No. 1) focuses on errors in capital budgeting, investing in security, internal rate of return analysis, and joint venture investments. Two articles from that issue are highlighted below. The first examines a number of real investments and how actual cash flow realizations differed from the original estimates, and the second examines the complications involved when investing in security.

Post-investment analysis

Analyzing an investment is difficult because it is based on future expected cash flows, which may be uncertain. While methods such as simulation and scenario analysis have been developed to deal with this risk and uncertainty, post-audit analyses — processes by which completed investments are analyzed and compared with original estimates — should help future estimation and analyses because one can learn from previous estimation mistakes. Unfortunately, post-audits are not commonplace, and empirical research in this area is scarce.

“Forecasting Errors in Capital Budgeting: A Multi-Firm Post-Audit Study” examines data obtained through the Portuguese public organization the Institute for Small and Medium-Sized Enterprises and Investment on a number of diversified investments that requested investment subsidies from European and national public funds. The data includes the original project estimates and post-investment financial statements. Theoretically, any bias would be eliminated in this study because all subsidy seekers were advised that post-audits would be conducted on funded projects.

A statistical analysis of the data showed that operating costs were forecasted with great accuracy, but sales were significantly overestimated. Furthermore, the data showed a high degree of volatility with regard to investment costs, which could be explained by a number of factors, including delays in launching a project. Finally, it was found that the results did not differ significantly based on the firm's size, location, or industrial sector.

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Investments in security

The need to invest in security has increased in the past few years, and doing so with limited resources is a critical challenge. Many security problems, including those in aviation and computer networking, involve interdependence among potential defenders, meaning that one agent's strategy can affect the security environment for other agents. For example, poor security on the part of one airline can increase the risk to other airlines.



Doctoral student Jun Zhuang and professor Vicki M. Bier study security risk at the University of Wisconsin-Madison.

This problem has been studied with the use of game theory in a static setting. In "Subsidies in Interdependent Security with Heterogeneous Discount Rates," the dynamic problem of addressing security risk over time is addressed. The analysis shows that providing incentives to a limited number of firms can make security investment sufficiently widespread that it becomes the norm, even for firms that are not subject to such incentives. Unfortunately, if the firms being targeted are sufficiently different, then solutions are much more complicated. Recognition of this phenomenon will hopefully contribute to both an improved understanding of the security challenges that we face and an enhanced ability to identify promising solutions to those challenges.

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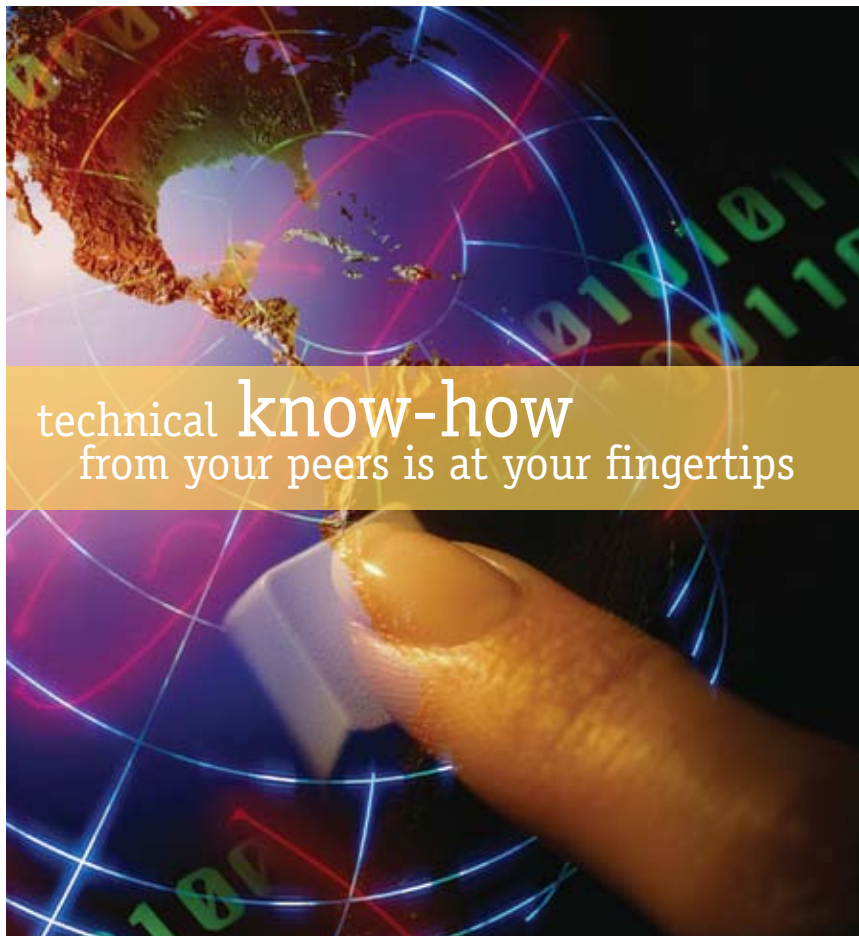
Joseph C. Hartman, Ph.D., P.E. is editor of The Engineering Economist. He is the department chair and the Soteria and George N. Kledaras Endowed Chair in the department of industrial and systems engineering at Lehigh University. Hartman has been a member of IIE since 1995 and currently serves as senior vice president for publications.

ABOUT THE JOURNALS

IIE Transactions is IIE's flagship research journal and is published monthly. It aims to foster exchange among researchers and practitioners in the industrial engineering community by publishing papers that are grounded in science and mathematics and motivated by engineering applications.

The Engineering Economist is a quarterly refereed journal devoted to problems of capital investment. Topics of interest include economic decision analysis, capital investment analysis, research and development decisions, cost estimating and accounting, and public policy analysis.

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