

Presentation
of

“A Literature Review Studying the Gaps
in Research on the Economic and
Productive Value of Information
Technology and Knowledge
Management within Biodiversity
Conservation”

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Purpose of Paper

- Provide the reader an understanding of potential overlaps between (3) disciplines in terms of economic value of data and information
 - Information Technology
 - Biodiversity Conservation
 - Knowledge Management
- Identify gaps where information is lacking

Introduction

- Researched the productive aspects of investments in information technology (IT)
- Much of literature focused on for-profit companies
- Studies used data sets from late 70's to mid 90's
- IT industry went through (3) phases during this period
- Some studies showed a negative correlation between IT investment & productivity, known as the “productivity paradox”

Introduction cont.

- Researched different ecological journals
- Difficulty finding articles about the economics of biodiversity and the value of information for decision-making
- No articles about value or non-value of IT and productive use in conservation

IT Value

- Mitra and Chaya (1996) reviewed IT budgets for 400 corporations
- Found that higher IT investments are resultant with
 - Lower average production costs
 - Lower average total costs
 - Higher average overhead costs

Mitra & Chaya (1996) cont.

- Defined (2) varying effects from IT investment
- Automation effect – the replacement of clerical labor w/ IT capital
- Information effect – ability for IT to provide better control, monitoring and decision-making to management

Mitra & Chaya (1996) cont.

- The automation effect is linked with the “productivity paradox”
- Popularized from Banker and Kauffman (1988) demonstrating that in the banking industry, there was no relationship between the # of ATMs a bank owned, and its share of local deposits and savings

“Productivity Paradox” cont.

- Summarized by Robert Solow “...we see computers everywhere except in the productivity statistics...”
- Solidified idea in Brynjolfsson’s (1993) article “The productivity paradox of information technology”, this article is cited in almost every economic IT article in the last 10 years

IT Value cont.

- Mahmood (2000), editor for *Journal of Management Information Systems*
- Very difficult to measure the effects of IT investment on firm performance
- A causal relationship cannot be established “using conventional statistical techniques”

IT Value cont.

- Tallon, et al. (2000) qualitative study
- Surveyed 304 business executives
- Research (6) hypotheses (3 shown)
 - Executives in firms with more focused goals for IT will perceive higher levels of IT business value
 - Higher levels of strategic alignment contribute to higher levels of IT business value
 - Firms that greater use IT evaluation techniques will achieve higher levels of strategic alignment

Tallon, et al. (2000) cont.

- Classified IT investment into four areas
 - Unfocused
 - Operations focus
 - Market focus
 - Dual focus
- Concluded that executives with more focused goals for IT had a higher perception of greater value of IT investments
- Propose this methodology as an alternative measure for IT payoffs, instead of traditional economic and financial measures
- Noted that only 25% of firms use ROI to evaluate IT investment
- Only 45% of firms consider ROI important for major IT investments

IT Value cont.

- Lee and Menon (2000), study of IT investment of hospital industry, 1976-1994, 18 years
- Important for two reasons
 - Extended period for data set
 - Concentrated on one industry
- Set out to demonstrate a link between IT investment and the efficiency of processes

Lee and Menon (2000) cont.

Noted in their study (3) distinct time periods in the IT industry

1. 1970s – early 1980s The Mainframe Era
2. Mid 1980s Introduction of personal computer
3. 1990s Distributed Computing/
Client-Server Architecture

Lee and Menon (2000) cont.

- Showed a positive association between IT capital and increased productivity
- Showed a negative association between IT labor and decreased productivity
- Hospitals that had high technical efficiencies had a greater investment in IT capital

IT Value cont.

- Chan (2000) performed a lit. survey of (4) technology journals 1993-1998
 - *Communications of the ACM*
 - *Information Systems Research*
 - *Journal of Management Information Systems*
 - *MIS Quarterly*
- Evidence shows a strong schism between use of qualitative and quantitative measures in IT value research
- Since Brynjolfsson's (1993) "productivity paradox" article, studies have focused on "hard" numbers, and not qualitative judgements
- Suggests more balanced views in IT needed

Economics of Biodiversity Conservation and IT

- Economics and value of biodiversity, relatively new concept, most studies in last 15 years
- Polasky et al. (2003) provides a wide overview of issues and cost considerations
- Most interesting question Polasky et al. asks “How can the greatest conservation return be achieved given limited resources?”

Biodiversity cont.

- Frazee, et al. (2003), performed cost analysis for conserving Cape Floristic Region Hotspot, South Africa
- 20-year plan
 - \$45.6 M/year for land acquisition
 - \$24.4 M/year for recurring management & maintenance
 - Would fully serve the needs of the region to maintain biodiversity

Frazeo, et al. (2003) cont.

Developed price tag through set of (5) analyses:

1. Estimates of the area of land and water required to represent and maintain biodiversity in a region
2. Identification of a system of protected areas that will achieve these biodiversity-based targets
3. The costs of acquiring and establishing the protected area system
4. The annual expenditure required to effectively manage the system
5. Information on the costs of off-reserve conservation in the unprotected landscape

Frazer, et al. (2003) cont.

- More than 16% of acquisition budget must be focused on eradication and control of invasive alien plant species in various reserves
- Single largest management issue for reserve park managers

Frazeo, et al. (2003) cont.

- Compared cost of \$3M investment to reserve 15 hectares of habitat in northern California, versus same investment for 70,000 hectares in Western & Northern Cape Provinces of South Africa
- Of \$24M recurring management costs, over \$7M (30%) is overhead
- Unclear how overhead is broken down in terms of salaries, office rent, vehicles, etc.

(2) Questions To Ask

1. What percentage of the budget is allocated for information technology?
2. How can information technology contribute to the efficient management of reserve areas and decrease the annual maintenance cost of these reserves?

Biodiversity Cont.

- Walpole and Sinden (1997) cite numerous applications of GIS during early 1990s
- “Geographic information systems can be a powerful tool to assist land management decisions”
- Little research demonstrating the economic or productive benefits of applied GIS on conservation
- Makes it problematic for practitioners to support the budgetary needs for purchasing high-performance PCs and licensing costs of GIS software (Fine 2004)

Biodiversity cont.

Huang and Chang (2003) argue:

“Information technologies are becoming more and more important for environmental management, due to increasing need for large-scale computational capability in order to handle the sophistication of environmental decision-making”

Knowledge Management and IT

- Theoretical frameworks for knowledge management going back to 1960s
- Application and implementation through applied IT, only in the last 10 years
- Numerous studies demonstrating applied use of knowledge management in for-profit companies
- Little demonstrated economic or productive value information on use of knowledge management

Knowledge Management cont.

- Okunoye and Karsten (2002) define KM as:
“Knowledge Management (KM) can be described as the systematic process of finding, selecting, organizing, distilling and presenting knowledge in a way that improves an employee’s comprehension in a specific area of interest.”
- Changes the economics of information by reducing the costs involved in disseminating information

Knowledge Management cont.

- Davern and Kauffman (2000) identify that creating a “knowledge-sharing culture” is critical for an organization’s ability to realize the value potential of IT
- To fully understand the value of KM
 - First, quantify amount of effort required to locate information with KM system
 - Second, quantify effort for locating same information without aid of KM system

Knowledge Management cont.

Earl (2001) identified “critical success factors” for successful KM

- Content validation incentives to provide content
- Culture/Incentives to share knowledge networks to connect people
- Knowledge learning and information unrestricted distribution
- Specialist teams/institutionalized processes
- Sociable culture knowledge intermediaries

Discussion

- Very little research found combining (3) aspects together
- Not much more information combining any (2) of the aspects together

Conclusion

- Still a large gap of available studies demonstrating quantitative payoffs of IT
- Large gap of studies describing the economic benefits of KM systems
- Very little research discussing these (2) aspects in terms of biodiversity conservation
- Research is not exhaustive, follow-up research in Appendix A
- Big opportunity for IT industry and conservation community to work together to understand the benefits of IT within conservation

Conclusion cont.

- Refer back to Polasky et al. (2003) “How can the greatest conservation return be achieved given limited resources?”
- (2) Questions to Investigate
 1. How can information technology be used in establishing reserve areas both more affordably and more efficiently?
 2. How can information technology be used to reduce the recurring costs of maintaining protecting areas?