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JUSTIFICATION OF IT IMPLEMENTATION: A CASE DISCUSSION OF CHILD TRACKING SYSTEM

Dr Debendra Kumar Mahalik
Reader, Sambalpur University, Orissa

Abstract: In the era of Information Technology enabled society, heavy investment is not an afterthought of government. As there is a demand from both side of the Government System i.e citizen and Government resulted in increase of these projects at a rapid pace. On one hand government is increasing the investment one the other hand time has come to show the return on investment of these projects for which reason, s are many. On the other hand available literatures are few and hardly any concrete steps are taken to investigate its justification. So there is need for investigation in to the issue. In this paper an attempt has been made to consolidate literature available and used McNemar's as a tool to justify these investment.

Key word: IT justification, Non parametric test, e-governance

Introduction: World over Government are trying to increase their efficiency and effectiveness through different mechanism to satisfy citizen needs through, various e-governance initiatives. E-governance is a technology enabled services, has resulted increase in citizen, government satisfaction and improvement in government process resulted in all round development in an around the world. But the degrees of success vary in different countries, India has no exception to it. On the one hand there is a demand for new venture on the other hand there is need for justification of these initiative, because of involvement of public fund No doubt Government in different countries are doing financial audit, but these financial audit take care of expenditure and related issue as per different government regulation but the present form of audit does not have any relationship with the effectiveness of the system and justification of these projects.

Literature survey: In Literature review some literature reveals that there is no relationship between IT and productivity (Brynjolfsson, 1993) and some literature reveals remains silent on the issue of expenditure and profitability (Strassmann, 1990; Barua et al, 1995;Loveman, 1994). Other have argue that either there is no relationship or negative relationship (Morrison and Bernt (1990), (Bernt and Morrison, 1995). Allen (1997), Van Nievelt (1999) and Dasgupta et al (1999). But during 1998 Brynjolfsson refuted their original research and are in infavour that there is a positive relationship between IT and investment. On the other hand literatures also strongly argue on the positive impact of IT investment (Bose (2002), Shin (1999) and Kraemer and Dedrick (1996)). Recent study mostly finds a positive relationship between ICT and organizational performance, resulted in large scale ICT implementation. The above variation are described by Marian

Carcary, 1998 on Evaluation of ICT Investment Performance, and reveal that due to organizational change; mis-measurement intensified by data weaknesses; the level of analysis; redistribution with some competitors thriving at the expense of others; inability of organisations to create an effective ICT capability; mismanagement of investments; deficiencies in evaluation practices and their application; and lack of process orientation (Bharadwaj, 2000; Brynjolfsson and Hitt,1999; Gregor et al, 2006; Kohli and Deveraj, 2003; Kwon and Watts, 2006; Lillrank et al, 2001; Willcocks and Lester, 1999a). literature also reveals that justification of IT investment is complex due to presence on intangible benefits (Irani, 1999; Irani, Ezingeard, Grieve, & Race, 1999; Swamidass & Kotha, 1998). On the other hand some author argues on the traditional method of IT investment find an uncertainty about their approach (Farbey, Land, and Targett (1992, 1993, 1995). They state that there is no 'best' appraisal technique that addresses 'all' project considerations. Further, they argue that the reason for this is that strategic investments in IT are aggregates of complexity, and notably different from each other. Essentially, each investment displays its own characteristics, and offers a range of benefits and costs. Conversely, each appraisal technique that can be used also displays its own characteristics, and has its own set of limitations (Irani, Ezingeard, & Grieve, 1997; Peppard & Ward, 1999; Hares & Royle, 1994). Therefore, the development of an 'all embracing' generic appraisal technique for justifying IT expenditure that takes account of the wide variety of IT related implications, may be considered too rigid and complex for use. According to Parker and Benson (1989), most chief executive officers (CEOs) are not comfortable with the current tools and techniques used to justify their investments in IT, because they lack the preciseness of definition in the financial methods used. The apparent inability of traditional modes of financial analysis to justify certain investments has led to a growing number of managers and observers to call for a moratorium in their use. Based on a review of the literature and findings from a case study, this paper proposes a model that can be used to determine the effectiveness of implementing IT at the strategic, tactical, operational levels as well as to determine intangible and non-financial benefits. Authors have argued that generally there is deteriorating trends in evaluating IT investment, as the organizations find it difficult to perform such evaluation (Ward & Peppard, 2002). Some authors argue that as because there is a lack of suitable and efficient evaluation methodology Sammon and Adam (2007). Some author Chen and Zhu 2004 also realized that the link between IT investment and firm performance is indirect.

Cost Benefit Analysis (CBA) involves comparing ICT acquisition, implementation and operational costs with the benefits derived through system usage (Farbey et al, 1999a; McBride and Fidler, 2003). The traditional CBA method does not considered ICT risk and deferred investments, resulted in a ratio method (Strassmann,1990) and option pricing methods (de Jong et al, 1999; Deschoolmeester et al, 2004; Fichman, 2004; Kumar, 1998; Lech, 2005; Silvius, 2004; Toffolon and Dakhli, 2002). Portfolio methods are concerned with positioning ICT applications on a grid and assessing them based on their relative locations. One such method is Berghout and Meertens Investment Portfolio technique (Berghout and Renkema, 2001). This formative method first evaluates tangible and intangible benefits (Farbey et al, 1999a). It suggests that it is more important to focus on value added rather than costs saved. This examines the gap between user and developer system expectations and their perception of actual performance (Gemmell and Pagano, 2003b; Hirschheim and Smithson, 1999). The key evaluation difficulties outlined in the literature (Balasubramanian et al, 2000; Ballantine et al, 1999; Berghout and Renkema, 2001; Doherty and King, 2001; Hallikainen, 2002; Mylonopoulos et al, 2004; Nijland, 2003; Powell, 1999; Stansfield et al, 2000; and Willcocks and Lester, 1999b) can be grouped under the following five headings:- Difficulties in ICT cost calculation;Difficulties in ICT benefit calculation; Limitations in evaluation techniques; ICT evaluation's social dimension; Disregard for evaluation outcomes.

Literature reveals several methods for IT investment justification some of them are ranges from objective, rational, positivist approaches to subjective, interpretive approaches (Wilson and Howcroft, 2005). Some author also proposed IT-Investment framework (Ross & Beath, 2002, Sammon & Adam, 2007), Business Case (Ward, et al., 2007; Davenport, 2000, Kimberling, 2006; Eckartz, et al., 2009). Some of theory such as Ex-ante evaluation theory used financial techniques such as the payback period, net present value, internal rate of return etc, which helps whether to proceed with a proposed IT project and justify the investment decision, It is complex in nature but only requires estimates of costs and benefits (Al- Yaseen et al,2006; Doherty and King, 2001; Farbey et al, 1999a; Gwillim et al, 2005). Where as Ex-post evaluation, used to assess the value of the ICT investment based on its actual costs and benefits, which determines ICT success(Farbey et al, 1999a), the extent of ICT use and user satisfaction (Sarosa and Zowghi, 2003), system effectiveness and efficiency, and program quality. It may also serve to justify ICT implementation to organisational stakeholders (Al-Yaseen et al, 2006). Continuous participative approaches known as Active Benefit Realisation stress upon decision making through involvement Remenyi et al's (1997) Literature also reveals that that ICT evaluation needs to be dynamic and continuous across the project lifecycle (Berghout and Nijland, 2002; Doherty and King, 2001; Farbey et al, 1999a & 1999b; Irani et al, 2005).Summative evaluation is performed once on the completed project (Cronholm and Goldkuhl, 2003; Miskelly et al, 2004; Shiratuddin and Landoni, 2001). Kumar 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.

There are numerous evaluation techniques Bannister and Remenyi (2000) categorised techniques as fundamental measures-47, composite approaches48 or Meta approaches49, Lech (2005) discussed 47, Berghout and Renkema (2001) identified 65 methods. Each of them differ in its own way with respect to data and characteristics. Authors also argue the accuracy dependent upon selection of an appropriate method and the way it is applied (Berghout, 2002; Khalifa et al, 2001; Pouloudi and Serafeimidis, 1999). Farbey et al (1999a) proposed a set of matrices that enable project characteristics and evaluation techniques to be matched. Further, Videira and da Cunha's (2005) manager-friendly roadmap helps select techniques based on the ICT project's characteristics, which are classified using McFarlan's strategic grid. Each ICT project has characteristics that lend itself towards a certain evaluation technique, while each technique is suited to a specific set of circumstances. The method chosen is influenced by many factors (Huang, 2003; Lech, 2005). These include social and organizational contexts, the organizational domain, the level of analysis, evaluation purpose and perspective, investment purpose, measurability of system impacts, and ICT application. It is now widely believed that several metrics are required to evaluate the different aspects of an ICT project.

Case Introduction:

Right to Free and Compulsory Elementary Education has become a Fundamental Right under Article 21A of Indian Constitution. "Sarva Sikhya Abhijan", is a initiative to provide free and compulsory education for all children up to the age of 14 years and to give thrust to spread of literacy in India, this integrated programme was lunched in 2010. For effectively monitoring of these initiative a comprehensive data base was made in 2005, of children from 0-14 years, the "Orissa Child Census-2005", which include all household of the state, with their name, age, sex, caste, educational status, the reasons for out of school and other indicators were built using the ICR (Intelligent Character Recognition) technology, where the data written on paper was scanned and converted into data base directly. The objective of this Child Census was to track each and every child in 0-14 age group throughout the state, prepare the data base, use the findings through on-line "CHILD TRCKING SYSTEM" (CTS) software and update it annually for better management. The CTS has been developed to track the educational and socio economic status of around 1.2 crore children between 0 to 14 years of age group in Odisha and to provide them right & free elementary education, which also helps better management of school. The CTS has e-Sishu project for Universalisation of Elementary Education (UEE) in Odisha. These include a unique child code to track their status, was developed and implemented by Odisha Primary Education Programme Authority (OPEPA) through odisha Computer Application Center (OCAC)b Bhubaneswar, which received the Prime Minister's Award for excellence in Public Administration for the year 2006-2007.

CTS has various advantage, these are

1. Tracking each and every child in 0-14 age group through unique CHILD CODE.
2. Assessment of the Reason for being out of school for every out of school child and providing remedial actions for them.
3. Identifying the Future school going children in every village wise and preparing advance action plan for them in terms of infrastructure based on micro planning.
4. Tracking each In-school children with their attendance, achievement, health status etc. and provide incentives, text books, uniform and coaching etc. for their improvement.
5. Count the number of children going to unrecognized schools/institutions and to bring them to mainstream of education.
6. Utilization of this data base by other departments of the Govt. like Health & Family Welfare, SC/ST Development, W & C.D., labour etc. for their projects & programmes.

7. Linking the School Information system (SIS) and Teacher's Information System (TIS) with CTS to access the need in infrastructure development and Teachers requirement w. r. t. the children in any school.
8. Giving access to the general public to get the detail information from this system through web (Internet) along with the progress in the education status of their children.

Methodology and Analysis

A survey was conducted in different part of odisha to analyse the justification of the CTS projects in different parts of odisha. The purpose of the study is to analyse significance change that has taken place before and after the CTS implementation. To justify the benefits of improvement the following hypothesis was taken and analysed using Friedman two-way anova test, a non parametric test for justification. Milton Friedman, an economist and a Nobel laureate introduced this test in 1937. Since then, this test has been popularly known as Friedman ANOVA. This test is used for analysing the ordinal scaled responses given to several attributes or elements by 'n' number of objects or individuals.

1. The variables should be measurable on ordinal scaled variables. In case of interval data the data needs to be converted into ranks (that is, an ordinal scaled variable).
2. The sample size can be any.
3. The sample size should be equal across groups. In other words, each block (row) element should have assigned the ranks to all the treatments (column attributes).

The method has various advantages as computations are relatively easy, no need to assume the normality of populations from which the samples are drawn, It is robust to the presence of considerable number of ties in the data and can be used even when data are measured on interval scales. However, such interval data should be converted into ordinal ranks first.

Procedure

1. Formulate hypothesis of no difference in the ranking of different treatments (columns) by different elements (blocks).
2. Ensure that the ranks are assigned by each element across all the treatments. If the responses to treatments were measured on numerical scores (rather than ranks), they need to be ranked first for each block separately.
3. Sum up the ranks formed for each treatment (column).
4. Square the sum of ranks obtained for each treatment (column).
5. Apply the Friedman statistic formula.
6. Find chi-square critical value for (k-1) degrees of freedom.
7. Make a decision by comparing the Friedman statistic value and the critical value.

We have conducted a survey for justification of using IT in CTS. The reason for using information technology in child tracking system is to have better decision making (BDM), transparency (T), simplicity (S), accuracy (A) and speed (Sp). These factors were identified and presented to six executives who were asked to rank the major factors that influenced the use of IT, as it was difficult to quantify the real benefits and respondents are comfortable in giving feedback in scale data. They were told to assign a rank of '1' to the factor that is more responsible for use of IT, a rank of '2' to next most influencing factor, and so on. Table 3.9, below presents the data provided by higher authority on their preferential order of the factors influencing the IT implementation in CTS.

Table: Preferential order of factors

Authority	BDM	T	S	A	Sp
A	1	3	5	4	2
B	2	5	4	3	1
C	1	2	3	5	4
D	1	2	4	5	3
E	2	1	5	3	4
F	1	2	5	4	3

In order to prove that, is there any significant difference among the ranking of factors influencing the IT implementation? Or can we identify those factors that are most likely to influence the use of IT in CTS.

In order to justify a null and an alternate hypothesis is formulated.

H_0 = There is no significant difference among the factors influencing the IT implementation.

H_a = There is a significant difference among the factors influencing the IT implementation.

As per Friedman statistic test, Sum the ranks formed for each treatment and square them as shown in following table 3.10.

Table: Sum and squares of the ranks

Authority	BDM	T	S	A	Sp
A	1	3	5	4	2
B	2	5	4	3	1
C	1	2	3	5	4
D	1	2	4	5	3
E	2	1	5	3	4
F	1	2	5	4	3
R_j	8	15	26	24	17
R_j^2	64	225	676	576	289

Calculating the Friedman statistic value:

$$= 0.067(1830)-108$$

$$= 14.61$$

We have number of columns (k) that is 5 and finding out the tabulated chi-square value. The table value for 5 percent level of significance for (k-1) degrees of freedom (that is, 4) is 9.49.

By comparing tabulated value and calculated value, we can conclude that calculated Friedman statistic value is greater than tabulated chi-square value. Thus we can conclude that null hypothesis is rejected. That is we can say there is significant difference among the factors influencing the IT implementation. Looking at the R_j scores, we find that better decision making is most influencing factor among those (because its R value is much smaller than other columns) in the implementation of IT in CTS.

Further an analysis was carried out, to compare the situation before and after the IT implementation in CTS with respect to decision making. For this research we have used McNemar test, a non parametric test. For the purpose of analyzing significant change that has taken place in a before-after situation where the data are collected from same respondent is to find out the effectiveness of a particular treatment.

Requirements:

1. Measurement of dichotomous data on the same variable at 2 time periods, say, a before-after situation.
2. Related sample, meaning the same sample should be measured twice on the variable studied.
3. The given data should be arranged in a 2×2 contingency table.

Advantages:

1. The test is simple and easy to compute.

2. This is the only technique available to study the effect of a particular treatment where the effect is measured on a nominal scale (dichotomous scale) from the same sample.
3. Since this test is based on chi-square distribution, the significance of the effect of treatment can be ascertained.

Procedure:

1. Formulate a null and an alternate hypothesis.
2. Ensure that the data are arranged in the 2×2 contingency table.
3. Apply McNemar's formula to find out the chi-square value.
4. Compare the calculate chi-square value with the critical chi-square value and interpret the result.
5. H_a = There is a need to use IT in CTS for better decision making process.

Arrange the data in 2×2 contingency table 3.11 as following.

Table: 2×2 contingency table

		After the new CTS		
		Decision making process not manageable	Decision making process manageable	Total
Before the new CTS	Decision making process manageable	16 (A)	5 (B)	21 (A+B)
	Decision making process not manageable	8 (C)	31 (D)	39 (C+D)
	Total	24 (A+C)	36 (B+D)	

Note that it is only A and D that represent the before-after changes. Cell A's responses shift from 'favourable' to 'unfavourable' while cell D's responses move from 'unfavourable' to 'favourable' condition. It should be noted that McNemar test focuses on these two cells only.

Compute McNemar's chi-square value. This can be calculated by applying following formula.

$$\chi^2 = \frac{(|A - D| - 1)^2}{A + D}$$

$$\chi^2 = \frac{(|16 - 31| - 1)^2}{16 + 31}$$

$$= 4.17$$

The critical chi-square value for 1 degree of freedom at 5 percent level significance for a 2-tailed test from table is 3.84. However this tabulated value should be halved since we are taking 1-tailed test. Therefore tabulated value is 1.92 and the calculated value also halved as it is 1-tailed test, i.e., χ_m^2 =4.17/2 = 2.08. As 2.08 (calculated value) > 1.92 (tabulated value), we can conclude that null hypothesis is rejected or in other words alternate hypothesis is accepted. Thus there is a justification for the use of IT in the CTS as it improves the decision making process.

Reference:

1. Al-Yaseen, H., El-Sheikh, A. and Al-Jaghoub, S. (2006). The IT/IS investment evaluation process: investigating the gap between prior operational use evaluation and operational use evaluation. In (Ed. D. Remenyi and A. Brown), *Proceedings of the 13th European Conference on Information Technology Evaluation*, pp. 22-30. Genoa, Italy, 28th-29th September, Academic Conferences, Reading.
2. Balasubramanian, P., Kulatilaka, N. and Storck, J. (2000). Managing Information Technology investments using a real options approach. *Journal of Strategic Information Systems*, **9**, 39-62.
3. Ballantine, J.A., Galliers, R.D. and Stray, S.J. (1999). Information Systems/ Technology evaluation practices: evidence from UK organisations. In Beyond the IT productivity paradox (ed. L.P. Willcocks and S. Lester), pp. 123-149. Wiley, Chichester.
4. Bannister and Remenyi (2000) Bannister, F. and Remenyi, D. (2000). Acts of faith: instinct, value and IT investment decisions. *Journal of Information Technology*, **15**, 231-241.
5. Berghout, E. (2002). A dilemma between decision quality and confidence in the decision: experimental validation of investment analysis methods. *Electronic Journal of Information Systems Evaluation,* **5**, (1).
6. Berghout, E. and Nijland, M. (2002). Full lifecycle management and the IT management paradox. In *Make or break issues in IT management,* (ed. D. Remenyi and A. Brown), pp. 77-107. Butterworth Heinemann, Oxford.
7. Berghout, E. and Renkema, T.J. (2001). Methodologies for IT investment evaluation:a review and assessment. In *Information Technology evaluation methods and management,* (ed. W. Van Grembergen), pp. 78-97. Idea Group Publishing, London.
8. Berghout, E. and Renkema, T.J. (2001). Methodologies for IT investment evaluation: a review and assessment. In *Information Technology evaluation methods and management,* (ed. W. Van Grembergen), pp. 78-97. Idea Group Publishing, London.
9. 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.
10. Cronholm and Goldkuhl, 2003; Cronholm, S. and Goldkuhl, G. (2003). Strategies for Information Systems evaluation – six generic types. *Electronic Journal of Information Systems Evaluation,* **6**, (2), 65-74.

11. Davenport, 2000, Davenport, Thomas, “Mission Critical: Realizing the promise of ERP systems, harvard Business school Press, USA, 2000.
12. De Jong, B., Ribbers, P.M.A. and van der Zee, H.T.M. (1999). Option pricing for IT valuation: a dead end. *Electronic Journal of Information Systems Evaluation,* **2**, (1).
13. Deschoolmeester, D., Braet, O. and Willaert, P. (2004). On a balanced methodology to evaluate a portfolio of ICT investments. In (Ed. D. Remenyi), *Proceedings of the 11th European Conference on Information Technology Evaluation*, pp. 115-126.Amsterdam, The Netherlands, 11th-12th November, Academic Conferences, Reading.
14. Doherty and King, 2001; Doherty, N. and King, M. (2001). The treatment of organisational issues in systems development projects: the implications for the evaluation of Information Technology investments. *Electronic Journal of Information Systems Evaluation,* **4**, (1).
15. Doherty, N. and King, M. (2001). The treatment of organisational issues in systems development projects: the implications for the evaluation of Information Technology investments. *Electronic Journal of Information Systems Evaluation,* **4**, (1).
16. Doherty, N. and King, M. (2001). The treatment of organisational issues in systems development projects: the implications for the evaluation of Information Technology investments. *Electronic Journal of Information Systems Evaluation,* **4**, (1).
17. Eckartz, Silja; Daneva, May; Wieringa, Roel; and Hillegersberg, Jos van. “Cross-organizational ERP management: how to create a successful business case?”, Proceedings of the 2009 ACM symposium on Applied Computing (SAC '09). ACM, New York, NY, USA.
18. Farbey, B., Land, F. and Targett, D. (1994). A taxonomy of evaluation methods. In (Ed. A. Brown and D. Remenyi), *Proceedings of the 1st European Conference on Information Technology Evaluation*, pp. 44-70. Henley on Thames, England, 13th–14th September, Operational Research Society, Birmingham.
19. Farbey, B., Land, F. and Targett, D. (1999a). Evaluating investments in IT: findings and a framework. In *Beyond the IT productivity paradox*, (ed. L.P. Willcocks and S.Lester), pp. 183-215. Wiley, Chichester.
20. Farbey, B., Land, F. and Targett, D. (1999a). Evaluating investments in IT: findings and a framework. In *Beyond the IT productivity paradox*, (ed. L.P. Willcocks and S. Lester), pp. 183-215. Wiley, Chichester.
21. Farbey, B., Land, F. and Targett, D. (1999a). Evaluating investments in IT: findings and a framework. In *Beyond the IT productivity paradox*, (ed. L.P. Willcocks and S.Lester), pp. 183-215. Wiley, Chichester.
22. Farbey, B., Land, F. and Targett, D. (1999a). Evaluating investments in IT: findings and a framework. In *Beyond the IT productivity paradox*, (ed. L.P. Willcocks and S.Lester), pp. 183-215. Wiley, Chichester.
23. Farbey, B., Land, F., & Targett, D. (1992). Evaluating investments in IT. Journal of Information Technology, 7(2), 109–122.

24. Farbey, B., Land, F., & Targett, D. (1993). IT investment: A study of methods and practices. UK: Published in association with Management Today and Butterworth-Heinemann Ltd.
25. Farbey, B., Land, F., & Targett, D. (1995). System-method-context: A contribution towards the development of guidelines for choosing a method of evaluating IS investments. Proceedings of the second European conference on technology investment, evaluated by Brown, A. & Remenyi, D. (pp. 267–276).
26. Farbey, B., Targett, D. and Land, F. (eds.) (1995a). *Hard money, soft outcomes,*Alfred Waller/Unicom, Henley on Thames.
27. Felix 2008; Felix T. S. Chan; N. Kumar; M. K. Tiwari; H. C. W. Lau; K. L. Choy, (2008). Global supplier selection: a fuzzy-AHP approach. International Journal of Production Research, Volume 46, Issue 14 July 2008,pp. 3825 – 3857. http://www.informaworld.com/smpp/content~content=a771200264~db=all~order =page
28. Fichman, R.G. (2004). Real-options and IT platform adoption: implications for theory and practice. *Information Systems Research*, **15**, (2), 132-154.
29. Fitzgerald, G. (1998). Evaluating Information Systems projects: a multidimensional approach. *Journal of Information Technology,* **13**, 15-27.
30. Goddard, J.; Etzkowitz, H.; Puukka, J.; Virtanen, I. (2006), Supporting the Contribution of Higher Education Institutions to Regional Development, *Peer Review Report*, The Jyväskylä Region of Finland.
31. Gwillim et al, 2005). Gwillim, D., Dovey, K. and Wieder, B. (2005). The politics of post-implementation reviews. *Information Systems Journal*, **15**, 307-319.
32. Hallikainen, P. (2002). Evaluating IS – the case of new business development. In (Ed.A. Brown and D. Remenyi), *Proceedings of the 9th European Conference on Information Technology Evaluation*, pp. 189-196. Paris, France, 15th-16th July, MCIL, Reading.
33. Hares, J., & Royle, D. (1994). Measuring the value of information technology. UK: Wiley.
34. Huang, 2003 Huang, J.P.H. (2003). An evaluation framework to support development of virtual enterprises. *Electronic Journal of Information Systems Evaluation,* **6**, (2), 117-128.
35. Irani et al, 2005). Irani, Z., Sharif, A.M. and Love, P.E.D. (2005). Linking knowledge transformation to Information Systems evaluation. *European Journal of Information Systems*, **14**, 213- 228.
36. Irani, Z. (1999). IT/IS investment decision making. Logistics and Information Management, 12(1), 8–11.
37. Irani, Z., Ezingeard, J.-N., & Grieve, R. J. (1997). Integrating the costs of an IT/IS infrastructure into the investment decision making process. The International Journal of Technological Innovation and Entepreneurship (Technovation), 17(11/12), 637–647.
38. Irani, Z., Ezingeard, J.-N., Grieve, R. J., & Race, P. (1999). Investment justification of information technology in manufacturing. The International Journal of Computer Applications in Technology, 12(2), 10–21.

39. Jing 2006; Jing-yuan Guo, Jia Liu¸ Li Qiu (2006)**.**Research on Supply Chain Performance Evaluation Based on DEA/AHP Model. *Proceedings of the 2006 IEEE Asia-Pacific Conference on Services Computing*,609-612.
40. Jukka 2001; Jukka Korpela, Antti Lehmusvaara and Markku Tuominen (2001,May).An analytic approach to supply chain development.*International Journal of Production Economics*, *71*(1-3),145-155.
41. Khalifa, G., Irani, Z., Baldwin, L.P. and Jones, S. (2001). Evaluating Information Technology with you in mind. *Electronic Journal of Information Systems Evaluation*,**4**, (1).
42. Kimberling, 2006; Kimberling, Eric, " In Search of Business Value: How to Achieve the Benefits of ERP Technology",Panorama Consulting Group, LLC,2006, link: www.panoramaconsulting.com
43. Kumar, R.L. (1998). Understanding the value of Information Technology enabled responsiveness. *Electronic Journal of Information Systems Evaluation,* **1**, (1).
44. 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.
45. Lech, P. (2005). Evaluation methods' matrix – a tool for customised IT investment evaluation. In (Ed. D. Remenyi), *Proceedings of the 12th European Conference on Information Technology Evaluation*, pp. 297-306. Turku, Finland, 29th-30th September, Academic Conferences, Reading.
46. Lech, P. (2005). Evaluation methods' matrix – a tool for customized IT investment evaluation. In (Ed. D. Remenyi), *Proceedings of the 12th European Conference on Information Technology Evaluation*, pp. 297-306. Turku, Finland, 29th-30th September, Academic Conferences, Reading.
47. McBride and Fidler,2003; McBride, N. and Fidler, C. (2003). An interpretive approach to justification of investment in Executive Information Systems. *Electronic Journal of Information Systems Evaluation,* **6**, (1).
48. McBride, N. and Fidler, C. (2003). An interpretive approach to justification of investment in Executive Information Systems. *Electronic Journal of Information Systems Evaluation,* **6**, (1).
49. Milind 2007; Milind Kumar Sharma, Rajat Bhagwat (2007).An integrated BSC-AHP approach for supply chain, management evaluation.*Measuring Business Excellence*,*11*(3),57 – 68.
50. Min Wu, (2007).Topsis-AHP simulation model and its application to supply chain management.*World Journal of Modelling and Simulation*, *3*(3), 196-201.
51. Miskelly, C., Moggridge, A., Stephenson, C. and Williams, M. (2004). Formative and interpretive approaches to the evaluation of community focused web-fronted projects. In (Ed. D. Remenyi), *Proceedings of the 11th European Conference on InformationTechnology Evaluation*, pp. 281-288. Amsterdam, The Netherlands, 11th-12th November, Academic Conferences, Reading.
52. Mylonopoulos, N.A., Doukidis, G.I. and Giaglis, G.M. (2004). Information Systems investment evaluation through simulation: the case of EDI. Viewed 13th October 2004, http://www.eltrun.aueb.gr/papers/slov95.pdf.
53. Nijland, M. (2003). IT cost benefit management improvement from a critical perspective. *Electronic Journal of Information Systems Evaluation*, **6**, (1).

54. Parker, M., & Benson, R. (1989). Enterprisewide information economics: latest concepts. Journal of Information Systems Management, 6(4), 7–13.
55. Paulson, 1993).
56. Peppard, J., & Ward, J. (1999). Mind the gap: Diagnosing the relationship between the IT organization and the rest of the business. Journal of Strategic Information Systems, 8, 29–60.
57. Pouloudi, A. and Serafeimidis, V. (1999). Stakeholders of Information Systems evaluation: experience from a case study. In (Ed. A. Brown and D. Remenyi),*Proceedings of the 6th European Conference on Information Technology Evaluation*,pp. 91-98. Brunel University, Uxbridge, UK, 4th-5th November, MCIL, Reading.
58. Powell, P.L. (1999). Evaluation of Information Technology investments: business as usual?. In *Beyond the IT productivity paradox,* (ed. L.P. Willcocks and S. Lester), pp.151-182. Wiley, Chichester.
59. Remenyi, D., Sherwood-Smith, M. and White, T. (1997). *Achieving maximum value from Information Systems*, Wiley, Chichester.
60. Ross, Jeanne W.; Beath, Cynthia M.," Beyond the Business case: New Approaches to IT Investment", MITSloan Management Review, vol.43, No.2, 2002.
61. Saaty T. L. .The Analytic Hierarchy Process.*McGraw-Hill, New York.*
62. Sammon, D. and Adam, F.,"Justifying an ERP Investment with the Promise of Realizing Business Benefits",proceedings of 15th European Conference on Information Systems (ECIS) University of St. Gallen, St. Gallen Switzerland, 2007.
63. Sammon, D. and Adam, F.,"Justifying an ERP Investment with the Promise of Realizing Business Benefits",proceedings of 15th European Conference on Information Systems (ECIS) University of St. Gallen, St. Gallen Switzerland, 2007.
64. Sarosa, S. and Zowghi, D. (2003). Strategy for adopting Information Technology for SMEs: experience in adopting email within an Indonesian furniture company. *Electronic Journal of Information Systems Evaluation*, **6**, (2), 165-176.
65. Shiratuddin, N. and Landoni, M. (2001). Evaluation of content activities in children's educational software. In (Ed. D. Remenyi and A. Brown), *Proceedings of the 8th European Conference on Information Technology Evaluation*, pp. 79-87. Oxford,United Kingdom, 17th-18th September, MCIL, Reading.
66. Silvius, A.J.G. (2004). ROI doesn't matter: insights in the true business value of IT. In (Ed. D. Remenyi), *Proceedings of the 11th European Conference on Information Technology Evaluation*, pp. 531-542. Amsterdam, The Netherlands, 11th-12th November, Academic Conferences, Reading.
67. Stansfield, M., Berghout, E. and Grant, K. (2000). Problems and issues relating to IT investment evaluation: experiences from Scottish and Benelux studies. In (A. Brown and D. Remenyi), *Proceedings of the 7th European Conference on Information Technology Evaluation,* pp. 145-151, Dublin, 28th-29th September, MCIL, Reading.
68. Stewart, R. and Mohamed, S. (2002). IT/IS projects selection using multi-criteria utility theory. *Logistics Information Management*, **15**, (4), 254-270.

69. Strassmann, P. (1990). *The business value of computers*, Information Economics Press, New Canaan.
70. Swamidass, P., & Kotha, S. (1998). Explaining manufacturing technology use, firm size and performance using a multidimensional view of technology. Journal of Operations Management, 17, 23–37.
71. Toffolon, C. and Dakhli, S. (2002). Software informative prototyping evaluation.*Electronic Journal of Information Systems Evaluation,* **5**, (2).
72. Videira and da Cunha's (2005) Videira, A. and da Cunha, P.R. (2005). Evaluating IT investments: a manager friendly roadmap. In (Ed. D. Remenyi), *Proceedings of the 12th European Conference on Information Technology Evaluation*, pp. 501-510. Turku, Finland, 29th-30th September, Academic Conferences, Reading.
73. Ward, et al., 2007; Ward, John; Daniel,Elizabeth; Peppard, Joe, " Building Better Business case for IT Investment" submission to California Management Review, 2007.
74. Ward, John; Daniel,Elizabeth; Peppard, Joe, " Building Better Business case for IT Investment" submission to California Management Review, 2007.
75. Willcocks, L.P. and Lester, S. (1999b). In search of Information Technology productivity: assessment issues. In *Beyond the IT productivity paradox,* (ed. L.P.Willcocks and S. Lester), pp. 69-97. Wiley, Chichester.
76. Wilson, M. and Howcroft, D. (2005). Power, politics and persuasion in IS evaluation:a focus on 'relevant social groups'. *Journal of Strategic Information Systems,* **14**, 17- 43.