Journal of International Technology and Information Management

Volume 13 | Issue 3 Article 5

2004

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ABSTRACT

Previous research has focused on a number of important variables that can influence the observed payoffs from information systems investments. In the current investigation conducted in the spring of 2002, personal, on-site interviews were conducted in 138 small and medium sized businesses. Vendor involvement in systems development was less related to systems cost than previously. Unfortunately, vendor involvement was unrelated to any of the four measures of systems success in the entire sample. Further analysis revealed a strong relationship between information system generation and payoffs. Specifically, there appeared to be a point of diminishing return with subsequent generations of information technology.

INTRODUCTION

The issue of payoff from investments in computer and information technology has been an important one over the years. The issue has been framed in many ways including the role of organizational strategy (Clemons, 1991), vendor involvement in systems development (Evans and Smith, 1993, 1995), quality effects (Sampson and Hulet, 2003), and investment priorities (Grover et. al., 1998). The concern has been the modest payoff resulting from significant investments in information technology (Brousell, 1993). More recently Kohli and Devaraj (2003) conducted a meta-analysis on the issue of IT payoff. Issues such as industry sector, type of data, and definition of payoff were discussed. Generally, they concluded that there has been a renewed interest in the study of IT impact. The current research was a broad-based examination of information system payoffs with a focus on several important variables that can influence the pattern of returns on systems investments.

Previous research has found that small and medium sized businesses extensively employ the use of vendors in the development and implementation of systems without subsequent payoff (Evans and Smith, 1993, 1995). In fact, the earlier picture revealed that vendor involvement in the development process resulted in more expensive systems without any perceptible change in systems success. See White and Cook (2003) for a discussion of vender certification. The question addressed here is whether a decade-long boom in computer and information technology has seen an increase in the sophistication of small-business owners and managers in systems development.

The overall literature on systems analysis and design practices is somewhat limited. Necco, Gordon and Tsai (1987) found that systems were historically developed within the framework of the systems development life cycle. However, their research was conducted in large firms with a median of 3,056 employees and 58 total EDP personnel. These firms with in-house development staff could design and develop their own systems with little input from vendors.

A critical issue in this research is how payoff is defined. The primary problem is not the absence of payoff measures but the fact that every study tends to have a unique measure of payoff. Kohli and

Devaraj (2003) noted that most measures of payoff focused on profitability measures such as return on investment, return on assets, and revenue; or productivity measures such as inventory turnover, management output, or labor hours. Chan (2000) took a different path and categorized payoff measures into qualitative and quantitative, and individual and organizational. We, Chu, Li, Han, and Sculli (2003) examined enterprise competitiveness as an outcome of the virtual organizing process of IT.

The current research took a more macro approach to the issue of measures of payoffs. As we formulate the issue, payoff will always be somewhat unique to the specific firm and type of system. In fact, in our discussion of outcomes based systems evaluation (Evans and Costa, 2003) we assume that each measure of payoff is unique and that systems evaluation must always be in reference to those reasons for which the system was designed and implemented. In this study, all questions concerning payoffs are in reference to the problems or opportunities the specific system was designed to address. This approach is similar to the process-oriented approach discussed by Tallon, Kraemer, and Gurbaxani (2000).

Our sample was small and medium sized enterprises (SME) because they form a rapidly growing sector in the US economy and are responsible for most of the 22 million new jobs added in the decade of the 90's (Blile and Raymond, 1993). Most research in systems analysis and design has focused on systems development in large enterprises rather than these smaller firms. Since small and medium sized enterprises seldom have in-house systems development resources, it follows that these organizations must depend more heavily on vendors and consultants for help. Moreover, the risk associated with adoption of new technology is greater in these smaller firms as demonstrated by Ballantine et. al. (1998).

The current research focused on three specific questions. First, to what extent do small and medium-sized enterprises depend on vendors for systems development expertise? The second question investigated the relationship between vendor involvement in systems development and the cost and success of the systems. This second question followed up on previous research that vendors produced more expensive systems will little perceptible payoff. The third question addressed the role that information system generation played in system payoff. Do firms that implement an initial information system receive different payoffs than firms who are implementing a second, third, or fourth information system?

METHODS

Instrument: A questionnaire was developed to be a comprehensive investigation instrument of systems development in small and medium sized businesses. There were a total of 141 closed-ended objective questions which addressed issues including the characteristics of the enterprise and the system developed, how needs assessments were conducted, how vendors and enterprise personnel were involved in the development process, the initial and ongoing costs of the system, and measures of success. There were several additional interview questions.

Sample: A stratified sampling procedure was used with the strata being composed of business types as categorized by the Bureau of Labor Statistics Sector Industrial Code (SIC). The enterprises interviewed were from the inland northwest (Eastern Washington, Eastern Oregon, Idaho and Montana. The only departure from random selection was that firms had to have implemented a new information system or a major upgrade in the previous year to be included in the sample. The resulting sample was composed of 138 businesses and closely matched the distribution of types of firms in the population except that manufacturing firms were under represented. See Table 1.

Procedures: On-site personal interviews were conducted by trained interviewers. The individual interviewed at each enterprise site was either the owner/manager, or the head of the information systems operations. The answers to the 141 objective questions were coded quantitatively and the interview questions were transcribed from interview notes.

RESULTS

Table 1 displays the distribution of the sample by business type.

Table 1. Business Types

Business Type

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Construction	5	3.6	3.6	3.6
	Transportation & Warehousing	3	2.2	2.2	5.8
	Healthcare & Social Services	17	12.3	12.3	18.1
	Accommodation & Food Service	11	8.0	8.0	26.1
	Wholesale-Other	5	3.6	3.6	29.7
	Retail	29	21.0	21.0	50.7
	Real Estate/Rental & Leasing	6	4.3	4.3	55.1
	Manufacturing	7	5.1	5.1	60.1
	Finance & Insurance	13	9.4	9.4	69.6
	Other	1	.7	.7	70.3
	Service	18	13.0	13.0	83.3
	Public Administration	7	5.1	5.1	88.4
	Information Services	9	6.5	6.5	94.9
	Arts, Entertainment, Leisure	2	1.4	1.4	96.4
	Educational Services	5	3.6	3.6	100.0
	Total	138	100.0	100.0	

Table 2 displays the generation of information implemented at each firm. Information system generation refers to whether the implementation was an initial system that replaced a manual system, or whether the implementation was a system that replaced or significantly modified an existing computerized information system. Thus, a second generation system would be one that replaced an initial system; a third generation system would be one that replaced a second system and so on.

Table 2. IS Generation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Initial System	44	31.9	32.1	32.1
	Second Generation	44	31.9	32.1	64.2
	Third Generation	21	15.2	15.3	79.6
	Fourth Generation or Beyond	28	20.3	20.4	100.0
	Total	137	99.3	100.0	
Missing	System	1	.7		
Total		138	100.0		

The types of systems implemented were accounting systems (65), point of sale systems (29), management information systems (57), payroll systems (41), decision support systems (22), web-based retail systems (30), expert systems (16), and database systems (66). The numbers in parentheses sum to more than 138 because many of the firms implemented more than one type of system. The types of hardware implemented included LAN (62), print server (39), workstations (79), web server (39), mini-computer (22), point of sale terminals (20), and file server (60). Again, the numbers sum to greater than 138 because some firms installed more than one type of hardware.

Tables 3 through 7 present the frequency distribution of the responses to the questions on degree of vendor involvement in the systems development process. The questions were designed so that the highest level of vendor involvements is represented in Table 3 and the lowest level of vendor involvement is represented in Table 7. Tables 4 through 6 also represent diminishing levels of vendor involvement.

Table 3. Vendor Developed, Designed and Installed System

Vendor Developed, Designed, and Installed System

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Involvement	26	18.8	18.8	18.8
	2	7	5.1	5.1	23.9
	3	9	6.5	6.5	30.4
	4	17	12.3	12.3	42.8
	5	24	17.4	17.4	60.1
	Total Involvement	55	39.9	39.9	100.0
	Total	138	100.0	100.0	

Table 4. Vendor Designed and Installed

Vendor Designed & Installed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Involvement	16	11.6	11.7	11.7
	2	9	6.5	6.6	18.2
	3	15	10.9	10.9	29.2
	4	24	17.4	17.5	46.7
	5	26	18.8	19.0	65.7
	Total Involvement	47	34.1	34.3	100.0
	Total	137	99.3	100.0	
Missing	System	1	.7		
Total		138	100.0		

Table 5. Vendor Installed

Vendor Installed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Involvement	27	19.6	19.7	19.7
	2	14	10.1	10.2	29.9
	3	9	6.5	6.6	36.5
	4	12	8.7	8.8	45.3
	5	26	18.8	19.0	64.2
	Total Involvement	49	35.5	35.8	100.0
	Total	137	99.3	100.0	
Missing	System	1	.7		
Total		138	100.0		

Table 6. Vendor Gave Specific Advise

Vendor Gave Specific Advice

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Involvement	19	13.8	13.9	13.9
	2	6	4.3	4.4	18.2
	3	14	10.1	10.2	28.5
	4	20	14.5	14.6	43.1
	5	35	25.4	25.5	68.6
	Total Involvement	43	31.2	31.4	100.0
	Total	137	99.3	100.0	
Missing	System	1	.7		
Total		138	100.0		

Table 7. Vendor gave General Recommendations

Vendor Gave General Recommendation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No Involvement	15	10.9	11.0	11.0
	2	9	6.5	6.6	17.6
	3	17	12.3	12.5	30.1
	4	20	14.5	14.7	44.9
	5	34	24.6	25.0	69.9
	Total Involvement	41	29.7	30.1	100.0
	Total	136	98.6	100.0	
Missing	System	2	1.4		
Total		138	100.0		

Table 8 displays the reported initial cost of the systems implemented.

Table 8. System Cost

System Cost

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	$0-$1000	9	6.5	6.6	6.6
	$1001-$5000	20	14.5	14.7	21.3
	$5001-$10,000	13	9.4	9.6	30.9
	$10,001-$15,000	13	9.4	9.6	40.4
	$15,001-$20,000	6	4.3	4.4	44.9
	$20,001-$25,000	2	1.4	1.5	46.3
	Over $25,000	73	52.9	53.7	100.0
	Total	136	98.6	100.0	
Missing	System	2	1.4		
Total		138	100.0		

Several reasons were cited as the motivation for implementing the system being studies. Lack of a previous computerized information system was a very important factor for about 32% of the firms interviewed. Lack of performance from the current computerized information system was a very important factor for almost 40% of the firms interviewed. Over half of all firms interviewed wanted additional functionally relative to their current system. Forty-two percent of the firms interviewed wanted to take advantage of a specific opportunity such as adding a web-based component to the business or accessing an industry-specific data source. Over 40% implemented the current system to solve a specific problem like inadequate system response time or inability for the current system to share data among departments. These percentages do not sum to 100% because firms could have had more than one reason for implementing a system Tables 9 through 13 display the detailed responses to these questions.

Table 9. No Previous System

No Previous System

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant Decision Factor	65	47.1	47.1	47.1
	2	8	5.8	5.8	52.9
	3	5	3.6	3.6	56.5
	4	8	5.8	5.8	62.3
	5	7	5.1	5.1	67.4
	Very Important Decision Factor	45	32.6	32.6	100.0
	Total	138	100.0	100.0	

Table 10. Lack of Performance from Current IT

Lack of Performance from Current IT

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant Decision Factor	19	13.8	14.1	14.1
	2	6	4.3	4.4	18.5
	3	12	8.7	8.9	27.4
	4	20	14.5	14.8	42.2
	5	24	17.4	17.8	60.0
	Very Important Decision Factor	54	39.1	40.0	100.0
	Total	135	97.8	100.0	
Missing	System	3	2.2		
Total		138	100.0		

Table 11. Performed Additional Tasks

Perform Additional Tasks

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant Decision Factor	6	4.3	4.5	4.5
	2	4	2.9	3.0	7.5
	3	3	2.2	2.3	9.8
	4	15	10.9	11.3	21.1
	5	34	24.6	25.6	46.6
	Very Important Decision Factor	71	51.4	53.4	100.0
	Total	133	96.4	100.0	
Missing	System	5	3.6		
Total		138	100.0		

Table 12. Take Advantage of an Opportunity

Take Advantage of an Opportunity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant Decision Factor	16	11.6	11.9	11.9
	2	6	4.3	4.4	16.3
	3	10	7.2	7.4	23.7
	4	19	13.8	14.1	37.8
	5	26	18.8	19.3	57.0
	Very Important Decision Factor	58	42.0	43.0	100.0
	Total	135	97.8	100.0	
Missing	System	3	2.2		
Total		138	100.0		

Table 13. Solve a Specific Problem

Solve a Specific Problem

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Unimportant Decision Factor	20	14.5	16.8	16.8
	2	7	5.1	5.9	22.7
	3	6	4.3	5.0	27.7
	4	10	7.2	8.4	36.1
	5	20	14.5	16.8	52.9
	Very Important Decision Factor	56	40.6	47.1	100.0
	Total	119	86.2	100.0	
Missing	System	19	13.8		
Total		138	100.0		

Tables 14 through 17 present the results of the measures of system success. Cost/benefit success addressed whether the systems costs were justified relative to the benefits derived from the system. Problem-solving success was whether the system successfully solved the problem which the system was designed to solve. Opportunity success was whether the system successfully took advantage of the opportunity which was the motivation for the system. Achieving performance goals was whether the system successfully achieved the performance goals contemplated for the new system. The detailed results from the systems success questions are displayed in Tables 14-17.

Table 14. Cost/Benefit Success

Cost/Benefits Success

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Failure	1	.7	.7	.7
	2	4	2.9	2.9	3.6
	3	9	6.5	6.6	10.2
	4	26	18.8	19.0	29.2
	5	50	36.2	36.5	65.7
	Complete Success	47	34.1	34.3	100.0
	Total	137	99.3	100.0	
Missing	System	1	.7		
Total		138	100.0		

Table 15. Problem Solving Success

Problem Solving Success

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Failure	1	.7	.7	.7
	2	2	1.4	1.4	2.2
	3	11	8.0	8.0	10.1
	4	25	18.1	18.1	28.3
	5	46	33.3	33.3	61.6
	Complete Success	53	38.4	38.4	100.0
	Total	138	100.0	100.0	

Table 16. Opportunity Success

Opportunity Success

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Failure	7	5.1	5.1	5.1
	2	12	8.7	8.8	13.9
	3	20	14.5	14.6	28.5
	4	30	21.7	21.9	50.4
	5	37	26.8	27.0	77.4
	Complete Success	31	22.5	22.6	100.0
	Total	137	99.3	100.0	
Missing	System	1	.7		
Total		138	100.0		

Table 17. Achieving Performance Goals

Achieving Performance Goals

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Failure	1	.7	.7	.7
	2	4	2.9	2.9	3.6
	3	10	7.2	7.3	10.9
	4	27	19.6	19.7	30.7
	5	58	42.0	42.3	73.0
	Complete Success	37	26.8	27.0	100.0
	Total	137	99.3	100.0	
Missing	System	1	.7		
Total		138	100.0		

Spearman correlations were performed on the entire sample of the five measures of vendor involvement (Tables 3 through 7) with measures of initial system cost (Table 8) and the four measures of system success (Tables 14 through 17). The only statistically significant correlation was with the most comprehensive level of vendor involvement (Table 3) and initial system cost (Table 8), r = .257, p = .003. There was a negative correlation between initial system cost (Table 8) and cost/benefit success (Table 14).

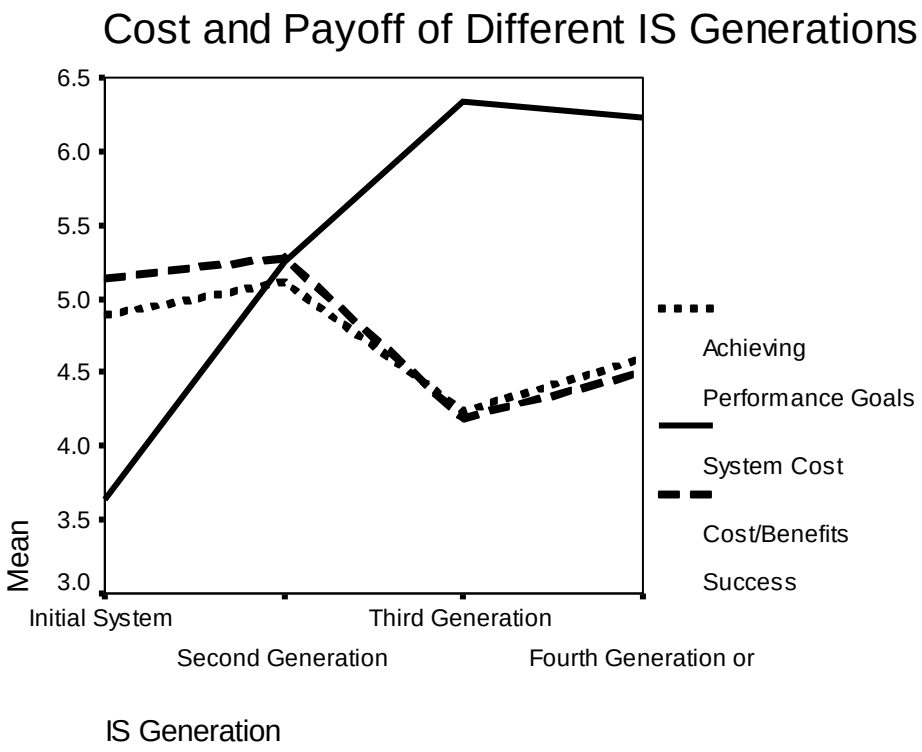
Spearman correlations were performed on the 44 firms who reported that the system reported on was their first or initial information system (see Table 2). Correlations were performed on the five questions addressing degree of vendor involvement in systems development with system cost and the four measures of system success. This analysis on first time systems produced seven statistically significant correlations. The highest level of vendor involvement (Table 3) was correlated with system cost (Table 8), r = .406, p = .006, and with opportunity success (Table 16), r = .397, p = .008. Vendor designed and installed systems (Table 4) was correlated with problem solving success (Table 13), r = .345, p = .024. The next highest level of vendor involvement, vendor only installed the system, (Table 5) was also correlated with problem solving success (Table 13), r = .442, p = .003. The vendor giving specific advice (Table 6) was correlated with cost/benefit success (Table 14), r = .394, p = .009; with problem solving success (Table 13), r = .392, p = .009; and with achieving performance goals (Table 17), r = .403, p = .007.

Ninety-one (91) firms reported implementing computerized systems that replaced older computerized systems; we call these subsequent systems as opposed to initial systems. The correlation between initial system cost and the four measures of system success produced two negative relationships. These two negative correlation were the correlation between initial system cost and cost/benefits success (r = -.179, p = .046) and the correlation between initial systems cost and problem solving success (r = -.175, p = .048).

To further explore the payoff of initial and subsequent information system generation, Spearman correlations were performed on IS generation (Table 2) and several cost and outcome measures. The relationship between IS generation (Table 2) and system cost (Table 8) was positive and statistically significant ($rho_{(137)}$ = .466, p < .01). This indicates that later generation systems were more expensive than earlier generation systems. Inflation is not a factor in this phenomenon since all systems were implemented within the past year.

The relationship between IS generation (Table 2) and cost/benefit success (Table 14) was negative and significant ($rho_{(136)}$ = -.247, p < .01). This indicates that later generation information systems produced smaller benefits relative to costs than earlier generation systems. The correlation between IS generation (Table 2) and achieving performance goals (Table 17) was also performed. The results indicated a statistically significant negative relationship ($rho_{(136)}$ = -.200, p < .05) demonstrating that earlier generations of information systems were more likely to achieve their performance goals than were later generation systems. Table 1 charts the change in average cost of payoff across the different generations. Clearly costs increase from initial systems while payoffs decrease significantly after the second generation of a system.

Figure 1. IS Generations



DISCUSSION

Several interesting outcomes are observed from the results of this research. First, small and medium sized enterprises appear to use outside vendors extensively in the process of implementing systems. Table 3 showed that 57% of the firms used vendors to develop, design and install the system. It is interesting to note that less extensive levels of vendor involvement (Tables 4 through 7) were reported by fewer enterprises than at the highest level of involvement (Table 3). Our results demonstrate that smaller firms depend more heavily on vendors for systems analysis and design expertise than did the larger organizations examined by Necco, Gordon, and Tsai (1987). This phenomenon is likely due to the lack of systems analysis and design expertise in smaller firms and the resulting need to seek that expertise outside the firm.

Results relating to the perceived quality of vendor services and the payoff from vendor involvement are more contingent on the generation of information system being implemented. For the entire sample, one could argue that the pattern noted earlier [3, 4] by the first author are repeated. Specifically, the highest level of vendor involvement where vendors develop, design, and install the system resulted in higher system acquisition cost with no accompanying association with any of the measure of reported system success. A cynic would conclude that vendors are better at improving their own bottom line than they are at improving their client's bottom line.

However, the picture is radically different when one examines the 44 firms that were implementing their first information system. A follow-up correlation analysis was performed of generation of system (Table 2) with the five levels of vendor involvement (Tables 3 through 7). There was no relationship between generation of system and any of the levels of vendor involvement indicating that level of vendor involvement was similar for initial systems and subsequent systems. However, as reported above, the higher levels of vendor involvement results in higher cost systems and in systems that were more successful based on response to the four systems success questions.

One explanation for these results is that an initial information system potentially provides a greater increment of operational success over a manual system than does a new information system over a previous

computer-based system. Quite simply, vendors probably have an easier time fulfilling client expectations on an initial system than on subsequent systems.

The picture is not as complementary for vendors when one examines the 91 firms that reported implementing subsequent systems; systems that replaced previous computerized systems. In this sub-sample, there was no relationship between vendor involvement and measures of system success or initial system cost. But, there were negative correlations between initial system cost and two measures of system success (cost/benefit success and problem solving success). This seems to indicate that subsequent generations of computerized information systems reach a point of diminishing return. Future analysis of this data set will focus on this possible phenomenon.

The results concerning the impact of information system generation on costs and payoffs are striking. The results clearly show that firms spend more money on later generation systems than they do on earlier generation systems. However the cost/benefit payoffs and achieving performance goals actually decline after the second generation. This clearly reveals a point of diminishing return for investment in information technology. The intuitive argument has always been compelling. For example, the payoff resulting from using a word processor rather than a typewriter is obvious. However, the payoff of moving to version 4.2 from version 4.1 is more dubious. These results provide some empirical support for diminished returns from adopting newer and newer computer and information technology.

In order to understand this phenomena better, analysis was done on the type of system implemented at each generation. The only pattern that emerged was that over two-thirds of the database systems were implemented as initial or second generation systems. All other types of systems were more evenly distributed among the various generations. A similar analysis was performed using type of business with IS generation. The only noteworthy result was that about two-thirds of retail and healthcare organizations reported first or second generation systems. The reasons behind this diminishing return pattern should be a topic for future research.

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