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JOURNAL OF INFORMATION SYSTEMS APPLIED RESEARCH

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A Study of Information Technology Integration

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Abstract

The integration of legacy and other disparate systems from a variety of vendors or developers has been seen as a major issue for information technology. This study reviews a major survey of financial executives and examines their views on aspects of systems integration. First, it was found that integration of disparate systems was viewed as an important issue in overall IT success. This impact was generally dependent on the size of an organization. It was next found that integration success and overall IT project success were significantly correlated. With regard to integration project success itself, there was a correlation between the ability to measure projects and overall system development or integration project success. Finally, the overall approach to integration was examined. The operation and maintenance of separate systems was found to be significantly less successful than other methods. The implications, limitations, and conclusions of these findings are discussed.

Keywords: systems integration, information technology, success, integration

1. INTRODUCTION

The integration of information technology and systems is one of the most important, complicated, and costly areas for an organization. Bernstein and Haas (2004) suggest that systems integration is the "biggest and most expensive challenge" in IT. Estimates suggest that integration costs 40% of IT large shop budgets. (Bernstein and Haas, 2004). Systems integration is the combination of all the disparate technology products that an organization uses to operate its organization. This can literally require the interaction and communication between thousands of different hardware, software, communication, and process components. "Systems integration has "two faces" …. The first face concerns the internal activities of firms as they develop and integrate the inputs they need to produce new products. The second face, which has become more important in recent years, refers to the external activities of firms as they integrate components, skills, and knowledge from other organizations to produce ever more complex products and services. External organizations include suppliers, users, government agencies, regulators, production partners and, sometimes, competitors as firms work together and compete in projects." (Hobday, Davies and Prencipe, 2005, p.1) Chawathe, et al. (1994) detail the extent of IS integration to include "databases, object stores, knowledge bases, file systems, digital libraries, information retrieval systems, and electronic mail systems." They note problems with information quality, inconsistency, and access. Hasselbring (2000) discusses the various levels of heterogeneity that occur in information systems including technical (hardware, operating systems, database, and programming) and conceptual (data models, process models, programming models). Overall. integration provides a major challenge for today's organizations

2. REVIEW OF THE LITERATURE

Though the importance of combining disparate systems has been well documented, there has been little empirical work done on the issue of information systems and technology integration.

Zachman (1999) proposed a widely used framework to deal with integration and information systems architecture. Weber and Pliskin (1996) found a significant relationship in integration success and firm effectiveness under certain specific circumstances. Steffen (2010) examined what was different about integration versus other IT project management and found the importance of a "useful" project plan in data integration projects as well as flexibility to be particularly different. In addition, focus and data quality and data feed timing add layers of complexity when combining different systems.

Bhatt (2000) studied information systems integration and business process improvement. The study survey of the Fortune 500 and subsequent analysis found "integrated technology environment is one of the important considerations in business improvement initiatives". Chang, Fu, Li, and Lee (2009) found in a collaborative information system integration case study, "some key success factors included: support and understanding from the entire team, simple process redesign, standard process development, government support, distinctive operation collaboration model, total support from top management, and an effective and experienced team."

Mendoza, Perez, and Grimian (2006) studied critical success factors for successful systems integration. They suggested eleven general CSFs for integration project success: administrative support, tech infrastructure, project leadership, project management, user involvement, training plan, organizational change, low impact of system on org, implementation strategy, skilled team, and helpful tech support. They are organized in a four step maturity model of point-to-point, structural, process, and external. Emery (2009) attempted to develop a model for sustaining cross-functional integration. Irani, , Themistocleous, & Love (2003) saw many issues with integration and the traditional life cycle. They present a case study with over 2000 disparate systems and sort through issues in technical, financial and managerial challenges. Mangan, A., & Kelly, S. (2009) caution that a purely technical solution may not address deeper organizational issues. McCarthy, D., Mueller, K., & Wrenn, J. (2009) detail challenges associated with a case study in integrating disparate health care systems. Goodhue, Wybo, and Kirsch (1992) examined both costs and benefits of data integration in IS.

In the past there was considerable debate on the contribution of IT to economic productivity. Over the last several decades however, there has been a significant amount of work done on overall information technology productivity and return. Many of the major studies have found that at the firm level there are good returns from IT. Many studies on this productivity paradox have suggested good returns on information technology investment (Dewan and Kraemer, 1998), (Lehr and Lichtenberg, 1999), (Bharadwaj, Bharadwaj, and Knosynski, 1999). In addition, Wilconsson and Chatham (2004) suggested improvement over recent time in information technology alignment.

There have been many researchers that have explored project success and its influencing variables. Wateridge (1998) suggests that there are many factors that can influence project success and not just the traditional meeting time and cost constraints. According to users, the top two success requirements' for successful projects were meeting user requirements and "happy" users. Delone and McLean (1992) suggested the following six categories of information systems success measures: system quality, information quality, use, user satisfaction, individual impact and organizational impact. Anderson and Aydin (2009) note the importance of social and behavioral processes in health care information success.

Nah, Lau, and Kuang (2001) suggest 11 factors relating to ERP success: 1. ERP teamwork and composition, 2. change management program and culture, 3. top management support. 4. business plan and vision, 5. business process reengineering with minimum customization, 6. project management, 7. monitoring and evaluation of performance, 8. effective communication, 9. software development, testing and troubleshooting, 10. project champion and 11. appropriate business and IT legacy systems.

The importance of systems integration is clear. As noted, Bernstein and Haas (2004) suggest that systems integration is the "biggest and most expensive challenge" in IT. Estimates range that integration costs 40% of IT large shop budgets. (Bernstein and Haas, 2004).

Mendoz, Perez, and Grimian (2009) note the many advantages of systems integration including links to customers, salespeople, and suppliers and see SI as a "means of responding to global competitiveness". Hobday, Davies, and Prencipe (2005) see system integration as a

core strategic business capability not just a technical task and see great importance for the overall organization success. Lam (2007) also sees integration of systems of high importance and views it as a technical, organizational, and project management challenge. Butler (2008) notes the benefits of integration while stressing its complexity.

Onishi (1991) distinguished between two types of integration business systems and information systems and the importance of both for integration. Market size in 1998 was estimated as $4.3 billion. But despite the importance of integration, it has had a spotty record of success, with most companies unable to establish an "architecture process" (Tuft, 2001)

3. MOTIVATION

The preceding analyses examined overall systems integration, its importance, return on information technology investment, and IT project success. There has been little work done however on the relationships between these issues. For organizations to improve their returns on IT integration, it is important to understand the landscape of systems integration as well as to begin to explore some variables that may affect integration project success. Little work has been done on understanding the internal structural environment that can correlate with information systems integration and project success as well as the importance of integration to overall views of information systems project management success. This manuscript is an attempt to start that process by examining current views on systems integration, its relationships, and some of the influencing variables.

4. HYPOTHESES

As a result of reviewing the literature there are a series of research areas that merited exploration. They all focus on the areas of systems integration and project success.

Integration of disparate legacy systems is a major factor influencing IT success. H1 tests how prevalent this is in major organizations. Bernstein and Haas (2004) see systems integration as the most important IT issue. To confirm its importance, hypothesis one was developed.

H1 Organizations will view integrating heterogeneous systems and applications in their organizations as important.

Many researchers have tested the impact of organization size on results such as Dewar and Dutton (1986). As a result, organizational size is analyzed to determine if there is a significant difference in the importance of systems integration based on size. Due to increasing complexity, it is hypothesized that larger organizations will find systems integration as a more important issue.

H2 Larger organizations will place a higher importance on systems integration in their organization.

Following up on the first hypothesis, we test whether success in integration affects overall IT success.

H3 Results in systems integration will significantly affect IT project success

One of the most important aspects of quality is the ability to measure. The next hypothesis applies this concept to systems integration.

H4 Ability to measure projects will significantly affect system development or integration project success

Weber and Pliskin (1996) found a significant relationship in integration success and firm effectiveness under certain specific circumstances. In hypothesis five we study various approaches to systems integration and their effect on success.

H5 There will be significant approaches to integration that will affect overall project success, and/or overall IT return.

The areas included confirming the extent and importance of integration.

5. SURVEY SOURCE AND METHODOLOGY

In order to test these hypotheses, specific major corporate data were required. We found a rich data set that was available from Financial Executives International. Financial Executives International is "the preeminent association for CFOs and other senior finance executives." It has … CFOs, VPs of Finance, Treasurers, Controllers, Tax Executives, Academics, Audit Committee members [in] companies large and small, public and private, cross-industry. (FEI, 2006) The FEI, each year, commissions a large scale study of "technology issues for Financial Executives". The survey instructions follow.

"FEI's Committee on Finance & information Technology (CFIT) and Financial Executives

Research Foundation (FERF), in partnership with Computer Sciences Corporation (CSC), are conducting the eighth annual survey of Technology Issues for Financial Executives. This initiative explores and reports on information technology from the perspective of the financial executive. Last year we set another record for survey participation with nearly 800 responses, continuing our unbroken streak of year-over-year increases since the survey's inception. As part of this year's effort, we are targeting another significant increase in response volume so that we can expand the resulting publication to include more analyses by industry and company size. ." (FEI, 2006 b)

As a part of this study, specific information was obtained from top financial executives on systems integration. These questions and responses were sufficiently detailed and pertinent to our hypotheses to serve as the bases for testing this study's hypotheses. The main advantage is the large data set and the independent collection from a private membership trade group. All data has been collected and furnished by the Financial Executives International and remains their property. Use for academic and research purposes was obtained by the author. The author wishes to sincerely thank the organizations for their cooperation.

The overall questionnaire included 44 broad questions in the noted categories but sub-questions and ranked responses raised the overall individual question responses to more than 220. From this overall report a small subsection was used to analyze the relevant hypotheses. Selected responses from the Demographics section were included as well.

The specific questions used to test the hypotheses are listed below:

IV

2. How significant is the issue of integrating heterogeneous systems and applications in your organization?
_ Extremely significant
_ Significant
_ Important
_ Moderately important
_ Not important

4. What is your organization's preferred approach to addressing systems integration issues?

(Mark only one.)

_ Discontinue all disparate systems and implement
a single new integrated system for core areas
_ Adopt best of breed applications and develop interfaces
_ Build new interfaces between existing systems
_ Operate and maintain separate systems

5. What is the most important consideration when deciding whether or not to undertake a new IT initiative?
_ Expected benefit
_ Expected cost
_ Project/business risk
_ All of the above equally
_ Other (Please specify.) _____

6. Please rank the primary criteria used to measure the success of a systems development project.

(Select only three with "1" being most important.)

Ranking

1 2 3
_ Delivered on time
_ Delivered within budget
_ Functionality meets user needs
_ Generated a positive return on investment
_ Improved the company's competitive position
_ Enabled the company to operate more efficiently
_ Other (Please specify.) _____

7. Rate your relative satisfaction with your organization's ability to measure the success of IT projects.

Very Dissatisfied 2 3 4 Very Satisfied

_ _ _ _ _

8. What percentage of systems development or integration projects are considered successful by management?

(Enter whole percentage.)

___% Example: 70 percent entered as 70%

III

3. What overall return is your organization obtaining on its technology investments? (Mark only one.)

_ High
_ Medium
_ Low
_ Negative
_ Unknown

1. What is your company's IT spending as a percentage of revenue?

___% Example: 3.1 percent entered as 3.1%

6. DEMOGRAPHICS OF PARTICIPANTS

Overall, in the survey there were 708 usable responses from major corporations (depending on the question). Since responses were anonymous, an exact number of companies participating is not possible, though qualitative data review suggests little if any company duplications. The demographics of the group follow.

Table 1. Level in Organization of Respondent

		Count	%	Valid %	Cume %
Valid	Corporate	598	84.5	86.3	86.3
	Group of Sector	27	3.8	3.9	90.2
	Division, wholly owned subsidiary, or operating unit	68	9.6	9.8	100.0
	Total	693	97.9	100.0	
Missing	System	15	2.1		
Total		708	100.0		

Table 2. Country Where Respondent is Based – All Respondents

		Count	%	Valid %	Cume%
Valid	Canada	79	11.2	11.4	11.4
	Europe	10	1.4	1.4	12.8
	US	591	83.5	84.9	97.7
	Other	16	2.3	2.3	100.0
	Total	696	98.3	100.0	
Missing		12	1.7		
Total		708	100.0		

Nearly 85% of the respondents were from the Corporate Level as shown in table 1. The sample reflects the strong executive position that most of the respondents held. This study thus reflects top executive views on the related technology. The remaining participants were at the Group or Division/Unit level. Table 2 reflects the location of the participants. Though Financial Executives International recently became an international organization, its international membership opened only in 2000 and the organization retains a heavy US membership. As a result, 84% of the respondents are from the US and another 10% are from Canada. There is a North American bias to the results.

Table 3 – Corporate Size in Sales – All respondents

		Count	%	Valid %	Cume%
Valid	< $100m	289	40.8	41.4	41.4
	$100-400m	199	28.1	28.5	69.9
	$500-999m	66	9.3	9.5	79.4
	$1b-5b	107	15.1	15.3	94.7
	>$5b	37	5.2	5.3	100.0
	Total	698	98.6	100.0	
Missing	System	10	1.4		
Total		708	100.0		

Table 3 reflects the size distribution of the organizations. In general, the organizations are large with 69% over $100 million in sales. The largest respondents were in the $100-499 million sales category but there were still 44 respondents

Table 4. Senior Executive Status in Organization – Respondents Who Outsource

		Count	%	Valid %	Cumulative Percent
Valid	Senior	139	76.8	77.7	77.7
	Not Senior	40	22.1	22.3	100.0
	Total	179	98.9	100.0	
Missing	System	2	1.1		
Total		181	100.0		

The overwhelming majority of respondents were senior executives (78%). There is a strong representation at the top levels of management.

7. HYPOTHESES

The literature is full of cases that suggest integration of disparate legacy systems is a major impediment to IT success. H1 tests how prevalent this is in major organizations.

H1 Organizations will view integrating heterogeneous systems and applications in their organizations as important.

Table 5 shows the count and percentage of firms and their views on the importance of systems integration. Only 13% of respondents reported that integration is not important. H1 is supported. Most organizations view integrating heterogeneous systems and applications in their organizations as important.

Table 5 Importance of Integration

		Count	%	Valid %	Cume%
Valid	Extremely significant	210	15.1	30.5	30.5
	Significant	135	9.7	19.6	50.1
	Important	205	14.8	29.8	79.8
	Moderately important	51	3.7	7.4	87.2
	Not important	88	6.3	12.8	100.0
	Total	689	49.7	100.0	
Missing	System	698	50.3		
Total		1387	100.0		

H2 Larger organizations will place a higher importance on systems integration in their organization.

Due to the complexity of larger organizations, it was suspected that larger organizations will view integration more importantly. Table 6 shows an increasing trend of importance (1 =extremely important) with each larger size of organization. Table 7 shows that the differences are significant at $p < .001$.

H2 is supported. Larger organizations generally have greater integration issues. In a separate post hoc analysis using LSD method, the only area where there was no significant difference was between $1 billion to $5 billion and over $5 billion. All other smaller groups had significantly less integration importance than larger organizations

Table 6 Importance of Integration And Size

	N	Mean	Std. Deviation
< $100m	282	2.71	1.361
$100-400m	194	2.70	1.309
$500-999m	65	2.31	1.345
$1b-5b	107	2.10	1.197
>$5b	36	1.81	1.091
Total	684	2.53	1.335

Table 7 Importance of Integration And Size ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	56.356	4	14.089	8.246	.000
Within Groups	1160.170	679	1.709		
Total	1216.526	683			

H3 Results in systems integration will significantly affect IT project success

Hypothesis three deals with the relationship between perceived success in systems integration and overall IT success for the firm. Tables 8 and 9 show the regression analysis. A significant and direct relationship between project success and overall IT success is supported. (The coefficient is negative only due to scale direction). Hypothesis three is supported.

Table 8 Integration and IT Success Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.159a	.025	.024	1.348

a. Predictors: (Constant), IntegrationSuccess

Table 9 Integration and IT Success

Model	Unstandard Coefficients		Standardized Coefficients	
	B	Std. Error	Beta	Sig.
1 (Constant)	3.411	.170		.000
IntSuccess	-.010	.002	-.159	.000

H4 Ability to measure projects will significantly affect system development or integration project success

The ability to measure is often seen as an important component of quality control. Hypothesis four tests the ability to measure projects and overall integration success. Tables 10 and 11 show a direct and significant relationship between ability to measure and integration success. H4 is supported.

Table 10 Integration and IT Project Measurement Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.432a	.186	.185	20.247

a. Predictors: (Constant), E7

Table 11 Integration and IT Project Measurement

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant	38.250	2.553		14.980	.000
E7	10.552	.879	.432	12.002	.000

a. Dependent Variable: E8

H5 There will be significant approaches to integration that will affect overall project success, and/or overall IT return.

An ANOVA analysis shows that there is a significant difference between the four noted approaches to systems integration:

1. Discontinue all disparate systems and implement a single new integrated system for core areas
2. Adopt best of breed applications and develop interfaces
3. Build new interfaces between existing systems
4. Operate and maintain separate systems.

A post hoc analysis however reveals that the only significant difference was between operating and maintaining other systems and the other choices. There are no significant differences between new integrated systems, best of breed, or new interfaces. Hypothesis five is partially supported. Separate systems are not good compared with the other approaches.

Table 12 Post Hoc Analysis Descriptives % Systems Development or Integration Project Success versus Approach to Integration

		N	Mean	Std. Deviation	Std. Error
%Proj Success	1	189	69.14	19.534	1.421
	2	227	68.31	22.000	1.460
	3	157	67.09	22.507	1.796
	4	51	54.37	29.787	4.171
	Total	624	67.12	22.446	.899

Correlation between success in integration and overall IT success.

Table 13 Multiple Comparisons LSD Post Hoc Analysis % Systems Development or Integration Project Success versus Approach to Integration

(I) E4	(J) E4	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1	2	.834	2.182	.702	-3.45	5.12
	3	2.054	2.393	.391	-2.65	6.75
	4	14.770*	3.497	.000	7.90	21.64
2	1	-.834	2.182	.702	-5.12	3.45
	3	1.219	2.300	.596	-3.30	5.74
	4	13.936*	3.434	.000	7.19	20.68
3	1	-2.054	2.393	.391	-6.75	2.65
	2	-1.219	2.300	.596	-5.74	3.30
	4	12.717*	3.572	.000	5.70	19.73
4	1	-14.770*	3.497	.000	-21.64	-7.90
	2	-13.936*	3.434	.000	-20.68	-7.19
	3	-12.717*	3.572	.000	-19.73	-5.70

*. The mean difference is significant at the 0.05 level.

8. DISCUSSION AND CONCLUSION

As with any research there are limitations with this study. The main limitation is use of secondary data to uncover the relationships between systems integration and IT success. On the other hand, this is a broad-based study by an independent organization with strong executive participation. Researchers can duplicate this study with primary research perhaps with in-depth interviews to further understand the initial findings.

The study confirms the importance of systems integration to an organization, at least from the top financial executives' perspective. There have been many anecdotal reports on the importance of integration to organizations. This is the first study to empirically confirm this. Generally, top financial executives in a wide cross-section of major industries report a majority of organizations do view integrating heterogeneous systems as a significant issue. It was also found that the importance of integration was affected by the size of an organization. The implication for practitioners is that systems integration requires greater attention from larger information technology departments. Next it was found that integration success does lead to higher overall IT success. Dedicated efforts are required to solve the integration issues. Conscious efforts must be developed and maintained. One of the areas found to help with integration project success was the ability to measure projects did statistically correlate with integration success. This suggests that for organizations, one of the first steps is to have strong project management measurements in place. Properly executed this can lead to higher levels of integration achievement.

Another key area examined was the overall approach to integration and to see if various methods positively affected overall information technology returns. Four different methods were surveyed: Discontinue all disparate systems and implement, a single new integrated system for core areas, Adopt best of breed applications and develop interfaces, Build new interfaces between existing systems, Operate and maintain separate systems

None of these methods were shown to correlate with higher IT return for an organization. The only one that was significant was operate and maintain separate systems which correlated significantly with lower IT returns and was shown to be significantly different from the other three methods.

It was also determined that higher success in integration does lead to higher overall IT returns significant at $p < .001$. This reinforces and confirms the perceived importance of information systems success.

Overall, this study extends the practical study of IT success and its influencing variables. Researchers can use the results as a springboard for further analysis and study. Practitioners should be able to use these findings to improve their operations

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