DETERMINANTS OF WEB SERVICES AND STRATEGIES DEVELOPMENT BUDGET

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ABSTRACT

Web Services and Strategies (WSSs) are becoming increasingly popular and companies continue to budget and invest in such ventures. The factors that actually drive such investments, as far as we know, have not been securely established. This study revealed that socio-economic characteristics of firms, except perhaps company's net-worth, and IT Portfolio Management (ITPM) seem to have very little influence on the amount of money expended on web applications.

Keywords: IT budget, Web Services and strategies, Digital firms.

INTRODUCTION

Information Technology (IT) budget analysis is relatively new in information systems research. Some of the pioneering works in the more general area of economics of computers and information systems include those of Borowitz et. al.[1], Smidt [9] and Solomon [10].

Until recently, much of the Information Systems literature and research have focused on aspects pertaining to "best practices" and good information systems decisions. To the extent that the economic aspect has been given some attention, the treatment of same has been unstructured and piecemeal [2]. There are two basic components in an IT budget. These are the amount of time IT personnel and users expend on the analysis, design and implementation of a particular system (time budget), and the amount of money earmarked and actually spent on a project in a defined time period (monetary budget).

This study is an empirical contribution to IT budget/investment research and an elucidation as to how stable some of the predictors can be. Perhaps one of the most typical problem areas in IT budget research, and which should necessarily interest researchers is the forcastability of IT budgets. For one thing, proper establishment of the relationship between IT development budget and their various determinants across industries will aid progress in such forecasts.

This study does not in any way, deal with the time-dimensions of IT budget. Rather, it attempts to determine the relationship between monetary expenditure on Web services development and several predictor variables in leading digitally-involved enterprises. The analysis is at two levels. The first level deals with cross-sectional data, and attempts to examine how the pattern of individual company expenditure varies over different web applications. The second level of analysis (is the determination of relationship between budget and relevant variables), is based on inter-organizational data, and does not have the application dimension explicit in the earlier objective.

BACKGROUND AND OBJECTIVE

The last several years can be described as a period of computer and communications technology "explosion". This is because the influx of all kinds of IT particularly, web-driven applications and tools to modern business continue to accelerate. It is quite apparent that large sums of money are, on a continuous basis, being committed to procuring these web-enabled systems and applications. What is troubling about the current general 'craze' for web-friendly systems' acquisition is, that for all that is spent, budgets and investments are not known to follow any definitive pattern.

One of the earliest works in this area is that by Kauffman [4] and Kivijarvi and Saarinen [5]. However, since the seminal work, considerable progress has been made in IT investment research. It has been asserted that the after accounting for variations due to firm-size, companies spend relatively similar amounts of money on online-related systems. Nevertheless, it has been argued that an invariant IT budget does not have to be consistent with rational economic behavior. It has also been suggested that after discounting for subvention differences, monetary expenditures by businesses on IT is greatest in technology-champion enterprises and least in technology-laggards types.

Perhaps one of the most typical problem areas in IT budget research pertains to the forcastability of IT budgets. An invariant budget presupposes that once a forecast has been made based on say the industry type, it applies unchanged to others within the same industry. However, the inconclusive nature of the invariant hypothesis implies that much research is needed in determining the precise nature of the relationship between budgets and the corresponding variables in order to determine whether the relationships are universal. In other words, proper establishment of the relationship between IT budgets and their various determinants in different settings, will aid progress in such forecasts. Furthermore, there is no doubt that the resolution of some of the issues related to IT budgets has to depend on the results of studies from various sectors of the economy.

In digitally-enabled enterprises, it appears certain functional units with popular products/services and reputations and visibility, do get and are willing to spend much more money than the rest of their counterparts. In other words, indicators of the firm's performance such as net sales, number of employees, number of office workers and level of infusion of technology into organizational business processes tend to be related to IT investments [5]. This trend is not peculiar to web-enabled organizations. For one thing, it is not unusual, for progressive brick-and-mortar firms with a forward-looking, technology-champion type of leadership to, on a continuous basis, invest in new and state-of-the-art information and communications equipment and technologies. This trend might suggest that the presence of a technology champion in the top echelon of management and overall management support for innovation are likely to promote favorable IT investments. Also, monetary appropriations or institutional disposable income could act as an exclusive indicator of IT investment in firms. Another factor which might be promoting the seemingly emerging pattern is the way fiscal budgets are generally administered to favor electronic business (e-business) projects.
Residual induced budgeting as practiced by many traditional firms, that is, appropriation for a particular period as a direct function of what has been spent in the past, may well be a potential explanatory variable which, could account for a sizeable amount of the variance.

The objective of this study therefore, is to explore the establishment of a rigorous and formal framework for treating the economic aspects of IT development budget.

The focus is on a contemporary concept known as Web Services and Strategies. For this study, Web services and Strategies are defined as "…software components that are based on a framework of Web and object-oriented standards and technologies for using the Web to electronically link the applications of different users and different computing platforms" [7] was adopted. Ultimately, the goal of the study, is to isolate the determinants driving WSSs expenditures, among others, within digital firms.

THE NEED TO STUDY INFORMATION TECHNOLOGY ECONOMICS

An examination of the economies of enterprise type information systems and technology expenditures requires some understanding of the trends of the U.S. information economy within which firms and corporation operate. The growth of the information economy across the globe and in the US in particular, and over the last several years, has been phenomenal. Since the beginning of the twentieth century, the United States has experienced a steady decline in the number of farm workers and blue-collar workers who are employed in factories. At the same time, the country experienced a dramatic rise in the number of white-collar workers, who produce economic value using knowledge, information and related information technology.

Available data suggest that aggregate expenditure on business development and implementation have steadily increased in the last twenty years. During the same period, investments in information technology have increased tenfold. Replacement of older technologies with newer and state-of-the-art ones and the monotonical increases in user populations are factors that contributed to this growth in relative and absolute terms. This is particularly true for certain industries and not the case with others. While "best practices" modern businesses, as a percent of their revenue, spent 8% in 2005, all the same, the figure turns out to be the lowest since 2001.

SUCCESSFUL IT INVESTMENT

A salient justification for this study among others, relate to the need to discover factors associated with "successful" investment; that is, what independent variables are related to successful investment as defined in literature? If there is any basis for believing a causal connection exists between independent and the dependent variable (successful investment), then it should be fairly easy to develop an investment strategy around the independent variables.

This study therefore, would analyze WSSs monetary investments with a view of establishing major predictors and the dynamics amongst them. It would also reveal how IT budget allocations in technology "best practices" firms compare with those that are not so driven.

AN EXPLANATORY MODEL OF IT EXPENDITURE

In the literature, business performance gains are the commonly identified correlate of the expenditure on IT by firms and business enterprises [6]. Also, total annual budgets of firms; have been shown repeatedly by trade journal and other sources as having a direct impact on their IT budgetary allocations. Aside from the model establishing a direct relationship between IT expenditure and total annual budget, it was also found that, as a percentage of either subvention or total expenditure, the amount spent on IT is lowest for the so called brick-and-mortar organizations, followed by those in the click-and-mortar category, and highest for pure-online organizations. In a 1996 study by Mitra and others [6], it was established that higher investments in information technology were associated with company's lower average production costs. The same study, interestingly could not establish an association between information technology and lower labor costs.

A fact that was empirically corroborated recently is that IT is not a commodity. There is ample evidence now that IT spending goes hand in hand with business performance gains. In 2005, ROI consultancy; Alinean's analysis of 5,000 U.S. companies across 37 industries found that the highest performing firms show a direct and positive correlation between increased IT spending and improved business performance [12]. The valid conclusion from this particular study is that "value doesn't come from the amount you spend, but how you're investing it." Also, it has been reported in the latest Information Systems Spending and Technology Trends study by Computer Economics that retailers ramped up their IT spending by 1% in 2005 relative to the year prior.

Since the turn of the new century, there has been a persistent call among IT researchers to develop and sustain a research agenda geared towards the development and validation of explanatory models of IT and their investments. A variable that has emerged as central in IT budget analysis is IT portfolio management (ITPM). A majority of IT leaders are familiar with ITPM. Despite that awareness, most organizations do not apply an aligned ITPM process. Anecdotal evidence shows that companies that apply ITPM are not as effective as they could be. While companies that apply ITPM successfully achieve relative performance gains, those that are unable to implement ITPM effectively are impeded by similar obstacles [3].

Some of the factors that emerged as predicting a company's effort to creating innovative and Strategic Information Systems (SISs) and having a direct consequence on the dynamics of IT budget allocations are – technical support within the firm, existing IT leadership position, and pressure from competition. One would expect same set of variables to act either individually or collectively in predicting amount of money budgeted and actually spent on organizational IT resources.

Perhaps not all of the identified variables may be related to IT expenditure. Furthermore, it may be a useful exercise to determine the exact nature of the relationship between the variables and IT expenditure. This is particularly useful as it is intuitively obvious that some of the variables, especially those of systems development behavior, will be related to the amount of money spent on IT development.

RESEARCH QUESTIONS

The main research questions can be summarized as follows:

(a) Are there any factors that act as major determinants of IT investments in digital firms? What are they and their quantities?

(b) Do budgets and investments on IT follow a definitive pattern?

(c) What factors are associated with successful IT investments?

RESEARCH PLAN

The research plan in general is described in terms of its context, data collection procedures and the variables. Based on the relevant economic, mathematical and econometric (stochastic) models, appropriate data was collected. This was followed by statistical analyses resulting in the estimation of the parameters of the model. The evaluation of the model on the basis of economic, statistical and economic criteria facilitated the derivation of the results and the interpretations.

SOURCES OF DATA AND DATA ANALYSIS

There are several sources of business IT statistics and reports on their compilation [8, 10]. However, few include any cost data that are reliable or useful for budget planning or forecasting. Some firms have even considered IT statistics a necessary chore for membership in selective professional associations or because of state/federal mandates rather than as a tool for management decisions. More recently, however, IS professionals have begun to use statistics to make budget comparisons with organizations of similar sizes and characteristics.

The data for this work derived from a field survey undertaken in 2005 on the provision, use, budget and perception of Web Services and Strategies among 504 IT-intensive enterprises. The specific research steps are – preliminary literature review and interviews with a select firms to identify relevant factors, synthesis of existing frameworks and interviews to construct a testable model, draft survey, survey validation, review survey construction and manageability with 18 professionals at IBM Users' Group meeting, survey revision, survey validation: administered survey to 30 firms, analyzed survey validation data from 22 firms, administered survey to 600 firms and finally analyzed and interpreted results from 504 firms.

The survey instrument consists of eight integrated components that obtain information on who provides IT services within the firm, who participates in project development and management, what WSSs are designed and implemented, the average times of completion, and the human and financial resources involved. Most trend tables presented in [8] draw on its annual Business General Information survey, which solicited information concerning institutional characteristics, salaries, finances, and other corporate information. Given the wide coverage and diversity of Plunkett's research on the provision, use and perception of IT infrastructure of medium- and large sized US firms, relevant data was easily derivable.

In spite of the importance of subvention as a major determinant of IT expenditure, which has been further corroborated by other authors, it is by no means the only correlate. For instance, in a spatial context, firm size also influences monetary expenditure on IT. The relationship in general is such that beyond a critical point, IT expenditure tends to decrease as the size of a business increases. This implies that expenditure on IT is more in relative terms in smaller enterprises than their larger counterparts.

Apart from these variables, it is possible, as Kivijarvi and Saarinen [5] have observed for the private sector, that other factors such as number of employees, growth rate, and funding position may be related to the amount of money expended on Information Technology. The choice of variables for this study therefore takes into consideration this possibility, and hence takes into account some variables that have not been considered in the literature. The issue of data availability has also largely guided the variables included. A good example might be the exclusion of subvention or total expenditure because of a general non-response to questions pertaining to such variables. Therefore, recourse was made to the use of other variables, which may be regarded as surrogates of actual budgeted figures.

Three groups of variables are postulated as likely determinants of the amount of money spent on IT. The first group pertains to the well established innovation-based factors, the second group is socio-economic and organizational characteristics of the enterprise, while the third are variables related to IT development itself.

Variables in the first group include innovation characteristics e.g. compatibility, relative advantage and complexity. As such, compatibility is operationalized and denoted by (X_1), relative advantage by (X_2), and complexity by (X_3). Organizational structure is represented by (X_4), IT Portfolio Management (ITPM) by (X_5), improved business gains by (X_6), Industry sector (X_7), Technology Champion (X_8), and firm size by (X_9). The implementation behavior variables are Vendor involvement (X_{10}), IT investment style (X_{11}), management support (X_{12}), IT subvention (X_{13}), Level of training (X_{14}), reach (X_{15}), richness (X_{16}) and IS planning (X_{17}).
Perhaps not all the selected variables may be related to IT expenditure. Furthermore, it may be a useful exercise to determine the exact nature of the relationship between these variables and IT expenditure. This is particularly useful as it is obvious that some of the variables, especially those of use behavior, will be related to the amount of money spent on IT.

The Pattern of Web Services Expenditure

Modern businesses, which are the focus of this study, are more or less uniform in terms not only of budgetary characteristics but also of their technology

adoptive features. One of their distinct characteristics is that they have all professed to use IT strategically. Certain Web services and business models are well known and documented in the literature [7]. Some of the trends in B2C and B2B e-commerce, and the business strategies and value driving these trends include major applications areas and technologies such as Collaborative Commerce, Customer Relationship Management, Supply Chain Management, Enterprise Systems, and e-Business Empowerment. Specific examples of web-methods that survey respondents cited include: Web Storefront and e-catalog, Interactive marketing, Integrated Web store, Self-service Web sales, B2C portal, B2B portal, Extranets and exchanges, Procurement automation, Customer Self-service.

Table 1: The Inter-Sample Variation In Web Services And Strategies Development Expenditure

Sample Investment By Industry	Min.	Max.	Mean	Mode
Petroleum Refining	0	80	33	20
Household furniture	1	100	25	20
Aircraft Engines	2	120	26	20
Surgical Equipment	0	60	13	0
Railroads, Line Haul	0	200	11	0
Electronic Light	0	130	11	2
Pharmaceuticals	0	160	14	0
Paperboard Mills	0	80	40	34
Beverages	6	80	34	14
Engines and Turbines	5	300	41	12
Metalwork Mach.	0	38	14	2
Television & Broadcast	5	40	24	40
Chemical, Allied Pro.	3	120	37	50
Newspaper: Pub & Print	10	50	26	10
Drugs & Proprietary	5	60	32	10
Plastic Products	2	150	34	20
Paperboard Mills	15	100	46	20
Books: Pub & Printing	20	200	71	20
Aggregate	0	300	26	20

On the aggregate, as shown in Table 1, the mean amount of money spent on Web services and strategies by the sample is $26 million, with a mode of $20 million. Some companies did not spend any amount on Web services (implying no application development) while at least one enterprise expended as much as $300 million. There are wide variations from company to company in this basic pattern of expenditure.

THE MULTIPLE REGRESSION AND CORRELATION MODEL

For brevity, the research model can be represented by a regression equation. The multiple regression equation which expresses the relationship between the amounts of money spent on IT and the various socio-economic and organizational characteristic variables may be given thus:

$$Y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 \ldots\ldots\ldots\ldots + U$$

Where;

Y	=	amount of money spent on IT
b_0	=	base constant
$b_1, b_2 \ldots$	=	regression coefficients
$x_1, x_2 \ldots$	=	relevant variables as defined.
U	=	stochastic disturbance term.

The objective of this analysis is to provide a summary statement on the relationship between some combination of the predictor set of variables and the criterion variable. All the explanatory variables in the equation except reach and richness are hypothesized as having a positive relationship with the dependent variable.
The reasoning here, for example, is that because the higher the number of customers a business can reach (called "reach"), and the number of interactions and information services it can provide to customers (called "richness") the less money such a company is likely to commit to new IT Web-based projects.

It is anticipated that not all of the independent variables would be included in the final model; as their pair-wise correlations turned out to be high. Such a situation (multi-colinearity) results in an imprecise estimation of the regression coefficients, due to large sample variance of the coefficient estimator. An unbiased way of dealing with this problem was to transform the data through a factor analytical procedure – "to collapse the indicators." This group of techniques was used in determining the minimum number of independent variables necessary to reproduce the variation in the original data sets. Table 3 shows six (6) underlying components with greater than 1.00 (>1.00) eigen-value resulting from a factor analysis of the data. This implies that these six basic factors instead of the original seventeen (17) may be used in explaining the monetary investments in WSSs. Therefore, the six (6) diagnostic and resulting variables, having the highest loading on

each of the factors were employed for further analysis. These variables are - by richness (X_{16}), level of ITPM (X_5), firm size (X_9), IT investment style – leader or follower (X_{11}), management support (X_{12}), and IS planning (X_{17}).

These variables were therefore used in a step-wise regression and correlation analysis. Table 4 indicates that up to the 4th step, each variable included in the analysis is significantly related to the dependent variable. By the 5th step however, only three of the variables are of any significance. This implies that four variables in the fourth step are really the only ones that ought to be included in the model. The variables are: firm size (X_9), IS planning (X_{17}), IT investment style; – leader or follower (X_{11}), and level of ITPM (X_5). The first two are significant at the 99.9 percent level of confidence, the third at the ninety-nine percent level while the level of ITPM is significant at the ninety-five percent level of confidence. Table 5 shows that these variables collectively explain about sixty-four percent of the variation in WSSs development budgets. This is a 7% loss from the original model incorporating all the seventeen variables (see Table 2).

Table 2: Analysis Of Variance For The 17 Independent Variable Model

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F* Ratio	R^2
Regression	236906.6	17	13935.7	28.3*	0.71
Residual	239635.5	487	492.1		
Total	476542.1	504			

*Significant at the 0.1 percent level

Table 3: Varimax Rotated Factor: Matrix of Independent Variables

VARIABLES	FACTORS					
	I	II	III	IV	V	VI
1	0.97	-.04	-0.08	-0.06	-.03	0.03
2	0.08	0.00	0.11	0.25	0.06	0.35
3	-.60	0.02	-0.03	-0.17	-.07	0.25
4	-.49	0.07	0.09	0.16	0.12	0.50
5	0.31	-.04	0.02	0.02	0.00	-.59
6	0.69	0.08	0.00	0.14	0.02	-.07
7	0.87	0.13	-.09	-.09	-.03	-.04
8	0.63	0.02	-.12	-.11	-.09	-.10
9	0.04	0.42	0.27	0.62	0.27	0.00
10	-.03	0.54	0.32	0.43	0.30	0.11
11	0.05	0.99	0.03	0.06	0.04	0.06
12	-.12	-.05	0.09	0.00	0.15	0.02
13	-.07	-.09	-.16	0.51	0.14	0.08
14	0.00	0.09	0.21	0.37	0.05	0.19
15	0.05	0.23	0.09	0.46	-.27	-.05
16	-.08	0.14	0.44	0.09	-.09	0.07
17	-.05	0.14	0.04	0.17	0.90	0.08
Percentage of Variance	**39.3**	**27.5**	**10.1**	**9.4**	**7.2**	**6.4**

It should be pointed out however, that this loss, which is not much, is more than justified by the much simpler model and structure that ultimately emerged. The last ANOVA table (Table 5), shows that in spite of this loss, these four variables, taken together, significantly explain the amount of money expended on WSSs in the sample. The model is significant at the 0.1 percent level of significance.

Table 4: Step-Wise Test of Significance of the Diagnostic Parameter Estimates

Steps	Variables In	β	Standard Error of β	F
1	9	3.81	0.30	158.8*
2	9	2.98	0.33	81.2*
	17	3.45	0.63	30.3*
3	9	2.63	0.36	52.2*
	17	3.47	0.62	30.9*
	11	2.28	0.99	5.2**
4	9	2.59	0.36	50.6*
	17	3.54	0.62	32.1*
	11	2.40	0.99	5.8**
	5	2.89	1.69	2.9***
5	9	2.61	0.36	51.1*
	17	3.58	0.63	32.7*
	11	2.33	1.00	5.4**
	5	2.38	1.78	1.7
	1	0.98	0.08	0.9

*Significant at the 0.1 percent level
**Siginificant at the 1 percent level
***Significant at the 5 percent level

Table 5: Analysis Of Variance For The Reduced Model

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F* Ratio	R^2
Regression	140421.5	4	35104.4	52.2*	0.64
Residual	336120.7	500			
Total	476542.1	504			

*Significant at the 0.1 percent level

SUMMARY AND CONCLUSIONS

Although this study deals with only one tiny sector of the US economy; firms that have developed and implemented Web services and strategies, some of its findings may be of interest to, and also have implications for IT budget research. An important derivable conclusion is the fact that socio-economic characteristics of firms, except perhaps company's net-worth, and IT Portfolio Management (ITPM) seem to have very little influence on the amount of money expended on web applications. What is fundamental are the various systems development variables. This is especially the case as these variables may not necessarily be so closely related to socio-economic ones. Even if there is such a relationship, it seems that socio-economic variables influence IT expenditure mainly through systems development behavior and implementation characteristics. This study can be useful by providing managers and IT leaders' guidelines and informed approaches to appropriately and adequately funding their information technologies and projects.

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