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DIFFUSING ENTERPRISE ARCHITECTURE STRATEGY

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ABSTRACT

Enterprise Architecture (EA) is a tool used by organizations to align strategy, business processes, and information technology (IT). Unfortunately, enterprise-level strategy is often not adequately encompassed by EA in such a way that it facilitates strategic IT alignment. Without such strategic orientation, EA may not provide benefits anticipated by firms using EA, such as enhanced levels of inter- and intra-organizational collaboration, agility, and performance. In this study, we examine organizational-level factors that might contribute to the degree to which EA embodies firm strategy from a diffusion of innovation perspective. Based on extant innovation routinization literature, we propose a model consisting of formal guidance addressing EA, EA training, funding to support EA, and EA strategic orientation. We show that organizations can dramatically enhance the level their EA embodies firm strategy and potentially, their bottom line, by employing formal guidance addressing EA, increasing EA training, and providing resources in support of EA.

Keywords

diffusion of innovation; enterprise architecture; information technology strategy; strategic orientation

INTRODUCTION

Organizations lacking a clear strategy for integrating and aligning information technology resources will likely end up with systems that are fragmented, dysfunctional, and ineffective (Bradley, Pratt, Byrd and Simmons, 2011). Conversely, firms can realize enhanced performance by aligning IT strategy and implementations with business strategy and initiatives (Vickery, Droge, Setia and Sambamurthy, 2010). Enterprise Architecture (EA), a tool to enhance this desired alignment, is a strategic framework defining the enterprise strategy, the information necessary to operate the enterprise and its business processes, and the IT infrastructure necessary to support such information needs (Federal Chief Information Officer Council, 1999).

Scholars suggest diffusion of an organization's EA occurs as a multi-stage process, seeing the firm move from an initial architecture of single applications to one of a mature, enterprise-level architecture replete with standards, technologies, and links to strategic opportunities and organizational objectives (Ross and Beath, 2006). As EA matures, it encompasses an increasingly more firm-wide strategy (Ross, 2003; Ross, Weill and Robertson, 2006). Unfortunately, factors contributing to enhancing EA's strategic orientation have received little attention in the literature. We examine how firms can enhance EA *strategic orientation*, or the degree to which EA embodies firm strategy. Higher levels of strategic orientation imply a more mature EA, which can foster strategic IT alignment and enhance performance (Ross, 2003; Tallon and Pinsonneault, 2011).

Our goal is two-fold. Our first objective is to provide clear, practical guidance practitioners can use to enhance the level their EA embodies firm strategy by their employing formal guidance addressing EA, increasing EA training, and providing resources in support of EA. For our second objective, we use Diffusion of Innovation (DOI) theory, which explains how new ideas, products, or processes spread through an organization (Rogers, 2003; Weigel, Rainer, Hazen, Cegielski and Ford, 2012), to develop a model exploring post-adoption factors that have been shown to routinize innovations. Research suggests several factors that help diffuse innovations within organizations (Hazen, Overstreet and Cegielski, 2012), and we explore those most salient in the case of EA strategic orientation. We posit that providing formal guidance, supporting funds, and training enhance EA strategic orientation. We seek to contribute to post-adoption DOI literature with an examination of how routinization factors enhance EA strategic orientation.

CONCEPTUAL DEVELOPMENT AND HYPOTHESES

Extant DOI literature suggests there are three post-adoption stages in the organizational diffusion process that play significant roles in helping firms incorporate a newly adopted innovation. The first stage is *acceptance*—constituents' intent to use or

actual use of an innovation (Venkatesh, Morris, Davis and Davis, 2003). Next is *routinization*—changing the organization's governance systems to accommodate the innovation (Yin, 1981; Zmud and Apple, 1992). The third stage is *assimilation*—widespread use of an innovation across organizational processes (Purvis, Sambamurthy and Zmud, 2001). We focus on variables that may affect progress toward EA strategic orientation and thus, examine the routinization activities.

A longitudinal study investigating how technological innovations become routinized within organizations marks one of the most significant contribution to this area (Yin, Quick, Bateman and Marks, 1978). Yin et al. (1978), found several activities that promote routinization, which became the basis for further study (Pluye, Potvin, Denis and Pelletier, 2004; Yin, 1981). Herein, we consider the most salient routinization activities that Yin and colleagues identified as they pertain to enhancing EA strategic orientation. Specifically, these activities are formal guidance, training, and supporting funds (Figure 1).

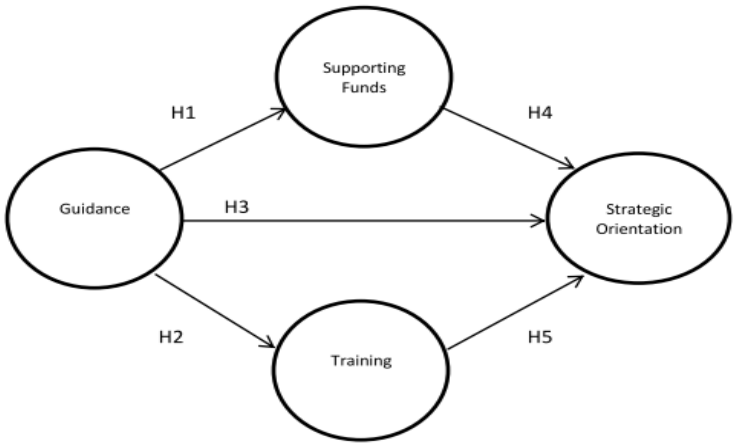

Figure 1. Model of Enterprise Architecture Routinization for Strategic Orientation

Yin et al. (1978) found innovations were routinized partly by being integrated in organizations' governing regulations or *formal guidance*. The changes in guidance may be made early in the diffusion process, so the organization directs use of the innovation, or later in the diffusion process, such as when an organization realizes the need to update guidance to account for the innovation. Including the innovation in formal guidance, organizational leaders solidify the firm's commitment to the innovation. Formal guidance is the first step toward routinizing innovations within an organization, initiating additional routinizing functions, such as appropriating supporting funds and introducing training programs.

Many innovations are first funded by external sources, such as from parent or governmental bodies (Yin et al., 1978). Other innovations are initially funded from within an organization, but with special monies, such as funds set aside for research and development or special projects. Transitioning from the external sources to local *supporting funds* entails transfer of funding from the initial, non-routine sources to an organization's routine operations budget, which serves to routinize the innovation.

Finally, research suggests that organizations establish ongoing *training* programs to support innovation they wish to routinize (Yin et al., 1978; Hazen et al., 2012). The firm should establish routine training so individuals new to the organization can learn about the innovation and existing employees can receive ongoing training. The organization should consider positioning and recurrence of the training activity. A training program that is a standard practice in the organization so it is readily available to members of the firm needing training helps routinize the innovation. Considering the above, we posit:

> *HYPOTHESIS 1. The degree to which an organization's formal guidance addresses EA directly affects the degree to which supporting funds are available for EA.*
>
> *HYPOTHESIS 2. The degree to which an organization's formal guidance addresses EA directly affects the degree of EA training.*
>
> *HYPOTHESIS 3. The degree to which an organization's formal guidance addresses EA directly affects the degree of EA strategic orientation.*

Because the aforementioned variables have been shown to enhance routinization of innovations, we consider each to be direct antecedents to routinizing strategy in EA. For instance, Yin's (1981) findings suggest that the normal budgeting process must account for all expenditures required to sustain the innovation in order for it to become routinized. Thus, in order for EA and

its initiatives to become routinized in an organization, local and routine funding must be available and allocated for sustainment. However, we posit the relationships in our model are more complex than simple direct relationships.

HYPOTHESIS 4A. The degree of EA supporting funds directly affects the degree of EA strategic orientation.

HYPOTHESIS 4B. The degree of EA supporting funds mediates the relationship between formal guidance and EA strategic orientation.

Yin (1981) suggests that an ongoing training program must be established if the innovation is to become routinized. Thus, organizational diffusion of innovation is often accompanied by large investment in training programs (Olfman and Pitsatorn, 2000; Swan, Newell, Scarbrough and Hislop, 1999). Indeed, training has been an effective way for organizations to fulfill employees' needs, promote the acceptance of new IT, and enhance return on investment (Sharma and Yetton, 2007).

HYPOTHESIS 5A. The degree of EA training directly affects the degree of EA strategic orientation.

HYPOTHESIS 5B. The degree of EA training mediates the relationship between formal guidance and EA strategic orientation.

METHOD

We used existing routinization measures and literature to create our measures (Saga, 1994; Zmud and Apple, 1992). We created a four-item measure of EA strategic orientation using Barney's (1991) strategically relevant firm resource definition and Yin's (1981) concept of organizational status. We assessed items with a 7-point Likert scale (available upon request).

Based on the nature of the survey items, our target population was those who are familiar with EA—senior managers, experienced consultants, and IT professionals in organizations that use EA. Qualtrics Panels, a survey distribution firm, provided us with our sample. We included filter mechanisms in the instrument ensuring respondents knew about EA and the organization. Incorrect responses to any of the filter items terminated the survey.

Of the 218 people who responded from 218 separate organizations, 50 (22.9%) are female and 168 (77.1%) are male. Most of the respondents (n=96; 44.0%) have five to ten years EA experience, followed at 28.4% (n=62) by those with less than five years EA experience. Forty-three (19.7%) have 11 to 20 years EA experience and the remaining 17 (7.9%) have 21 or more years of EA experience. The respondents' years of experience with their organizations stratify similarly to years of EA experience: (n=92; 42.2%) have five to ten years with their organizations, 69 (31.7%) have less than five years, 37 (17.0%) have 11-20 years, 16 (7.3%) have 21-30 years, and only four (1.8%) have 31 or more years with their organization.

The organizations in which the respondents work range in size from those with fewer than 100 employees (n=29; 13.3%) to those with greater than 100,000 employees (n=3; 1.4%). The majority of the firms have 101 to 1,000 employees (n=81; 37.2%) and 1,001 to 10,000 employees (n=80; 36.7%). The remaining 28 (12.9%) firms have more than 10,000 employees. Although some organizations (n=68; 31.2%) adopted EA less than five years ago, most (n=111; 50.9%) adopted EA in the past five to ten years. Twenty-seven (12.4%) firms adopted EA 11 to 20 years ago, 10 (4.6%) adopted EA 21 to 30 years ago, and only 3 (1.4%) adopted EA more than 30 years ago. The range in the organizations' gross profits is large; 11 (5.0%) have annual profits less than $100,000; 29 (13.3%) range from $100,000 to $1 million; 33 (15.1%) have profits of $1 to $10 million; 40 (18.3%) have profits of $10 to $100 million. The largest segment of firms (n=55; 25.2%) has annual profits greater than $100 million and the respondents from the remaining 50 (22.9%) firms did not know the organizations' profits or are in an organization that does not make a profit (e.g., government organization).

We collected survey data over a 14 day period. We assessed non-response bias with wave analysis (Rogelberg and Stanton, 2007) by examining differences between early (first week) and late (second week) responses. We compared a random selection of 20% of the survey items via two-way t-tests and found no significant differences. In total, we received 200 responses out of 1,006 initially solicited (19.9% response). After adding 24 responses from our pilot test and removing unusable and duplicate responses, we kept a final sample of 218 responses. We conducted missing values analysis that indicated less than 2% of values missing. Little's (1988) missing completely at random test was non-significant, indicating missing data do not depend on observed or missing data. We used Estimation, Maximization (EM) to impute missing values.

ANALYSIS AND RESULTS

We employed covariance-based structural equation modeling (SEM) in AMOS 20. Our analysis followed a two-step procedure, as recommended by Anderson and Gerbing (1988). First, we examined the measurement model in order to assess the adequacy of our model and data. Then, we used the structural model for hypothesis testing.

Measurement Model

As shown in Table 1, our measures demonstrated adequate levels of reliability and both discriminant and convergent validity, as per generally accepted heuristics (Anderson and Gerbing, 1988; Hair Jr., Black, Babin and Anderson, 2010; Werts, Linn and Jöreskog, 1974).

	Mean	SD	CR	Guidance	Funds	Strategic Orientation	Training
Guidance	5.12	1.36	0.945	**0.810**	0.448	0.446	0.637
Funds	4.87	1.33	0.939	0.669	**0.795**	0.169	0.419
Strategic Orientation	5.08	1.32	0.939	0.668	0.411	**0.795**	0.511
Training	5.03	1.40	0.949	0.798	0.647	0.715	**0.824**

Average variance extracted along the diagonals (bold). Squared correlations above the diagonals

Table 1. Descriptives and Correlation

Our confirmatory factor analysis (in AMOS 20), indicated suitable model fit for each construct. As such, we constructed our measurement model using all study constructs. The resultant fit indices suggest an acceptable fit to our model (χ^2 (98) = 210.65, $p < .001$; CFI = .96; RMSEA (90CI) = .073 (.059, .086); SRMR = .043) (Hair Jr. et al., 2010). We assessed common method bias by including a latent method factor in our structural equation model, in which all indicators load on both their substantive construct and the method factor (Podsakoff, MacKenzie, Lee and Podsakoff, 2003). The method factor loadings were either insignificant or the method factor variance was less than the variance attributed to the substantive construct. We concluded common method bias is not a threat to the our findings' validity (Williams, Edwards and Vandenberg, 2003).

Structural Model and Hypothesis Test Results

The fit of the structural model is similar to that of the measurement model; our hypothesized model appears to fit the data well (Table 2). With evidence of acceptable fit, we tested our hypotheses, beginning with direct effects. We used our hypothesized model for hypothesis testing. Hypothesis 1—influence of the degree of guidance about EA on the degree of supporting funds—is supported ($\beta = .72$, $p < .001$); considering the squared multiple correlation (SMC), guidance explains 52.5% of variance in supporting funds. Hypothesis 2—influence of the degree of guidance on the degree of training—is supported ($\beta = .90$, $p < .001$); considering the SMC, guidance explains 73.6% of variance in training. Hypothesis 3—direct effect of the degree of guidance regarding EA on the degree of EA strategic orientation—is not supported ($\beta = .03$, $p = .740$) in the partial mediation model (but is in the non-mediated model, as discussed below). Hypothesis 4A—relationship of supporting funds and EA strategic orientation—is supported ($\beta = 0.47$, $p < 0.001$). Hypothesis 5A—relationship of training and EA strategic orientation—is supported ($\beta = 0.30$, $p < 0.001$).

Model	χ2	df	Sig	$\Delta\chi$2	Δdf	ΔSig	CFI	SRMR	RMSEA (90C.I.)
1. Partial mediation	219.37	99	.000	-	-	-	.963	.0483	.075 (.062, .088)
2. Full mediation	219.49	100	.000	0.12	1	n/s	.963	.0480	.074 (.061, .088)
3. No supporting funds mediation	349.08	100	.000	129.71	1	.000	.923	.2854	.107 (.095, .119)
4. No training mediation	440.60	100	.000	221.23	1	.000	.895	.3153	.125 (.113, .137)
5. Direct effects only model (no mediation)	562.25	101	.000	342.88	1	.000	.858	.3884	.145 (.133, .157)

The partial mediation model was the baseline for all other models; N = 218

Table 2. Model Comparisons

We hypothesized supporting funds (Hypothesis 4B) and training (Hypothesis 5B) mediate the relationship between guidance and EA strategic orientation, and tested such using steps recommended in prior studies (Kenny, Kashy and Bolger, 1998). Table 2 contrasts alternate models examining mediation effects. First, we established there is a path that may be mediated by showing that the initial independent variable, guidance, has a significant effect on the dependent variable, EA strategic orientation. We examined this relationship in our direct effects model (model 5 in Table 2) and found the relationship to be

significant (β = .13, p = .001). Second, we established that guidance has a significant effect on the proposed mediator, supporting funds (β = .72, p < .001). Third, we established that supporting funds has a significant direct effect on the outcome variable, EA strategic orientation (β = .47, p < .001). Finally, we assessed the relationship between guidance EA strategic orientation while controlling for supporting funds and found the relationship was no longer significant (β = .09, p = .152). Based on Kenny et al. (1998), we find support for Hypothesis 4B, supporting funds mediates the relationship between guidance and EA strategic orientation. Further evidence of mediation is shown in Table 2, where the mediation model provides a significantly better fit to the data than the non-mediated model (Kline, 2011).

We followed the same procedure to assess training as a mediator. Again, we note that there is a significant relationship between guidance and EA strategic orientation in the non-mediated model. Second, we established that guidance has a significant effect on the proposed mediator, training (β = .90, p < .001). Third, we established that training has a significant direct effect on the outcome variable, EA strategic orientation (β = .30, p < .001). Finally, we assessed the relationship between guidance and EA strategic orientation while controlling for training and found the relationship was no longer significant (β = .08, p = .319). Based on Kenny et al. (1998), we find support for Hypothesis 5B that training mediates the relationship between guidance and EA strategic orientation. The results are supported by our model comparisons in Table 2 (Kline, 2011). Summary results are in Table 3.

Hypothesis/Direct Path[a]	Std. Coef.	Unstd. Coef.	S.E.	p-value	Hypothesis support?
H1: Guidance → Funds	.725	.722	.063	< 0.001	YES
H2: Guidance → Training	.858	.902	.063	< 0.001	YES
H3: Guidance → Strategic Orientation	.039	.034	.103	.740	NO
H4a: Funds → Strategic Orientation	.535	.468	.069	< 0.001	YES
H5a: Training → Strategic Orientation	.358	.297	.086	< 0.001	YES
Hypothesis/Mediation[b]	$\Delta\chi^2$	Δd.f.		p-value	Hypothesis Support?
H4b: Funds mediating Guidance → Strategic Orientation	129.71	1		< 0.001	YES
H5b: Training mediating Guidance → Strategic Orientation	221.23	1		< 0.001	YES

[a] Hypothesis testing and reported coefficients based on partial mediation (hypothesized) model results
[b] Comparisons drawn between partial mediation model and corresponding non-mediation model, as shown in Table 2

Table 3. Hypotheses Test Results

CONCLUSIONS

The purpose of this study was to examine how firms may enhance the strategic orientation of EA. Because of space limitations, we do not thoroughly discuss the implications of our findings here. We also hope to more fully develop our hypothesized model in a future iteration of this paper. Nonetheless, this study provides an initial investigation into the role of salient routinization factors proposed in the extant diffusion of innovation literature and we found that firms can use formal guidance, supporting funds, and training to enhance the degree to which their EA embodies firm strategy. Our study extends the literature on post-adoption innovation diffusion by providing a deeper examination of how routinization factors contribute to EA strategic orientation. Our model explains 70.9% of the variance in EA strategic orientation (SMC = .709) and provides firms with a better understanding of how to create a more strategically oriented EA. In practice, organizations can dramatically enhance the level their Enterprise Architecture embodies firm strategy and conceivably, their profitability, by employing formal guidance addressing EA, increasing EA training, and providing resources in support of EA.

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