Building Information Technology Based on a Human Behavior-Oriented Approach to Enterprise Architecture

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Abstract
Enterprise Architecture (EA) frameworks (EAF) define a comprehensive step-by-step process with an expected outcome an EA plan that details the guidelines for governing and aligning an enterprise’s strategic business plan with its IT capabilities. The process attempts to simplify the capture and validation of the design artifacts used to implement new information systems. Yet, many EA projects fail. In analyzing failure, EA changes the culture, character, and structure of an enterprise that often manifests itself in new stakeholder behavioral patterns (i.e., organizational transformation). Existing EAFs, though technically comprehensive, fail to acknowledge non-technical factors such as stakeholder behavior which may have more influence on EA than technology. This paper progresses earlier work assessing the affect of stakeholder behavior and organizational transformation on EA. Our approach to EA encourages a more holistic, humanistic, and behavior-driven process using Giddens’ Theory of Structuration as a lens guiding EA design.

Keywords: Enterprise architecture, organizational change, stakeholder behavior

1. Introduction

In today’s increasingly competitive economic landscape, many organizations are looking to improve operational efficiency and effectiveness by implementing new and/or enhanced technology [13]. Enterprise Architecture (EA) represents the first step towards this goal using a framework (EAF) and modeling techniques that specifies high-level, macro-oriented abstraction of functional and non-functional requirements that will drive subsequent information technology (IT) design, development, and implementation. In its simplest form, EA provides a layered view of desired enterprise-wide systems [18][23][27]. Usually tiered as a series of architectural views of the enterprise’s information assets and needs, the layers define the business, application, data, and technology requirements needed for IT [28][37].

In literature, EA is defined as the alignment of an enterprise’s strategic business plan and operational model with its IT capabilities [26][28][37]. In reality, EA organizes into a single, easy to understand, and neatly documented plan called an EA plan (EAP) that contains the guidelines to manage and govern the alignment process. The EAP thus represents both an aggregation of design requirements derived from both explicit and tacit organizational knowledge and descriptions of the systems, subsystems, resources and infrastructure needed to progress IT. In effect, EA defines what IT is to do and IT is doing EA.

Collectively, the requirements input to EA represent the foundation for guiding, managing, governing, controlling, and building IT [3][27]. As can be seen, failure to capture and validate design requirements not only jeopardizes EA, it can also doom IT. The EAF, usually under the direction of an Enterprise Information Architect(s) (EIA), provides a comprehensive set of techno-centric processes to elicit and document EA requirements [28][37]. To be effective, the requirements gathering and analysis process must capture and analyze both explicit and tacit organizational knowledge [24][26].

As inclusive as the EAF and modeling processes appear to be, EA design and implementation remains difficult and often confronted with obstacles with many EAs being either partially implemented or completely abandoned [3][6]. Statistics support this assertion claiming that between 20-30% of all private sector EA and IT projects are completely abandoned with an additional 30-60% ending in partial implementation [17][33]. Public sector projects, on the other hand, fare even worse with a success rate of only 16% [8][9]. The cost for failure is even more significant with expenditures of money and resources estimated annually into the billions of dollars [8][33].

Failed EA is often attributed to erroneous requirements and is commonly referred to as “poor architecture” [24]. Poor architecture, in this context, means [8][9][19][31]:

- The requirements do not meet the expectations of the stakeholder(s)
- The requirements are inconsistent or incomplete
- Changing the requirements is too costly after they have been agreed upon
With stakeholders responsible for the input to the EA requirements engineering process, “poor architecture” might have more to do with their reaction to and acceptance of EA rather than any technological concern. In essence, an analysis of stakeholder behavior can be traced to:

- The impact new technology has on organizational transformation reflected in both organizational/stakeholder behavior [1][2][24]
- The manner in which the EA is being introduced by management into the enterprise [7][18][20][29]
- The either covert and/or overt stakeholder resistance and/or reluctance to change [2][12]
- The intentional and/or unintentional miscommunication and/or providing misleading information related to design requirements needed for the EAP [10][24]

Solving these issues, however, can be difficult, perhaps requiring a major shift in the way EA is approached. This may require adopting practices from the fields of psychology and sociology to mitigate negative stakeholder behavior and thus enhance the traditional processes and procedures found in existing EAFs and modeling schemes. This paper treats stakeholder behavior as a major factor in EA design. It focuses on technology and organizational transformation recognizing stakeholder behavior and the risks to management from the inherent uncertainties surrounding projects such as EA. This paper specifically progresses our earlier research [22][24][25] by expanding our knowledge in human behavior and its effect on the design of large, complex, and multi-faceted systems/entities of EA [22][24][25].

This work builds on our earlier communicative approach to EA proposing, as a first step in recognizing stakeholder behavior, an Architectural Design Plan (ADP) that formulates how EA should be approached. The communicative aspect of the ADP encourages stakeholder collaboration and participation by allowing stakeholders an active role in EA design throughout the EA life-cycle. From this position, potential EAF and modeling solutions can be planned for and implemented that facilitate verification and validation of design requirements.

2. Stakeholder Behavior and Organizational Transformation

Stakeholder behavior may be influenced by several factors such as: technology, the cognitive capacity of stakeholders to contribute to, and the way EA is introduced into an organization [2][13][24][29]. In most instances, management expects stakeholders to learn, accept, adapt to, and use without question new technology and processes [2][29]. What management forgets is that today, stakeholders frequently question the rationale and need for new technology. In the case of EA, these factors alone can play a significant role in acceptance or rejection of EA. Given this perspective, the behavior of project stakeholders, who have the capacity to act for or against the enterprise’s desires, must be taken into account during EA design [2][10][29].

If we analyze the manner in which EA is introduced into the enterprise, we find many EAs are unexpectedly initiated without any stakeholder input [2][29]. This affects EA in several ways. First, this kind of management behavior works only in organizations where a tightly controlled and constrained environment is the norm. Second, in other organizations, some stakeholders may accept the new technology and simply move on while others may resent the way change was introduced and thus resist EA. Third, stakeholders may actively threaten and jeopardize EA either overtly or covertly perhaps even resorting to sabotage. Two factors that influence this kind of stakeholder behavior are their perception of and reaction to how EA will affect:

- The environment in which they currently function [10][35]
- Their future status and their new assigned roles, duties, and responsibilities [2][12][29]

Stakeholder attitudes towards and use of technology has long been recognized as a key ingredient to EA success [4][5]. In fact, stakeholder acceptance is often considered the pivotal factor in determining the success or failure of an EA [5]. Thus, stakeholders may accept, reject, and, in some cases, modify the technology to suit their own self interests [24][29]. In the most extreme situations, stakeholders may intentionally misuse (and/or sabotage) the technology and thus EA [10][13][20][29]. In most cases, stakeholder reluctance or resistance to change usually follows some action that has the potential to affect the enterprise’s equilibrium/status quo [2][12][16]. Given behavior alone, resistance to change follows human action caused by stakeholder [1][2][4][10]:

- Parochial self-interests – some stakeholders are more interested in “what’s in it for them” rather than the good of the enterprise
- Fear of change – some stakeholders operate from a personality position that fears change
- Low tolerance for change – some stakeholders feel more secure maintaining a sense of stability and security in their work
- Misunderstanding of the situation – some stakeholders may disagree with the rationale for change
In addition, change affects people differently and may be the product of insecurity brought about by internal organizational influences. Though all of the these factors are well known, there are no provisions for mitigating these negative influences in either existing EAFs [25] and/or the modeling schemes (see Table 1). To succeed, EA requires a well-designed EAP that adequately defines design requirements produced by the right kind of tool sets, EAFs and modeling schemes [16][26].

Design requirements elicited from stakeholders lie at the heart of EA providing the building blocks that define the system specifications needed for IT [3][7][16][31][34]. Thus, the capture of design specifications is critical to EA success and if incorrect, they can plant the seeds for EA failure. Supporting this line of reasoning, most EA literature blames failure on the requirements used describing the requirements as “poor architecture” [24]. Extending our analysis of “poor architecture” allows us to take into account stakeholder behavior and miscommunication. This is most prevalent in eliciting tacit, undocumented knowledge known only to a single or group of select stakeholders.

EA design today relies on an EAF and modeling schemes to capture and validate design requirements [28][37]. The procedures found in each framework establish the enterprise’s goals and objectives aiming to ensure adequate documentation for the EAP [16][26][37]. However, the organizational goals and objectives desired of EA are not always those shared by stakeholders responsible for doing work.

In today’s environment, existing EAFs and modeling schemes follow generally accepted software engineering and requirements engineering principles and practices with the expected outcome a

<table>
<thead>
<tr>
<th>Modeling Approach</th>
<th>Definition Documentation</th>
<th>Ease of Use</th>
<th>Stakeholder Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unified Modeling Language (UML)</td>
<td>Well defined, industry-standard notation lending itself to several automated modeling tools.</td>
<td>The present version is overly complex, though Version 2.0 may be addressing this issue. It does not lend itself alone to modeling business requirements as needed in EA.</td>
<td>UML is not used extensively in EA development. It does not take into consideration stakeholder behavior in its scheme for modeling specifications and requirements.</td>
</tr>
<tr>
<td>Model-Driven Architecture (MDA)</td>
<td>Provides guidelines for structuring system specifications. Typically just as much as model-driven automation as it is about model-driven architecture.</td>
<td>Uses XML and UML to generate and produce modeling diagrams, notation, and semantics for the system. Often used with other modeling schema such as EUP and RUP. Encourages developers and architects to work at higher levels of abstraction.</td>
<td>The primary focuses of MDA are mapping documents, transformation, and UML profiles. A review of various works published on MDA methodologies does not highlight any issues on the process regarding human or organizational related to this approach.</td>
</tr>
<tr>
<td>Zachman Framework (Z</td>
<td>FA)</td>
<td>Uses rows and columns to define an EA. The notation used within Z</td>
<td>FA represents various/ different views of stakeholders.</td>
</tr>
<tr>
<td>Enterprise Unified Process (EUP)</td>
<td>An instantiation of the Unified Process (UP) and RUP.</td>
<td>IBM’s approach to software Development, a well-defined and rigorous process. Divides the development process into phases with each concluded with a project milestone.</td>
<td>Provides for agreement with stakeholders on lifecycle objectives for the project and the design and implementation focusing on a viable marriage of essential business requirements and the technical architecture.</td>
</tr>
<tr>
<td>Rational Unified Process (RUP)</td>
<td>Defined for software development and follows the Unified Process (UP). It reflects business “best practices” and typically does not codify approaches until they are well established in the field.</td>
<td>Explicitly brings EA into the RUP arena.</td>
<td>Human behavior not considered as part of this approach.</td>
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**Table 1. Comparison of Enterprise Architecture Requirements Modeling Schemes**
documented set of requirements that includes the resources and infrastructure, necessary for IT [26][27]. The frameworks and modeling schemes are comprehensive, disciplined, and designed to handle large volumes of complex and interdependent system and subsystem requirements from a purely technological perspective [26][27][31]. State-of-the-practice EAFs formulate EA aimed at maintaining business continuity and the alignment of the enterprise’s strategic business plans, business operations with its IT infrastructure and resources [7][11][26]. These are the strengths of existing EAFs.

Conversely, the inherent weakness of each EAF centers on the techno-centric and techno-oriented solutions they prescribe producing only a desired set of technical deliverables for the EA [7][26]. This process satisfies the high-level abstraction of design requirements needed for EA identifying, in detail, the proposed organizational structure, business processes, desired information systems, design requirements, implementation plan, and associated IT infrastructure. However, the processes discount the importance of the intersection of technology with human behavior, the inevitable organizational transformation that takes place as a result of EA, and their potential effect on the quality of the work effort delivered, specifically the design requirements [24].

For example, the key element around which all design activity takes place in The Open Group Architecture Framework (TOGAF) Version 9.1, the Application Development Method (ADM), describes a purely technical perspective and detailed series of step-by-step processes and procedures for EA [28]. Stakeholder roles, responsibilities, and contribution to EA are identified through the ADM based on what is termed “Stakeholder Management”. This process consists of four concepts: Stakeholders, Concerns, Views, and Viewpoints. The process essentially identifies who will be involved and needed in EA design [28]. The process analyzes stakeholder role, decision-making, and resource control. Though these questions by themselves sound relevant, the process itself fails to ask questions that would improve good decision-making and problem-solving such as “why?” and “why not?” For example, questions not asked by this and other EAFs are:

- Why is one stakeholder assigned to EA while another is not?
- What is the cognitive capacity of the stakeholder to contribute?
- What will be the impact on stakeholder behavior caused by EA and/or organization transformation?

In general, little attention or recognition is given to stakeholder behavior and the consequences of either positive or negative influence on EA.

There are some modeling approaches with the inclusion of stakeholder behavior in validating EA requirements. For example, the i* modeling scheme [36] recognizes human input and their respective behavioral patterns to the requirements elicitation process. We will study i* in more depth in the future.

3. The Theory of Structuration Applied to Enterprise Architecture

The large-scale development of IT systems planned for in EA expects change to take place in an orderly and controlled manner. With the introduction of new EA technology, a transformation of the enterprise’s culture, aimed at improving operational effectiveness and employee productivity is expected by management [29][30]. This transformation however affects stakeholder in several ways as the result of learning new processes and procedures and the change is their respective roles, duties, and responsibilities. Thus, an EA initiative that incorporates psychological and sociological principles and practices to facilitate a dynamic behavior-driven view of an enterprise would be Giddens’ Theory of Structuration [24][29]. The Theory of Structuration uses the term structuration to refer to the conditions governing the continuity or transformation of structures and social systems indicating that structure represents the codes for social action. Agency, on the other hand, indicates the activities of individual members of the system existing in a recursive manner and relationship [10]. Simply, agents draw on structures during their processes of interactions, they perform social activities and continually reproduce the actions that make these practices possible [10][29][30].

In previous work [22][24][25], we described, in detail, the concepts and principles underlying Giddens’ theory describing the sociological aspects of Giddens’ theory applied to technology. Giddens’ theory in it’s original formulation pays little attention to technology. However, if we examine the pervasiveness of IT on everyday life, especially in the workplace, we can apply Giddens’ theory to any organization’s everyday operation and the reality of technology in contemporary organizations.

Given this perspective, the Theory of Structuration does not merely provide a means to understand the nature of an organization but can be applied to gain insight on the impact of the use of technology [34]. Orlikowski [29] proposed the Structurational Model of Technology (SMT) based on Giddens’ theory to provide a more complete model of understanding of how technology affects organizations. This theory is predicated on the perceptions of the Duality of Technology and the
Interpretive Flexibility of technology. The Duality of Technology posits that the socially created view and the objective view of technology is intertwined and are differentiated because of the temporal distance between the creation and use of technology. Interpretive Flexibility defines the degree to which users of a technology are engaged in its constitution (physically and/or socially) during its development.

SMT has three components – the Human Agents, Technology and Institutional Properties of Organization. The model specifies an interactive recursive relationship between these in that each of these components influences and is at the same time influenced by the others. Technology is created by and exists through ongoing human action. Humans constitute technology by using it, while at same time making it an outcome of human actions such as design, development, appropriation and modification. However once technology is implemented, it both facilitates human action through the provision of interpretive schemes, facilities and norms.

From an organizational perspective, institutional properties influence humans in their interaction with technology, through, by constituting: professional norms; rules of use – design standards and available resources (time, money and skills). There is a consequence of the institutional interaction with technology and are manifested by impacting the institutional properties of an organization through reinforcing or transforming Giddens’ structures of signification, domination and legitimization that characterize the institutional realm.

In summary, the theoretical premise of the Theory of Structuration [10] and the SMT [29] is an acknowledgement that organizational structures, technology, and human action are not distinct but are intertwined such that each is continually reinforced and transformed by the other. We can therefore conclude that an initiative such as the formulation of EA remains incomplete if it does not explicitly take into account human action. The Theory of Structuration provides a framework which, if adopted, could form the basis for a more inclusive, holistic, humanistic, and behavior driven approach to formulating an EA. Specifically, this theory provides a lens for the EIA to take advantage of understand the dynamics of an organization and use that information to formulate an EA that is contextual to that enterprise and advocated by the stakeholders.

In this context, stakeholders are recognized as purposely able to provide reasons for their activities, including perhaps even lying about them. However, this behavior can be managed by promoting an environment that encourages stakeholder collaboration and participation in the decision-making process. Successful implementation of new technology is the product of navigating human behavior and the resultant influence on organizational change. In this context, the actions of EIAs leads to changes in the way people behave and in a business context, human behavior and organizational factors contribute more to the success or failure of an EA than technical factors. Simply stated, stakeholders are affected by IT change and may be resistant if the change is forced upon them without warning and input from them.

4. Building and Modeling Enterprise Architecture

Stakeholder requirements represent one of the essential elements for managing, governing, and controlling the complexity, risk, project magnitude scope and boundary, and ambiguity associated with the elicitation of stakeholder requirements. These requirements form the basis for defining the goals and objectives of EA and what IT is to do and therefore are critical to EA success. However in a typical EA, it is not a matter of choosing which requirements to meet but of trying to meet all practical requirements.

In earlier work [22][24][25], several causal factors leading to EA failure are identified and addressed. From that work, we propose a solution and approach where management, the EIA, and key stakeholders collectively define, establish, and execute a management system that manages and governs EA that also includes a reliability plan that better ensures the quality of EA design requirements.

The solution establishes an Architectural Design Plan (ADP) put together by all stakeholders, an analysis of the “as is” environment, management style, organizational knowledge base, available skill sets, and the overall capabilities of the enterprise from a stakeholder behavior point-of-view. As currently envisioned, the ADP consists of two components: a Development Plan (DP) and a Control Plan (CP). The DP documents and establishes how the overall conduct of the EA is to be progressed, stakeholders selected and assigned to the project, the kinds of procedures to be used in eliciting design requirements, the communications and feedback loop(s) needed to verify design requirements, and the measurement, monitoring, and governance techniques needed to ensure the validity of the design requirements. The primary purpose of the plan is twofold:

- Provide the mechanism for the EIA to learn the existing organizational environment and identify areas of potential concern
• Provide the basic scheme for eliciting information (i.e., requirements) from which to design the EA.

This process provides an excellent opportunity for the EIA to learn not only what needs to be done but also who is to participate along with their personalities, how the project is to be managed and governed, and why it needs to be done.

The second step in this process, the CP, defines and describes the specific design handles and control processes that are to be used to ensure stakeholder requirements are met. In this step, factors such as organizational capabilities, skill sets, organizational reaction to nonconformance to either the DP or CP, and the exact critical in-design parameters that control the quality attributes of the design are established, documented, assessed, and agreed-upon to ensure that exact stakeholder expectations are met focused on the “to be” state of the enterprise.

Giddens’ Theory of Structuration can be used to establish and formulate the ADP primarily because it recognizes stakeholders as individuals that have the ability to act in ways other than those that support the existing organization or social structure. Therefore the ADP must be cognizant, structured, and designed to identify, and perhaps anticipate, adverse influences before they can seriously affect EA. A final and complete definition of the ADP would be made on an enterprise-to-enterprise situation as each enterprise has its own character, culture, and structure. Finally, EA should begin only upon completion of the ADP.

5. Discussion, Concluding Remarks, and Future Directions

Systems of coordinated activities represent work embedded in complex networks of technology-centric relations and boundary-spanning exchanges. The by-product of EA and the introduction of new technology into the workplace is a transformation of the organization’s character, culture, and structure as well as a change in the hierarchical sociological and political structure of the enterprise. This latter change should not be discounted but rather expected and planned for as it manifests itself in new stakeholder behavioral patterns.

Giddens’ Theory of Structuration [10] recognizes and addresses how relationships between human agents and structures can be both beneficial and at odds with each other. The theory also states that individuals have the ability to act in ways other than those that support the existing organization or social structure. In other words, their actions may be counterproductive. Orlowski’s Structural Model of Technology (SMT) [29] recognizes the impact of technology on human behavior and organizations postulating Giddens’ theory and providing more insight into the human behavioral aspects of and new technology in the organization.

The factors contributing to EA failure can be minimized by providing an environment where stakeholders become active participants and are receptive to change. A work atmosphere where stakeholders are encouraged to share ideas and information, communicate and collaborate whenever and however they need to in order to solve problems and exchange knowhow and knowledge. The possibility and prospect of EA success becomes more realizable if an enhanced working environment where participation in the design and implementation of new EA technology is welcomed and not perceived as a threat to stakeholder well-being. As can be envisioned, the derivable benefits from such an environment surely would include improved workforce morale and productivity.

In conclusion, the Theory of Structuration and it’s relationship to human behavior and organizational change [10], SMT’s approach to the effects of technology on human behavior [29] coupled with a well designed Architectural Design Plan, conceptualize unique opportunities for successful EA implementation. Finally, to address modeling schemes, future research will include an in-depth analysis of Yu’s i* agent oriented approach to EA to better ensure the validity of EA design requirements.

6. References


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Additional notes:

- Giddens' Theory of Structuration provides a framework for understanding how technology impacts human behavior and organizational structures.
- The SMT model by Orlowski offers insights into the relationship between technology and human behavior, emphasizing the need for a balanced approach to technology adoption.
- The discussion on EA failure highlights the importance of creating an environment that fosters active participation and collaboration, which can enhance the success of EA initiatives.
- Future research directions suggest exploring the i* agent-oriented approach to EA, offering additional opportunities to understand and improve EA implementation.
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