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SEVERITY ASSESSMENT OF ERP–ORGANIZATION MISALIGNMENT: HONING IN ON ONTOLOGICAL STRUCTURE AND CONTEXT SPECIFICITY

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Abstract

It has been estimated that at least half of all ERP (enterprise resource planning packages) implementations fail to meet expectations or achieve estimated benefits. In many cases, the misalignments between ERP features and organizational requirements have resulted in costly workarounds. In extreme cases, such misalignments have even contributed to project abandonment and organizational failure. One question that arises is why such severe misalignments have not been surfaced and recognized by organizations. Specifically, this paper proposes a framework that seeks to assess the severity of misalignment by critically examining the seductive universal best practices *embedded in ERP. The framework is grounded theoretically on key ontological and context specificity concepts. We illustrate the framework by applying it to several hundred instances of misfits that we collected from multiple ERP implementations. We use the results of the analysis to shed light on the functionality "black box" of ERP misalignment.*

1 INTRODUCTION

Enterprise resource planning (ERP) systems are package software products that potentially deliver best-of-breed, integrated business processes. However, it has been estimated that at least half of ERP implementations fail to meet expectations (Al-Mashari 2000). In many cases, the misalignments between ERP features and organizational requirements have resulted in costly workarounds. In extreme cases, such misalignments have even contributed to project abandonment and organizational failure.

Although the issue of package–organization misalignment has been highlighted in the ERP literature, little work has been done to explode the functionality "black box" to investigate the nature and sources of misalignment. Existing approaches to assessment (e.g., Stefanou 2001) tend to treat misalignment as one of many evaluative dimensions, and are not sufficiently fine-grained to critically assess the extent to which the *universal best practices* embedded in the ERP are appropriate for the organization.

Package-organizational misalignment comprises many specific instances of **misfits** where package functionally falls short of organizational requirements.[1] Resolving these misfits are often tricky in the ERP context as changes to the application are discouraged in order to achieve rapid implementation and ease of future maintenance. Thus, surfacing these misfits early and understanding their severity are important in order to avoid catastrophic adoption, or to plan adequately with regard to the budget for customization, prioritization of misfits for resolution, and managing user expectations.

Given the increasing prevalence of package software and package-enabled process redesign, there is an urgent need for a theoretically-grounded misfit assessment framework that is parsimonious and yet sufficiently fine-grained to guide practical analysis. This paper proposes a framework for assessing the severity of ERP–organization misalignment. Specifically, it posits that an analysis of the ontological structure and context specificity of the misalignment provide a good gauge of the severity of

[1]It thus excludes instances of functional excess where ERP functionalities exceed the business requirements of the organizations.

ERP–organization misalignment. It illustrates the framework by applying it to hundreds of misfits from ERP implementations at three hospitals.

2 ONTOLOGICAL ASSESSMENT OF ERP–ORGANIZATION MISALIGNMENT

We draw on the research on the ontology of information systems in developing our framework. Ontology is the branch of philosophy that deals with models of reality and defines representation structures for describing reality. We have adopted the Bunge-Wand-Weberm (BWW) ontological model (Wand and Weber 1990) as it has been widely applied to information systems (e.g., Green and Roseman 2000; Heales 2000), and it provides a normative frame for assessing the structural completeness of the embedded reference models in ERPs.

The BWW ontology distinguishes between deep and surface structure[2] representation of reality in information systems. Deep structure conveys the meaning of the real-world system that the information system is intended to model by representing real world things, their properties, states and transformation. Surface structure is concerned with the interface between the information system and its users, and the way the system appears to its users. Table 1 lists the key elements of deep and surface structure, their definitions, and examples of their application to this study.

Table 1. Elements of Ontological Structure

Ontological Construct	Explanation	Examples
Deep Structure		
Thing • Entity or Event (DE)	A thing is the elementary unit in the BWW ontological model. The real world is made up of things. The things can be concrete or conceptual.	Missing health benefit scheme entity, missing counter collection event
Property	Properties must always be attached to things.	
• Property (DP)	A property that is inherently a property of an individual thing is called an intrinsic property.	Need more fields to capture the details of physicians, e.g., rank, specialization, language spoken.
• Relationship (DR)	A property that is meaningful only in the context of two or more things is called a mutual or relational property, e.g., "is part of," "interaction connection."	Inability to retrieve/search fixed asset purchased by PO number, inability to relate new-born bills to mother's account
State (DS)	Vector of values for all property functions of a thing.	Validation routine for national ID # , setting of maximum value for treatment type
Transformation (DT)	Mapping from a domain comprising states to a codomain comprising states.	Inadequate down-payment processing rules, interest computation for overdue accounts, splitting of professional fees
Surface Structure		
• Information Access (SA) • Input Interface (SI) • Presentation format (SP) • Output report(SO)	Interface between information systems and its users	More refined access, establishing automatic screen flow, defaulting input parameter, design of interactive dialogue, suppress inactive fields, upper-case presentation on screen, missing reports, report customization

[2]A third perspective, physical structure, manifesting the nature and form of the technology used to implement the system has been excluded from our study as it deals with the implementation specifics of technology rather than the abstract conceptual assessment of reference models.

Wand and Weber established that for an information system to be stable, its deep structure must represent a "good" mapping between the real world and the information system. Misfits arise when the representational model embedded in the system (the ERP package in this study) does not map well to reality (the implementation context), giving rise to inconceivable or unlawful elements in the context where the system is being applied. Such deep structure misfits are severe because they are complex and costly to fix. They have ripple effects; for example, missing elements (e.g., the omission of counter-collection event) often interact with other elements (e.g., patient's account, deposit monitoring) in reality. The effects even permeate through to the surface structure (e.g., lack of counter-closing report). In addition, the operational consequences of the incomplete representation of a stable component of the reality are likely to be long-term.

The impacts of deep structure misfits are, therefore, likely to be greater. While workarounds may be acceptable for the surface structure misfits (e.g., having the users adapt to the standard report format), the cost of working around deep structure misfits will be very high (e.g., the tedious and error-prone efforts of manually matching records).

3 SPECIFICITY ASSESSMENT OF ERP–ORGANIZATION MISALIGNMENT

While ontological structure is useful in assessing the likely severity of the misfits, it does not provide cues for identifying the sources of these misfits. Misfits arise when embedded practices in ERP do not fit the context of the organization. Technology has embedded assumptions that reflect its original development context. For example, Shields (2001) noted that software packages for firms in manufacturing have specific industry focus. One package may focus on process manufacturers (e.g., chemical) while another focuses on engineer-to-order manufacturers (e.g., aircraft).

The consequences of context mismatches can be severe. AeroGroup, for example, abandoned the implementation of the Apparel Footwear Solution of SAP/R3 because of its inability to model the complexities of the footwear business. Similarly, the failure of Fox Meyer has been partially attributed to the ERP system that was designed more for manufacturers than for wholesale distributors.

Davenport (2000, p. 156) stressed need to clarify "how common is common?" by distinguishing between global and local requirements. Soh et al. (2000) noted that the application reference models embedded in ERP are often designed for a particular institutional context. These models often have implicit country biases (e.g., European countries), sector biases (e.g., private sector), industry biases, (e.g., manufacturing) and even biases in organizational practices (e.g., centralized structure, process-oriented workflow). These dimensions of context specificity are presented in Table 2.

Table 2. Dimensions of Context Specificity

Context Specificity	Explanation	Examples
Pervasive Misfits		
• Country-specificity	The unique regulatory, social or cultural practices within a country	Use of national ID # as patient account #, co-payment healthcare model requires counter collection and down-payment monitoring, bed-class subvention requires greater service pricing and billing features.
• Sector-specificity	The more stringent accountability requirements and the complex procedures for public organizations	Tighter control of fixed asset purchases from approved government/donated/research funds requires greater tracking functionality. Missing health benefit scheme to handle special medical privileges of civil servants.
• Industry-specificity	The unique practices specific to some industry	Inability to allow ward sharing across multiple medical specialties, billing computation to take higher of accouchement or Caesarian fees, additional field to capture source of referral.
Organization-Specific Misfits	The idiosyncratic organizational differences in terms of product complexity, management structure, user preferences, etc.	Patient search by phonetic name, validation routine for diagnosis code, capping of budget limits, missing fixed asset purchase quotation evaluation, layout of performance reports

Often, these misfits arise from some fundamental incompatibilities in the underlying operating models (e.g., state funding model, private vs. civil service structure, service vs. manufacturing industry, wholesale vs. retail business). The severity of the impacts is dependent on an organization's ability to adapt or modify the operating model (be it at the country, sector, industry, or organization level) to align with that embedded in the ERP. The pervasive, organization-specific framework thus provides the contextual cues to assess the severity of misfits in terms of an organization's ability to change the operating model. Exogenous factors arising from country, sector, and industry specificity are, therefore, likely to be more severe than the endogenous, organization-specific misfits. Organizations may be able to adapt organizational structures and processes to the EPR package in order to resolve organization-specific misfits, but they are seldom able to modify the external environment. In addition, the external sources of specificity are often **pervasive** in nature and noncompliance may involve sanctions from regulatory authorities or business partners.

4 THE MISFIT ASSESSMENT FRAMEWORK

Together, the ontological structure and context specificity perspectives enable us to construct a matrix that suggests the severity of misfits (see Figure 1). Where the misfits are deep and pervasive (Q1), they are likely to be severe given the inability to align the underlying operating model and the high cost of repair (complex customization with the need for additional workarounds and compromised performance expectations). The opposite is true for surface and organization-specific misfits (Q4). The framework also highlights two types of misfits that can be severe: organization-specific deep structure misfits, where the complexity in resolving the deep structure misfit (through customization or workarounds) significantly raises the cost of repair (Q3), and pervasive-surface misfits, where the inability to align operating model creates substantial gaps that necessarily amplify the cost of resolution (Q2).

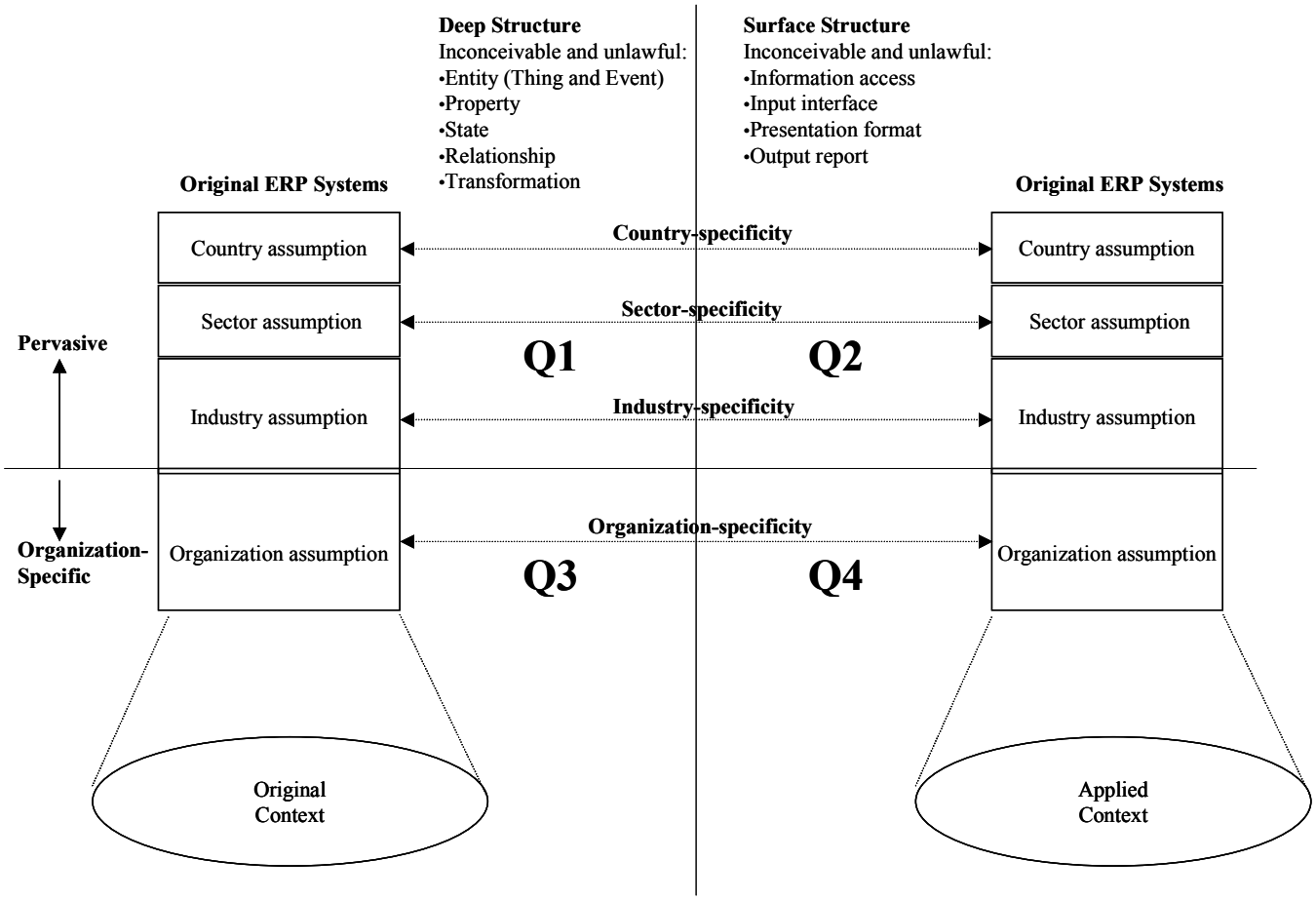

Figure 1. Ontological Structure and Context Specificity of ERP Misfits

The framework offers several contributions. First, it provides a theoretically grounded basis for assessing misfit severity. Our arguments suggest that the more severe misfits (i.e. Q1, Q2, and Q3 misfits) are associated with higher cost of resolution (in terms of the cost of customization, additional workarounds needed, and the compromised performance expectations), and undermine the anticipated benefits of ERP (e.g., improved cycle time, information availability, customer service). The framework also suggests that modules that address less context specific areas such as accounting (governed by international accounting standards) may be less prone to severe misfits that other modules. Finally, empirical categorization of misfits will surface patterns of ontological structure and context specificity. This information will facilitate critical user-consultant interaction during misfit assessment, a process that is hampered by the difficulty in articulating the sticky knowledge (Von Hippel 1994) that resides with the user (context specific knowledge) or the consultant (knowledge of ontological structure).

5 METHODS

We employed a multiple case study approach (three hospitals) with embedded units (multiple ERP modules) to examine the nature and sources of misfits in ERP implementation (see Table 3). The commonality across the three hospitals (same country, public hospitals, same ERP package, same consultant) enables us to identify recurring misfits that were the result of common environmental specificity, i.e., country, sector, and industry. Two embedded units of analysis were selected to provide theoretical variation on context specificity: finance (FICO), where international accounting standards promulgate some degree of global standardization, and hospital management (ISH), where practices vary more depending on the local operational context.

We identified misfits from the formal contracts and requests for change (RFC) up to 3 months after roll-out. This enabled us to exclude trivial misfits as only those reviewed by users and consultants were included in the contract and RFCs. It also enabled us to obtain reasonably detailed and standardized description of misfits. The misfits were independently coded by two researchers (Kappa coefficient of 0.88 for the coding of ontological elements). To analyze context specificity, we compared misfits across all three hospitals and identified as pervasive those that were common to all hospitals. In-depth understanding of the misfits, their sources and organizational impacts were obtained from interviews with project team members (15 to 20 users and consultants per hospital), and review of project files, meeting minutes, and issue logs. Organizational impacts include cost of customization, effort required for workarounds, compromised organizational objectives with regard to cycle time, customer services, information availability, and data accuracy and security.

Table 3. Background of ERP Implementations in the Hospitals

Hospital	Nature	Size	Modules Adopted	Period	Number of Misfits
A	Multi-specialty public hospital	1,500 beds	FICO, MM, HR, ISH (inpatient), ISH (outpatient)	4/97 – 1/99	FICO: 53 ISH (inpatient): 179
B	Multi-specialty public hospital	1,200 beds	FICO, MM, HR, ISH (inpatient), ISH (outpatient)	12/97 – 2/99	FICO: 45 ISH (inpatient): 145
C	Multi-specialty public hospital with special focus on women and children	800 beds	FICO, MM, ISH (inpatient)	12/97 – 6/99	FICO: 47 ISH (inpatient): 131

6 PRELIMINARY FINDINGS AND DISCUSSION

We analyzed the misfits for hospital A. We found that 45 percent of the misfits were deep structure and 26 percent were both deep and pervasive (see Table 4. We also found a fairly substantial number of Q2 and Q3 (13% + 19% = 32%) misfits that were of intermediate severity. This suggests that there was significant misalignment. The assessment is consistent with the negative organizational consequences we noted (cost of customization, qualitative evidence of costly workarounds/compromised objectives[3]). More telling is that, less than two years after ERP roll0out, the hospital is already embarking on a major initiative to scout for a better hospital system.

[3]Not presented here due to space constraints.

OVERALL

	Deep	Surface	Total
Pervasive	61 (26%)	29 (13%)	90 (39%)
Org.-specific	43 (19%)	99 (42%)	142 (61%)
Total	104 (45%)	128 (55%)	232 (100%)

FICO

	Deep	Surface	Total
Pervasive	6 (11%)	14 (27%)	20 (38%)
Org.-specific	7 (13%)	26 (49%)	33 (62%)
Total	13 (25%)	40 (75%)	53 (100%)

ISH

	Deep	Surface	Total
Pervasive	55 (31%)	15 (8%)	70 (39%)
Org.-specific	36 (21%)	73 (40%)	109 (61%)
Total	91 (51%)	88 (49%)	179 (100%)

Table 4. Overall Severity Assessment of Hospital A Misfits

The findings also confirmed the expected pattern of misfit severity across modules. FICO manifests fewer overall misfits (53 vs. 179) as well as a lower proportion of deep structure misfits (25% vs. 51%) than ISH. The results show that standardized modules are ontologically more complete as the sharing of a global view of reality has ensured the inclusion of most ontological elements. However, the proportion of pervasive misfits across the two modules seems comparable (38% vs. 37%). Context specificity issues appear to permeate through all modules, probably due to the integrated nature of ERP. Hence, consideration of context specificity remains important even for the adoption of a so-called "standard" ERP module.

6 PLANNED ANALYSIS AND POTENTIAL CONTRIBUTION

We will demonstrate how the framework is used to assess the extent of package-organization misalignment by analyzing the misfits across the three hospitals. Comparisons across the hospitals will provide insights into the sources of pervasive misfits and the nature of deep structure misfits (e.g., the common ontological issues that require closer attention). Comparison across modules will demonstrate that ERP packages are not monolithic with regard to package-organization alignment, but can differ depending on the module. On a more exploratory basis, we also plan to examine the specific organizational impacts arising from the different types of misfits.

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