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Managerial Understanding as Data Integration Technology

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Introduction

Management support increasingly requires access to multiple organizational and external data sources and the ability to compare, contrast, and combine the data these sources contain. It is often the case, however, that the underlying systems are inconsistent or heterogeneous along several important dimensions. This inconsistency or heterogeneity complicates the task of meaningfully incorporating data from multiple sources into a common analytical framework.

We characterize most of the past research on data integration (DI) as *technology-oriented.* It takes the view that the data management system (the hardware, software, and data model) itself shoulders the responsibility for resolving heterogeneities in order to bring about *seamless integration*, so that what users see is, or has the look and feel of, a single, homogeneous data source.

In addition to the technologically-oriented research on DI, there is an emerging body of what we characterize as *organization-oriented research on DI*, where the objective of seamlessness or total integration is questioned. Examples of this perspective include Litwin (1986) who argues that, in real-world organizations, the very existence of heterogeneous semantics implies that there exists no integrated value capable of meeting all users' needs. Goodhue et al. (1992) argue that total integration is exceedingly difficult to achieve, and that attempting to do so can result in an inadequate representation of a complex organizational reality. They propose that "partial integration" be the desired objective. Heiler et al. (1991) also support the idea of making certain inconsistencies visible to users and argue that partial integration represents those "practical" levels of integration attainable in organizations. Wang and Madnick (1990) provide examples of users who prefer to see multiple versions of the same data from different sources and who use *their* knowledge of the source to arrive at a single, "integrated" response. Kanter (1983), and Quinn (1980) have all found that the tension created by differing, often inconsistent, perceptions of events and objects is one characteristic of "excellent" companies. This tension is diminished to the extent that systems hide, eliminate, or in other ways make "seamless" the user's view of data in organizational systems.

Objective

In the technology-oriented research on DI, the notion of seamlessness assigns responsibility for resolving heterogeneity to the design of the data itself (standards) or some component of the data management software (mapping). In this framework, the user is viewed as a passive recipient of totally ("seamlessly") integrated data. Dis-integrated data are assumed to have little value, to lead to incorrect decisions, or will paralyze managerial decision making.

In contrast, the notion of "partial integration" implies that users have a role as active components of the organization's DI technology and share responsibility with the data design and the data management software for resolving inconsistencies.

For organization-oriented researchers, and for users themselves, the fact that users can, and indeed often must, serve as a DI technology is obvious. However, this fact is not obvious and rarely even acknowledged in the technology-oriented research on DI.

Because the predominant research perspective on DI is overwhelmingly technological in its orientation, there is a need to document and explain further how users play active roles as data integrators and to expand the focus of traditional DI research from just a technological orientation to include an organizational orientation.

Hence, the organization-oriented research on DI examines technological solutions as well as the organizational mechanisms that support or result from those technological solutions. Organization-oriented DI research does not oppose, but rather complements, technology-oriented DI research and re-affirms a classic conception of information systems as being composed of not only hardware, software, and data, but also personnel and procedures (Davis and Olson 1985 p. 53).

Research approach: Interpretivism

Information systems research has been giving increasing attention to interpretive research approaches (Baroudi and Orlikowski 1991; Lee 1991; Orlikowski 1993; Lee 1994). In contrast to traditional positivist approaches, interpretive approaches account for the meanings and understandings that the observed people (e.g., subjects observed in an experiment or managers observed in a field study) have about themselves, their situation, and the organization around them.

In this study, we interpret a real-world situation involving the use of a database *not* for what it would mean to a data analyst or systems designer, but for what it actually means to the database user herself, a manager named Carmen at a university accounting office. We videotaped and transcribed an interview with Carmen. Whereas in all field work the specifics of Carmen's situation itself can never be replicated, we believe that our research *findings*, like all scientific findings, can and must be offered in a way such that another researcher can attempt to replicate them. To make this possible, we have made available both our transcript data and our step-by-step interpretation of the data. This will allow other researchers to perform studies in comparable ways, where their findings could then serve the scientific function of corroborating, refuting, or otherwise building on the current study.

The Case Data

Urban MidSized University (UMU) offers programs in the liberal arts, sciences, and professions. It has approximately 30 years of experience with computerized administrative systems. The student accounts office is part of the general university accounting office. It is responsible for student accounts, including assessing student tuition, insurance, and user fees as well as crediting student accounts through individual payments, grants, fee waivers, and various other payments to students.

The university fee structure is determined by local government regulation and varies with academic program, class standing, and immigration and citizenship status. Eligibility for and amounts of various student financial assistance are also determined by these factors. Although rules governing tuition and fees are relatively stable, rules governing financial assistance change quite often. In addition, students drop or add courses, change immigration status, and incur various fees and fines on a regular basis, all of which can affect the amount of financial assistance for which they are eligible.

In addition to determining the current balance of student accounts, the student accounts office must ensure that fees are correctly charged and that any changes in student status or enrollment are reflected in these balances. The consequences of not respecting these rules include unintentional over- or under-billing of student accounts, disbursing undeserved fee reimbursements, and improperly applied fines and service fees. Improperly disbursed financial assistance is ultimately charged to the budgets of departments or individual researchers by external funding sources.

To ensure that accounts balances are correct, managers in the student accounts office work closely with the university registrar's office and rely heavily on data from both accounting and registration systems to

perform their job. The data in the student accounts office are far from being seamlessly integrated. Although some data standards exist (student and course numbers), the systems have different interfaces, define data in different ways, and provide no support for data dependencies. UMU's central administration is considering replacing the entire student records system at a projected cost of over $5 million and four years.

An Instance Where 4,290 = 3,100.93

We provide one instance from our interview with Carmen. In this instance, an internal funding form indicated "4,290" as the amount that the department was awarding to a student, but Carmen responded by processing the "4,290" and changing it into "3,100.93."

I happened to catch it on time. [Carmen turns to a paper form for this student.] *See here, the department put down for the deposit, 4,290. I go into his account -- this was the fall of last year.* [Carmen points to a field on the monitor.] *The fees came out to 3,853.93. What they were trying to do was pay this, plus health insurance. Which is $440 for health insurance. Which comes out to 4,290. So they have the right concept. They're telling me they're paying the whole fees. So I look and, OK, that sounds good. Now in the meantime, while I was processing this, I notice* [Carmen changes screens to another systems and points to a field on the monitor] *that this student got a partial fee waiver. You see that? 753 credit. So I couldn't possibly do 4,290. He also got exempt from health insurance.* [Carmen points to another field on this monitor.] *International health insurance, zero. He's not paying 440. He got 753 credit. So what I did I took this amount* [Carmen points to a field on the paper form for this student] *and I reduced it to 3,100.93.*

In all, I have to come out to 3,853. [She points to this number appearing in a field on the first system's monitor]. *That's what my goal is.* [Carmen points to different parts of the two screens.] *So I reduce 440* [the exact figure is 436.07] *from this* [that is, from the 4,290]*, I put in 753, and* [she points to the paper form] *the department I just took from their account $3,100. So we're saving -- I mean, I would have taken out 4,290. Instead, I only took out 3,100.93... coming out of their research account.*

In explicitly drawing attention to "3,853" as her goal and in walking us through her processing, Carmen revealed her use of several related (perhaps, hierarchical) rules-in-use concerning international tuition, health insurance, and fee waivers.

Through her accumulated experience in the UMU student accounts office, Carmen was able to develop these rules-in-use and, perhaps more importantly, apply them correctly to a dis-integrated and inconsistent set of data. From the University's perspective, she was able to do this correctly, instantly, and at a low cost relative to the development of an integrated student accounts/registration system. Although the university will eventually replace its legacy systems, its short term decision has been to spend relatively small amounts of money to support increased communication and coordination among the human actors involved in determining and applying rules for student accounts and relying on these human actors as an active component of its data integration technology.

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