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ERP Usability and the Mangle of Practice: Improving Work Processes and Employee Performance

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ABSTRACT

After investing billions of dollars in their ERP implementations, many companies have continued to struggle with system inefficiency and user dissatisfaction. This paper aims to redefine ERP usability through the lens of sociomateriality and the related concept of the mangle of practice. Presenting research on agencies and assemblages derived from ERP system utilization, we conduct a content analysis of 50 interviews with ERP users to explore how material agencies are not pre-given but emerge temporally in practice through a dialectical process of resistance and accommodation. The insights gained from this research may offer a better understanding of the agency of ERP systems, their users, and the interrelated attributes of this assemblage. This approach may be particularly valuable in researching the expansion of management knowledge related to ERP best practices in everyday organizational life.

Keywords

ERP, ERP usability, sociomateriality, performativity, shared collaboration, user satisfaction theory, assemblages, mangle of practice.

INTRODUCTION

Many companies around the world have invested significant material and human resources in ERP implementations, only to realize major implementation and process misalignments, resulting in serious user backlash and requiring considerable customization to bandage the problem. Despite companies investing billions of dollars in ERP services and software licenses over the last two decades, most systems continue to be woefully inefficient, with very low levels of end user satisfaction. Research has shown that this dissatisfaction is directly related to poor user interface design and inaccessibility of data for meaningful business reporting and decision making.

This paper aims to reflect on and redefine ERP usability through an alternative lens—that of sociomateriality. We contend that this approach may be particularly valuable in researching the expansion of management knowledge related to ERP best practices in everyday organizational life, especially in application to business management and information technology professionals.

Over the last three decades, research in computer system usability has ranged from the user satisfaction theory to the collaboration theory, with focus on discrete entities such as users and systems. Through the lens of sociomateriality and the related concept of the mangle of practice, this paper explores how material agencies are not pre-given but emerge temporally in practice through a dialectical process of resistance and accommodation (Orlikowski and Scott (2008)).

Following critical review of these organization theories, we present research on agencies and assemblages that temporally emerged as a result of ERP system utilization. The insights gained from this research may offer a better understanding of the agency of ERP systems, their users, and all of the interrelated attributes of this assemblage.
User Satisfaction: Discrete Entities

In the stream of work focused on user satisfaction, technology is treated as a specific and relatively distinct entity that interacts with various aspects of the organization.

The key trend in user satisfaction research, from the perspective of discrete entities, is that studies began to reflect on multiple factors affecting human-computer interaction, such as content, accuracy, format, ease of use, and timeliness (Doll and Torkzadeh, 1988). Therefore, more reliable measures of user information satisfaction (UIS) started to emerge, especially in the area of collecting and interpreting UIS scores. However, these metrics started to signal possible issues with a user satisfaction-centric viewpoint (Galletta and Lederer, 1989). For example, a user would score well in terms of user satisfaction, but there were no meaningful insights into how much the user had to accommodate the various intricacies of ERP system interaction.

The user satisfaction perspective puts the focus of ERP usability squarely on the computer system capability (e.g., does the system provide the precise information that the user needs?). However, this scope overlooks entirely the actual interplay, or the “give and take,” between user and system, including the level of user and system accommodation and the level of pain that a user would be willing to experience before resisting the system usage. Therefore, a broader lens is needed to expand this idea of human-system collaboration.

Collaboration: Mutually Dependent Ensembles

Research on collaboration has focused on the dynamic interactions between people (or organizations) and technology. These interactions and outcomes are seen to be mutually dependent, integrative, and co-evolving over time.

Collaboration is defined as “the collaboration between the user and the computer, as opposed to between users” ((Babaian, Lucas et al. 2004). Collaboration theory proposes a shift in emphasis from human-computer interaction to human-computer collaboration, the “give and take” between user and system (Grosz 1996). According to this theory, the strength of the shared cooperative activity (SCA) depends on the interaction of the following properties that ultimately determine a system’s usability (Bratman 1992):

- Commitment to joint activity—how each party in the interaction commits to the joint activity and is aware of the context surrounding their collaboration;
- Mutual responsiveness—how each party responds to the intentions and actions of the other by adjusting his/her/its own behavior based on the behavior of the other party;
- Commitment to mutual support—how each party is committed to supporting the efforts of the other party when that party needs help, including ability to recognize the need and provide the assistance.

In the early 2000s, Babaian and colleagues (2004) set forth collaboration theory as a potentially beneficial way to conceptualize the relationship between user and system, and to provide a foundation on which interfaces that enhance user performance and satisfaction with ERP systems could be developed. This was one of the first applications of Bratman’s theory, applying it to moving from a computer user satisfaction model to a collaborative view of human-computer interaction. Babaian et al. (2006) focused on critical aspects of usability design guidelines while positioning these aspects in the context of the collaborative approach, which provided practical considerations to human-computer interaction design.

Sociomateriality: Assemblages (Resistance and Accommodation)

Sociomateriality is a recently emerging theoretical perspective in the study of technology and organizations (Orlikowski 2007). When this lens is applied to usability research, the focus is transferred from discrete entities such as users and systems to a user-system composite in which the boundaries are blurred to the point of a single agency emerging as a shifting assemblage (Orlikowski and Scott 2008). The sociomaterial lens draws together concepts from studies in the sociology of science, technology, and organizations, including actor-networks (Callon 1986), the mangle of practice (Pickering 1993) and performativity (Barad 2003). Underlying the sociomaterial perspective is the premise that humans (or organizations) and technology exist only through their temporally emergent constitutive entanglement, which is calibrated by the duality of resistance and accommodation.

In actor-network theory, no distinction is made between the social and the technical. Rather, social and technical elements align in an actor-network to achieve particular effects (Law, 2000). Therefore, when considering how ERP systems are used in practice, one recognizes that what is done is the temporary outcome of an alignment of social and material actors, including the interface and its designers, databases, accounting methods, and corporate and human resource policies.
Similarly, according to the concept of the mangle of practice, emergent human and material agencies reciprocally engage by means of the dialectic of resistance and accommodation (Pickering 1993). Considering entanglement in the context of an ERP production system, one can visualize how a constant series of accommodations to ERP transaction processing and all of the various activities surrounding these processes, coupled with general computer system requirements and resistance to these very same requirements and processes, are mangled or deeply intertwined. This entanglement provides the basis for analyzing the holistic ERP usability experience.

The notion of performativity draws attention to how relations and boundaries between humans and technologies are enacted in practice. In the ERP user-system entanglement that is determined by accommodation and resistance, performativity defines relations and boundaries of how practicing people think about resistance and accommodation parameters (Barad 2003). Thus, performativity refers to the practices associated with implementing processes, as determined by the entanglement.

Essentially, performativity begins with instigating innovation by sharing ideas, best practices, and experiences with ERP users, leading to the final acceptance of an idea (e.g., an innovation on an existing order entry system process). Since technology and contemporary work practices saturate each other, further efforts to theorize practice must encompass technology in organizations (Feldman and Pentland 2003). Although we acknowledge the importance of performativity in the context of ERP usability, the scope of this paper focuses on the sociomateriality aspects as they relate to entanglement, resistance, and accommodation. Future research will incorporate more discussion on performativity.

Sociomateriality relies on a view of the world in which everyday practice is configured and re-configured by multiple meanings and materialities (Suchman, 2007). An example of this is a customer service agent’s cubicle, the person’s physical hub of work practices composed of an array of materiality, including order-entry processing manuals, post-it note reminders, directory pages pinned to the cubicle wall, hand-written notes for ERP system processing shortcuts, and, of course, a computer system, a monitor, and a local phone/fax system. All of these components are entangled to form an assemblage, ready to be actively configured into a situated, ERP-based order-processing work performance.

**The Value of Sociomateriality**

An important challenge for research going forward is developing ways of addressing the social and material worlds as inseparable or constitutively entangled (Orlikowski and Scott 2008). Sociomateriality-based studies can enable researchers to find ways to bring to the foreground patterns within the constitution of everyday work practices.

Leonardi and Barley (2008) suggest that a continuing problem faced by researchers in building theory about the relationship between information technology and organizing is associated with conflating the distinction between material and social with the distinction between determinism and voluntarism. That is, that studies of technology-induced change largely imply material determinism and this perspective is countered by researchers championing an idealist and voluntarist point of view in which humans exhibit agency. They argue that “tilting” toward either determinism or idealism creates epistemological and ontological difficulties in which the degree of agency and constraint that occurs within the entanglement of the material and the social cannot be precisely understood. They suggest that in order to address this problem, researchers should broaden the range of technologies chosen to study, focusing on both the development and use of technology, and explore why different organizations experience similar outcomes with the same technology (Leonardi and Barley 2008). Sociomateriality-based studies can enable researchers to find ways to bring to the foreground patterns within the constitution of everyday work practices.

A sociomaterial lens may be particularly valuable in researching the expansion of management knowledge in everyday organizational life. The expansion of management knowledge in an organization marks the escalation of specific sociomaterial techniques, such as ERP, into packages of ideas, technologies, and management recipes that spread until they attain the status of commonly espoused or “canonical” practices or are recognized as best practices. Research into the specific link between sociomateriality and ERP usability is relatively nascent, although work published by (Wagner, Newell et al. 2010) placed particular focus on “recovering” a troubled ERP system after going live, as opposed to analyzing the pre-go-live blueprinting and configuration phases of ERP deployments. Sociomateriality is inseparable from these formulations of management knowledge, their implementation, and their capacity to adapt to different environments (e.g., countries, organizations). Salient research questions would be how particular, inherently sociomaterial organizational forms pattern practice, as it relates to ERP system usability, and what value may be derived from understanding the implications of ERP usability through the lens of sociomateriality.

This research paper investigates the aforementioned challenges and the question of how resistance and accommodation interrelate in given ERP use-case scenarios. Given the nature of complexities associated with the ERP system user interface, program logic, and workflow, exploring the questions related to the breadth and depth of both resistance and accommodation should provide a basis for better understanding how to ameliorate the consequences of resistance and accommodation that
ultimately lead to greater ERP user acceptance and overall ERP system usage. This research is being conducted to gain a broad contextual understanding of the overall impact of resistance and accommodation on ERP usability across a spectrum of personas and ERP functional areas. The intent of this research is to pay attention to not only what specific ERP users can execute, but also what obstacles ERP users experience and, most importantly, what workarounds they implement to accommodate these obstacles. Particular attention is given to materiality’s relevance while focusing on transformative ERP usability technologies. In line with (Leonardi and Barley 2008), this research also views ERP usability through both development and usage lenses. Following this initial phase of data gathering, interviewing, and analysis leveraging content analysis tools, a second phase focusing on a particular functional area and persona would potentially provide even further insights into selected assemblages, where resistance and accommodation boundaries could be analyzed in further detail.

RESEARCH DESIGN

The research presented in this paper was based on a series of interviews with ERP users. The data was collected over a 3-month period and involved one-on-one interviews with 50 ERP users from various industries in North America and Europe. The interviews were conducted with a range of ERP user types, including line of business management and staff, information technology management and staff, and ERP administrators and programmers. Each interview lasted approximately 30 minutes. The interviews were recorded with a handheld device and transcribed for further analysis.

Four topical areas where explored in every interview:

1. Describe your roles and responsibilities as they relate to your ERP environment.
2. How is your ERP technology infrastructure currently implemented in terms of modules installed, versions, and overall configuration?
3. Where are you currently experiencing ERP usability challenges as they relate to your organization?
4. What current ERP business processes are you now engaged in implementing, updating, or evaluating for enhancement?

Some examples of the challenges presented by the interviewees are highlighted in Table 1.

<table>
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<tr>
<th>Industry</th>
<th>Key ERP Usability Challenges—Excerpts from Interviews</th>
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<tr>
<td>Government</td>
<td>“Our number one goal is to optimize business processes (e.g., reduce data entry).”</td>
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<tr>
<td>Consumer Goods</td>
<td>“A major challenge is ongoing pricing maintenance. There are constant changes going on all of the time. Doing this manually is not possible.”</td>
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<tr>
<td>Manufacturing</td>
<td>“We don’t need to cut down the employees here, but we do need to cut down on the data entry time and leverage our employees in doing more operational improvement tasks.”</td>
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<td>Services: Professional Retail</td>
<td>“The big challenge for us, in particular the finance team, headed by myself, is handling the entire vendor master setup, trying to streamline this process.”</td>
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<tr>
<td>Manufacturing: Consumer</td>
<td>“Journal Entry Management had some templates to put the journals in and then use legacy system migration workbench tools. I was never able to accomplish this process.”</td>
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<td>Manufacturing: Telecomm Government</td>
<td>“The first process we wanted to resolve was the goods receipt/invoice receipts (e.g., ideally ship the goods; goods receipt; do inventory; bill shows up and is paid by accounts payable). We have 25,000 line items in two different company codes.”</td>
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<tr>
<td>Manufacturing: Telecomm Government</td>
<td>“Part number creations for everything we buy internally and externally—currently numbering 170K codes in our ERP system and adding to this on a daily basis.”</td>
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<td>Manufacturing: Telecomm Government</td>
<td>“We are looking to automate as much of the data entry processes as possible. We need to stop duplication. We don’t want to use any paper. Our logged changes currently are running at 45-50%; we want to get this to 80%. Our candidate process improvements include: 1. Rolling out the new payment system now for managing payments for managers; 2. Personnel actions—hiring, leave of absence—requests, approvals, reporting after the fact; 3. Organization changes—researching how to deal with this.”</td>
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Table 1. ERP Usability Interview Excerpts

The interview transcripts were processed by Leximancer, a content analysis software tool that searches for context and meaning within texts and assists in understanding how these concepts change over time. The program analyzes documents, identifying key concepts by assessing the relative contextual coefficients of words through metrics such as co-occurrence,
position, and frequency of key text (Kamimaeda, Izumi et al. 2007); (Young and Denize 2008). The tool suggests clusters of meaning based on word groupings (Crofts and Bismar 2010) and provides methods for analyzing knowledge pathways—the linkage and weighting of a chain of concepts. This tool was used to analyze the aggregated content of the textual interview documents and then to display the extracted information visually, using a concept map. The concept map (Figure 1) displays the main concepts in the text data and depicts the relationships among concepts resulting from the consolidation of 50 ERP user interviews. Using the concept map, we developed the research questions and performed a directed search of the text.

The use of the content analysis tool also enabled us to identify significant knowledge pathways. A knowledge pathway displays and describes the most likely relationship chain between two concepts identified by the content analysis tool. The relationship between a series of concepts is best thought of as correlations, though the text segments describing the relationship may define a direction for cause. For this research design, we analyzed the knowledge pathways by identifying the links between two concepts—“SAP” and “usability”—to gain further insight into the relationships of associated concepts and by weighting each of the associated concept’s contribution to meaning.

RESULTS

An “SAP-Usability” knowledge pathway was created from the analysis of 50 interviews with ERP users. This particular knowledge pathway was of key interest to the research interviewees, as the premise of the interviews centered on the users’ roles as related to SAP, their perceptions about the usability of SAP, their key processes, and the processes that they were considering to optimize to improve SAP usability. The selected knowledge pathway traversed the following concepts: SAP, data, things, business, process, stuff, challenges, and, finally, usability. Specific correlations between pairs of concepts in the pathway were examined, and contribution weightings were determined for each linkage.

The premise for this analysis relates to the published work of Orlikowski (2007), in which the author stated that “the challenge for organization scholars is to figure out how to take seriously the recursive intertwining of humans and technology in practice.” The results from the interviews and related content analysis exemplify the very nature of recursive intertwining, as demonstrated by the resistance and accommodation of human-ERP system interaction in the context of “SAP-Usability.”

Figure 1 illustrates the “SAP-Usability” knowledge pathway in a concept map and highlights the variety of concepts resulting from the interviews conducted with 50 ERP users. The content analysis tool provided a holistic ability to navigate selected concepts, helping to quickly visualize pathways to see where stronger concept correlations existed. The concept map provides various levels of granularity related to over 50 concepts, detailing linkage, count, and relevance by concept. The map depicts the relative strength of a concept by the size of the concept bubble. The colors indicate relative degrees of “hot” and “cold” (red to blue), with the hotter concepts having higher degrees of relevancy to other concepts than the cooler concepts.
Table 2. | Concept Links | Contribution Weighting | Text Associated with Concept Links | Relationship to Sociomateriality, Performativity, and Mangle of Practice |
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<td>SAP to Data</td>
<td>0.03</td>
<td>“The sheer idea of having a data dictionary that provides you with a detailed understanding of the critical SAP table structures and relationships and attributes and so on... It’s a great tool for extracting production data and scheduling it and not impacting production and security.”</td>
<td>The concept analysis tool highlighted 8 interview quotes in which the concepts “SAP” and “data” were discussed. The statement “having a data dictionary that provides you with a detailed understanding of the critical SAP table structures” exemplifies the role of performativity, with ideas for process usability enhancements brought forth by the user during the interview.</td>
</tr>
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| Data to Things | 0.01                   | “We started in the packaging group on enhancing not only just the ERP system but our business processes in general. Along the way, we did some things like rolling out a shop floor data collection programs, strictly ERP-based, just modifying the screens.” | The mangle of practice is implied by how the interviewee describes not only enhancing the ERP system usage but also the overall packaging business processes, highlighting the mangle of ERP system usage, packaging processes, and shop floor data collection screen modification. Further analysis would
likely reveal additional components of the assemblage, including system upgrades, hardware modifications, training, and documentation.

The 4 interview quotes identified for this concept pairing revealed that “things” tend to encompass items beyond the baseline ERP system. For example, a discussion about the usability challenges associated with integrating handheld devices with the business process and the ERP system ended with this comment: “It requires manual intervention from our employees to get things sorted out.” With many affected components, using the term “things” appeared to be a quicker way to describe an overload of usability challenges resulting from the use of wireless devices in the warehouse environment.

The contribution weighting of this concept pair is several times more significant than that of the 3 prior concept pairings. From the analysis of the 6 identified quotes, “business” and “process” appeared to be very tightly correlated, implying significant importance to the interviewees, as is evident in this statement: “I do a lot of testing, training, identifying functional change…working with the business to solve problems, to put business process into SAP the way they need it to be.” Only one quote had “stuff” linked to “process,” resulting in insignificant correlation. This interviewee highlighted the mangle of practice in describing how a system enhancement to production planning requires his expertise not only in the material master data process but also in assisting the engineering planners in understanding the impact of this enhancement on “stuff” (i.e., other business processes, the ERP system, users, etc.).

A total of 5 quotes were highlighted for this concept pairing. While an insignificant correlation was observed, it still implied a linkage to challenges and ultimately to usability. The following quote highlights the delicate balance between accommodation and resistance and the resources required to address resistance (e.g., creating new innovations that enable better user system accommodation): “I suppose the challenge is to be able to maintain what you’ve already built while still being able to innovate and create new stuff.”
Challenges to Usability  | 0.53
---|---
“I think that’s where the challenges we are facing currently lie, including how European countries are going to restructure, the types of VAT that are increasing, and that additional countries are now going into [using] euros. I think those business issues are the ones we are at the moment hassling with in terms of our ERP system.”

This concept pairing had the highest correlation weighting, with 8 interview quotes supporting the significance. These tight correlations indicate a very high association of SAP with “challenges” and “usability,” as well as an array of practice entanglements: “We face other challenges where we deploy SAP”; “The challenges we face are now with European countries going through restructuring”; “To understand the pain points, where we have usability issues, process issues, SAP issues...”; “The training challenges...of users who come to SAP very new...”; “I know SAP executives acknowledged 10 years ago that they have a real usability challenge.”

Table 2: Concept Links Identified in the “SAP-Usability” Knowledge Pathway

DISCUSSION

Our research question focused on the depth and breadth of resistance and accommodation that exist in ERP system usage. The results from the ERP user interviews and related content analysis focusing on specific knowledge pathways revealed extensive accommodation and resistance to ERP system usage. Some examples of resistance and accommodation discovered via the research included developing additional screens to enhance system usability, changing business processes to accommodate ERP system processing, “going back to the drawing board” as a result of ERP system upgrades, mapping business processes to the ERP system process, and managing master data while training others to accommodate changes to engineering material planning.

The results pointed to a number of encountered ERP usability challenges, ranging from master data maintenance challenges to a myriad of challenges related to functional business processes, such as hire to retire, procure to pay, order to cash, and financial period close. The data from the interviews and the resulting analysis provided a means to distill ERP usability cases into five distinct areas of ERP usability challenges: data entry, data workflow, data integration, data maintenance, and data migration. In future research, analyzing sociomaterial assemblages in the context of each of these use cases, and uncovering their similarities and dissimilarities, could prove helpful to identifying areas of key value for the ERP usability focus.

Approaching the research with the idea of sociomateriality (e.g., interpreting resistance and accommodation in the mangle of practice) provides a holistic view of a business process (Pickering 1993) well beyond simply counting keystrokes or taking a survey. Understanding the entire workflow—the phone calls to interpret the transaction, the rekeying of the order fax, the look up of a code in a 3-ring binder on a desktop, etc.—gives the researcher far more contextual meaning to ERP usability and, therefore, the ability to identify a number of approaches to lessen the resistance and the associated accommodation in a given business process.

In our work and research as outlined in this paper, we found that sociomateriality relies on a view of the world in which everyday practice is configured and re-configured by multiple meanings and materialities (Suchman 2007), and that without an understanding of this worldview bettering any business process would be fruitless. By engaging with a sociomaterial worldview, eliminating resistance and accommodation may increase the capacity for ERP system users and enhance their ability to leverage work time with more meaningful and strategic activities.

The central premise of sociomateriality is that humans/organizations and technology are assumed to exist only through their temporally emergent constitutive entanglement, which is calibrated by the duality of resistance and accommodation. Therefore, it is valuable to consider all elements of a given assemblage for the user and the system. By viewing the assemblage holistically, one would able to break it down into discrete components, fine-tune those components, and rebuild them into a more efficient assemblage.

CONCLUSION

Viewing the challenge of ERP usability through the lens of sociomateriality provided us with a broader and deeper contextual view of the issue. The perspective of sociomateriality enabled us to gain a wider understanding of how assemblages work to resist and accommodate each other. Leveraging the mangle of practice, we have begun to explore how material agencies are
not pre-given but emerge temporally in practice through a dialectical process of resistance and accommodation. By better understanding the mangle of practice, both line of business and information technology management will be better positioned to address the entire business processes and, therefore, derive accelerated benefits from their ERP infrastructure.

Future research in sociomateriality should further explore the role of performativity as it relates to teasing out accommodation and resistance practices in ERP usability assemblages. This research should include quantitative analysis of resistance and accommodation levels related to pre- and post-process ERP usability innovations and statistics associated with the various sub-processes that make up the assemblage.

REFERENCES


