The Messy Details: Insights From the Study of Technical Work in Healthcare

I. Introduction

A. Tensions Between the Universal and the Particular

The test of a study of cognitive work in context is: did you discover the significance of small details? The catch is that most details are not significant.[1] This ironic circumstance captures the tensions in the study of technical work [1], [2]: one must be immersed into the details of technical work in order to see the deeper adaptive dynamics. However, it is very easy to get lost in the many specific details of significant work settings. To avoid getting lost in the details of a particular setting, some investigators would remain on the surface and substitute tabulations that are gathered at a distance for authentic contact with the actual conduct of technical work. However risky and messy it is for the researcher, contact with the details of work is necessary. This is not simply in order to overcome limits to authenticity. This is because, even though they transcend any specific domain, the regularities of cognitive work can be discovered only through examination of the details of the specific settings to see how these patterns play out [3], [4].

The study of complex settings is messy because the work there changes as people adapt to varying degrees and types of pressure. Healthcare is a set of domains that undergo organizational and technological change [6] as a result of pressure for greater economic efficiency, improved patient safety, and broader access to care [7]. The system of care at different levels adapts in order to exploit new capabilities and to work around complexities [8]. Studies of technical work need to capture the interactions in this dynamic and adaptive process. The study of cognitive systems in context is fundamentally a process of discovery. Through it, the researcher learns how practitioners adapt their behavior and strategies to the various purposes and constraints of the field of activity. As a result, studies of technical work must cope with a basic constraint on the discovery of how a complex system functions. To paraphrase Orville Wright on discovering the secret of flight: "doing a cognitive task analysis is like trying to learn the secret of a magic trick: once you know the trick and know what to look for, you see things that you did not notice when you did not know exactly what to look for" [1].

Another basic difficulty arises and is captured by the law of fluency in cognitive systems: "well adapted cognitive work occurs with a facility that belies the difficulty of the demands resolved and the dilemmas balanced" [9]. Field studies shape the conditions of observations in different ways. The researcher looks underneath current practice to see what it has adapted to and how changes reverberate to transform roles, judgments, difficulties, strategies, and vulnerabilities [6], [8].

Operators—those who work at the sharp end of an organization—create success in work through their efforts to manage the messy details. As they confront different evolving situations, operators navigate and negotiate the messy details to bridge gaps and to join together the bits and pieces of the system. Operators do this job so well that the adaptations and effort disappear to outsiders and insiders alike. Outsiders' attention is captured by more exotic aspects of the setting, and insiders come to view these adaptations as simply the everyday nature of the work [12]. Technical work studies, such as the ones in this issue, deliberately and carefully uncover and disentangle these conflicts and uncertainties in order to understand how operators cope with such complexities.

B. Messy Details

The studies in this special issue on technical work in healthcare ride the above tensions between the universal and the particular in studying cognitive work in context. Until recently, most of the human factors "looks" into healthcare have been "one offs." These brief forays serve to whet the appetite, but never actually produce a satisfying meal. Healthcare does not have a tradition of looking closely at the human factors. There is neither an established repertoire of experience on which to draw, nor a stable source of funding. The knowledge and skill of physicians, nurses, and pharmacists is arcane. This is partly because the machinery about which they are expert is not manufactured in the traditional sense but is instead assembled *ad hoc* to fit each procedure's unique needs. Just getting inside these worlds of work is difficult. Healthcare professionals have highly developed masks that they can adopt when dealing with "outsiders." The intergroup relationships between physicians, nurses, pharmacists, and between organizations, are complex, tense social webs, and researchers must take great care to avoid alienating one or another group. Concerns about privacy and the ever present threat of becoming embroiled in litigation further complicate research efforts.

All of these obstacles are overwhelmed by the complexity of healthcare work itself. In every domain, the Law of Requisite Variety ensures that the complexity of technical work corresponds with the underlying domain complexity [10]. However, healthcare is, to coin a term, hypercomplex when it is compared with other domains. The healthcare system's complexity and variety are driven by four factors: 1) the complexity of human physiology and the variety of disease; 2) the historical primacy of healthcare work as a human activity; 3) the recent explosion of biotechnology and medical knowledge; and 4) by the scale of the endeavor itself, which dwarfs all other activities in which human factors professionals have been engaged.

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[1]From D. Woods' presentation to the Workshop on Cognitive Task Analysis, NATO, and Office of Naval Research, Washington, DC, October, 1997.

Confronted with an unruly domain, human factors experts may bound their work by focusing narrowly on a particular device or aspect of a procedure. This is an efficient way to bring human factors expertise to bear. Deliberate myopia may help to produce fine-grained precise improvements, especially in those domains in which human factors involvement is mature and models of the relevant cognitive work are more developed. Nuclear power plant control rooms are an example. However, this approach can also produce a nearsighted view that misses key aspects of how adaptations make technical work *work*. This approach may also obscure more than it reveals. Healthcare is really a group of domains where complexities commingle. Technical work here is based on the knowledge of illness and response, as well as a host of details about how to get things done, where things happen, how they can be configured, what is likely to happen, and, most of all, how to make what is needed happen and happen *quickly*. Those who are unfamiliar with this setting may perceive these as messy details. However, they are actually the fabric of technical work in healthcare [11], [12]. A primary function of technical work studies is to make these messy details visible and, if possible, amenable to intervention. Rather than excluding the messiness by bounding it out of the research, *technical work studies take the messiness itself as the object of study*.

II. Technical Work in Healthcare

The papers in this special issue cover a wide range of topics, use different methods of investigation, pursue different lines of inquiry, and yield different sorts of insights. The papers show some of the many ways that human factors researchers can study technical work in healthcare. The collected results of these studies offer powerful insights into technical work performance and performers. The studies can serve as a set of benchmarks because they are carefully calibrated, densely packed, methodologically sound descriptions of the technical work of healthcare. Such benchmarks are essential to plan, conduct, and interpret the results of experimental interventions that are directed at patient safety improvements.

The papers demonstrate how to employ concepts about cognitive work in order to better understand specific healthcare settings where success depends on the combination of different kinds of expertise [13], [14], where different groups need to communicate as events occur and situations change [15]–[17] where many artifacts are clumsy [18], [19], where there are different vulnerabilities to failure and where groups have devised different countermeasures to forestall these failures [20], [21], and where improvements can have complex and surprising reverberations [19], [21], [22]. The papers illustrate how to look at the process of change and adaptation, how improvements can introduce side effects [6], [19], [21] and how proposed changes need to be evaluated to anticipate how the people and systems will adapt [13], [22]. By linking the patterns that are observed to generic results on cognitive work in context, studies point to opportunities to improve care and to improve patient safety. These can be derived even in the face of the demand for more efficiency in healthcare delivery, such as in [15], [18], and [23].

Many of the papers illustrate how studies of technical work take on and contrast the points of view of different actors in the situations of interest. By taking the perspective of the patient, Klein and Meininger [23] illustrate how providers inadvertently fail to help those who suffer from chronic illness and even make their disease management more difficult.

In different ways, the studies observe and trace the course of technical work to reveal what makes situations hard and whether potential "improvements" create new difficulties or provide support to meet the cognitive and coordinative demands of these situations. This is particularly well illustrated in Patterson *et al.* [15], which traces the breakdown in communication and common ground in medication misadministration.

The papers describe several different ways that investigators can wedge into worlds of technical work and break apart adaptations to see the constraints, resources, demands, and affordances. For example, Nemeth *et al.* [17] noticed that some artifacts were particularly significant in terms of how work practices were organized. These artifacts allowed them to trace how work flowed across events and individuals. Xiao *et al.* [19] also examined the role of an artifact. In this case, it was continuing deficiencies with alarms. They conducted an historical analysis to see how people adapted to workaround alarm deficiencies and how they tried to modify alarms systems over time to better recognize signs of developing trouble. Other studies focused on using naturally occurring points of change as a means to wedge open the messy details of technical work [22].

All of these studies take for granted what was once contentious: field work is a legitimate and essential means to study and design cognitive work systems [5]. The results show that activity is distributed across multiple people and computers so that the basic unit of study is not an individual or device, but rather the coordination, collaboration, and joint activity across individuals and devices. Unlike the laboratory, the real world has ongoing, interconnected streams of activity that fluctuate as the tempo of operations varies. Multiple goals and perspectives come into conflict and must be resolved through integration or coordination. Expertise and failure intermingle. Practitioners become aware of vulnerabilities and devise failure-sensitive countermeasures. They also fail to see some pathways to failure and become skilled at rescuing the system from the brink of breakdown. Practice occurs in and is conditioned by the larger contexts of group, professional, organizational, and institutional factors and pressures. Technological and other forms of change are rampant. Gaps in the continuity of operations are endemic [24]. People adapt in order to bridge those gaps and to create coherence and continuity. This adaptability is fundamental to daily work, as people both create changes and accommodate changes in order to meet pressures to improve.

Significantly, the papers in this issue illustrate another requirement for progress. They are the products of long-term cooperation between human factors professionals and medical practitioners. Such collaborations are essential for these types of studies and, arguably, for all progress on human factors in healthcare. At one level this mutual dependency is straightforward. The practitioners need the human factors professionals to define the boundaries of research projects, to avoid becoming bogged down in unproductive lines of inquiry, and to interpret and link the results of studies to the research base. The human factors professionals need the practitioners if they hope to focus on the appropriate aspects of the domain, to clarify domain semantics, and to gain access to the workers and work itself. However, mutual need is not in itself collaboration. Successful collaborations are marked by frequent role reversals. Sometimes, the human factors professional is the teacher and the healthcare practitioner is the student. At other times, the reverse is true. This can be exhausting for everyone and can also produce friction. However, intellectual friction ultimately produces opportunities for new insights and innovations. These papers demonstrate what human factors professionals and healthcare practitioners can do as they study technical work together.

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