

Healthcare groups at work: further lessons from research into large-scale coordination

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Published online: 13 January 2007
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Abstract The first special issue in Large-Scale Coordination earlier this year showed the breadth of application research from air traffic control to the military and multi-agency emergency response. This special issue shows depth of research at large scale in healthcare. These studies of large-scale coordination examine work between and across groups, beyond earlier conceptions of social human factors. Revealing the complexity of work domains and the subtle, yet effective, ways that workers negotiate its challenges opens the way to develop information and communications technology support tools that are grounded in a scientific understanding.

Keywords Healthcare · Large scale · Coordination · Naturalistic decision making · Cognitive systems engineering

1 Introduction to the second of two special issues

This is the second in a set of two special issues of *Cognition, Technology and Work* on research into large-scale coordination that started as a symposium at the September 2005 Human Factors and Ergonomics Society annual meeting in Orlando, FL (Nemeth 2005).

As the editor's essay in the first special issue mentioned, naturalistic decision-making (NDM)

(Klein 2000) and cognitive systems engineering (CSE) (Hollnagel and Woods 2005) are means to engage and understand complex, high hazard work settings. CSE evolved from the efforts of cognitive psychologists to develop methods and a base of knowledge that are suited to understand human performance in complex real world settings. The papers in these special issues explore the use of NDM methods including CSE to reveal how groups of operators have developed ways to perform inter-group work in real world settings. Insights from such studies inform the development of system-level products, including safety countermeasures and information and communication technology (ITC) that are intended to support this work. The work studies tradition (De Keyser 1988; Luff et al. 2000) recognizes and reveals the sophisticated approaches to work that individuals and groups develop. The systemic aspects of work, though, are not available through the study of individuals or a single group. They can be revealed by cognitive research at large scale—among and across groups. That is the focus of these special issues of *Cognition, Technology, and Work*.

This second special issue on Large-Scale Coordination issue features the work of a small but insightful cadre of researchers who study the healthcare setting. In contrast with the previous special issue that presented two theoretical and two methods papers, this issue's papers are all applied studies that were conducted in three different care settings. Patterson et al. describe how clinicians on the patient floor collaboratively cross-check each others' work to build resilience among team members. Three papers examine large-scale coordination in the intensive unit (ICU) and operating room (OR) suite. Albolino et al. apply

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Weick's (1993) notion of sense-making to understand how clinicians manage patient care in the ICU. Nemeth et al. describe how clinicians initiate their own ways of coordinating work at the point where sets of rules are no longer sufficient. Xiao et al. document the complex interrelationship among clinicians, their departments, and agendas as they strive to schedule assignments fairly using the OR suite whiteboard. The final two papers account for issues in the emergency department (ED). Wears et al. depicts the dynamics of efforts to coordinate ED activity in both the US and UK using the whiteboard as a locus of interest. Anne Sophie Nyssen examines the contrast between intended and actual procedures and how information systems that are poorly configured to support actual practice can fail in that role.

These authors' findings are remarkable in light of the difficulties that researchers encounter in the healthcare sector. Even within the walls of each acute care center, the boundaries to access are set high to avoid scrutiny and to protect patient privacy. The tempo of operations is kept high to protect operating margins and serve as many patients as possible. The knowledge that is required to provide care is dense. Types of procedures that are necessary and the way they are performed vary widely. Healthcare settings also vary widely, ranging from the operating room (OR) suite to the intensive care unit (ICU), laboratories, patient wards, clinics, offices, and other hospitals. Each aspect makes human subject research difficult.

The planning and management that is required to care for patients makes their coordination large in scale. While the first issue showed breadth of application areas, this special issue demonstrates research that takes a deeper look in one complex, challenging sector: healthcare.

2 Issues at large scale

The authors in both special issues have studied a diverse selection of applications, including military logistics, the national air transportation system, disaster response, and the coordination of acute healthcare organizations. Their papers explore the use of NDM methods to reveal how groups of operators have developed ways to perform inter-group work in real world settings.

Even though the particular details of each application vary, the authors discovered a number of interactions among people, technology and work (Woods 2000) that were common traits among the organiza-

tional settings that they studied. In each instance, initiatives by groups of workers make it possible to perform in challenging and frequently unforgiving settings. Each of the papers in this and the previous special issue, which are referred to here by their senior author, shows how the theme plays out in the real world from small crisis management centers to national and global networks.

2.1 Short-term goals are nested with long-term goals

In the previous special issue: Focusing on the way that work is distributed reduces the demands on any one person while also introducing longer term safety benefits that are based on built-in redundancies (Smith et al.).

In this issue: The goal of operating room (OR) team stability is nested within longer term goals of equity in the assignment of work and allocation of resources (Xiao et al.). Clearing space to accommodate sicker patients in a patient care unit is nested within the longer term goal of accommodating the demand for care (Wears et al.; Nemeth et al.). Making sense of diagnostic and therapeutic needs "on the fly" in a hospital intensive care unit (ICU) is nested within a plan for a course of treatment that serves as a defense against future days, weeks, or months to come (Albino and Cook).

2.2 Stakeholders interests compete with each other

In the previous special issue: Flight dispatcher focus on safe, timely, cost-effective completion of one flight and its effect on other flights in his airline can conflict with an air traffic manager concern over safely routing traffic flows at a higher level of throughput (Smith et al.). Public information officer need to inform the press conflicts with emergency response core group members focused on resource dispatching (Militello et al.).

In this issue: Competition for limited OR resources results in various departments such as neurosurgery and orthopedics "bumping" each other out of scheduled procedures as surgeons perform multiple simultaneous procedures to optimize billing. These require coping efforts such as mediation by the coordinators who are responsible for scheduling, exchange/bargaining, and ingratiation/friendliness (Xiao et al.). Intensive care units and patient wards are responsible for their own patient population, but lack the resources to negotiate patient transfers between services (Nemeth et al.).

2.3 Organizational and professional structures are intertwined

In the previous special issue: A joint cognitive system consists of a social system, technical system, and organizational system that necessarily overlap each other (Johansson and Hollnagel).

In this issue: The needs of individual practitioners such as surgeons to optimize billing rates conflicts with hospital organizational needs to use resources fairly and efficiently (Xiao et al.). Professionals such as nurses, physicians and pharmacists are also members of functional units such as shifts that minimize interaction in order to reduce complexity (Wears et al.).

2.4 Organizational boundaries impede work by being either too weak or strong

In the previous special issue: Even when it would benefit the organization, constituent groups can fail to communicate if organizational boundaries such as a strong hierarchy impede human abilities to adapt to situations (Johansson and Hollnagel). During crisis management, the core group with the most information and tasking in a crisis can become separated into a “stovepipe” that exists apart from others who also have a role in the event (Militello et al.).

In this issue: Emergency department (ED) work teams have shifting, amorphous boundaries that can result in parochial perceptions and interpretations of the organization (Wears et al.). Healthcare workers use cross-checking outside of official roles and responsibilities as a way to build team effectiveness (Patterson et al.). ICT exerts a democratizing influence across work groups that can erode the ability of OR coordinators to structure relationships and assignments (Xiao et al.). Local action by workers outstrips the ability of centralized ICT (e.g., medical records) to share information, which resulted in a failure to integrate crucial healthcare information among medical units (Nyssen).

2.5 Initiatives at the operator level create resilience

Resilience (Hollnagel 2006) is the ability of a system to withstand challenges and return to normal operation with a minimum decrement in performance. Resilience engineering accounts for factors that build or erode the ability of a human-technical system to adapt in a changing environment (Patterson et al., in this special issue).

In the previous special issue: During a crisis exercise, offsite experts were able to provide a kind

of “transactive” memory to assist problem solvers who are preoccupied with making decisions (Mackenzie et al.). Passively sharing information through methods such as voice loops makes it possible to increase the flow of information among crisis managers without the need to increase efforts to share it (Militello et al.).

In this issue: When rules no longer suffice, health-care workers create consensus procedures that make it possible to subtly adjust their responses to meet current and prospective needs (Nemeth et al.). Cross-checking methods such as hand-offs can make processes more evident and detect and correct erroneous assessments and actions, although poor versions can create gaps in care continuity (Patterson et al.).

2.6 Operators collectively cope with complexity

In the previous special issue: The use of ICT enabled experts who are remote from the scene to assist on-site decision-makers (Mackenzie et al.). Operators accommodated inflexible displays by repositioning themselves in a crisis room (Militello et al.). Fragile interlaced ICT systems impeded worker ability to understand and act (Mackenzie et al.). Rather than persons working with tools, ICT systems should instead support persons working jointly, interacting with tools (Johansson and Hollnagel). ICT systems that reflect human-centered collaboration are most likely to facilitate the kind of interaction among groups that is essential to create and operate logistical systems (Ritter et al.).

In this issue: Operators developed local procedures and sanctions as a defense against unilateral efforts by individuals to manipulate the allocation of resources (Xiao et al.).

3 Further research at large scale

Lipshitz et al. (2006) recently examined the relationship between NDM and organizational decision making (ODM), encouraging efforts at conceptual integration, sharing methods, and taking a shared point of view with regard to specific contexts and problems. Opportunities certainly exist at large scale to examine the intersection between NDM and ODM.

Research at large scale also presents an opportunity to explore issues that matter to NDM as a research method. These include concerns about whether the standard of expert decision making is good enough to provide a benchmark for non-expert real world decisions (Bazerman 2001), whether NDM’s reliance on

experts can produce results that can be generalized (Klayman 2001), and whether distinctions can be clarified between prescriptive and descriptive approaches, and between a research program and its results (Teigen 2001).

Further research activity would help to understand the implications of how group work changes in response to the introduction of ICT with regard to social and political processes, the redistribution of work, complexity, and flexibility:

- *Social and political processes*—Improved access to information may subvert expectations of privacy, autonomy, fairness, as well as the ability of those who are in charge to exert control.
- *Work redistribution*—Work is shifted in a system when ICT is introduced. While shifts may be detectable within a group, their effects can be difficult to detect between and among groups. Local effects may improve but their reverberations across other parts of the organization can degrade net performance and resilience.
- *Complexity*—Work is fragmented, not simplified, which requires more coordination. Organizations must constantly adapt to uncertain reliability of ICT, rapid advances in ICT, and introductions of new ICT versions and systems over time.
- *Flexibility*—Fragmented work roles and workload can be difficult to reorganize in the face of unexpected events.

4 Conclusion

In order to be a team player (Christoffersen and Woods 2002) in these work settings, ICT must reflect the sophisticated ways that workers have evolved to deal with sometimes daunting constraints. Each of the themes provides insights that can guide the development of ICT to aid groups as they confront the constraints and challenges of daily work. Procedures, people and technology do interact. Understanding how they interact and what the implications are for future ITC systems flows from research using NDM and CSE methods. Additional inquiry into this rich and chal-

lenging field can address questions that include what it means to be a team, how IT can aid cognitive work, and how IT can be used to enrich cognitive work within and among groups.

Acknowledgments Dr. Nemeth is grateful to each of the contributing authors, particularly those who participated in the original 2005 Human Factors and Ergonomics Society symposium on Large-Scale Coordination that formed the genesis for this special issue. His research is sponsored by a grant (R03 LM007947) from the National Library of Medicine, NIH, Valerie Florance, Ph.D., Deputy Director.

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