TradeoffsCharacteristics of Patient Safety

Five Principles That Underlie Productive Work

David Woods and Richard Cook*

September 16, 1998

Cognitive Technologies Laboratory

1. Safety is made and broken in *systems*, not individuals.

Safety emerges from the *interaction* of the components of the system. Safety does not reside in a person, device or department. Improving safety depends on learning how safety emerges from the interactions of components.

A. Successful systems support detection and recovery from incipient failures.

There are many opportunities for failure but few overt accidents. This is because people are able to detect and recover from failures in the making. Adaptations by people, especially at the sharp end, produce safe operations. Improving safety depends on supporting and reinforcing these activities.

B. Successful systems support learning about interactions at all levels.

Like other complex systems, healthcare is constantly changing at all organizational levels: technical, managerial, social, political. Change in one place has effects at other places and at other levels. Improving safety depends on understanding the effects, and the side effects, of change on interactions. The effects and side effects are often subtle or hidden.

2. Progress on safety begins with understanding technical work.

All progress on safety depends on precise, calibrated knowledge about how technical and organizational factors play out in real technical work.

> *The potential cost of misunderstanding technical work [is the risk of setting policies whose actual effects are] not only unintended but sometimes so skewed that they exacerbate the problems they seek to resolve…Efforts to reduce 'error' misfire when they are predicated on a fundamental misunderstanding of the primary sources of failures in the field of practice and on misconceptions of what practitioners actually do…*†

A. Success and failure flow from the same sources.

People make operations successful in the face of hazards. The way success is usually produced (in the presence of competing demands, difficulties, pressures, and dilemmas) also leads to failure. Failure is not an anomaly or marker for aberrant operations but simply the normal operation of the system that usually produces success.

B. Understanding technical work begins by learning what makes problems difficult.

Problems can be difficult for a variety of reasons: resource limitations, conflicts, uncertainty, and complexity. The difficulties of real technical work are often not appreciated either by the workers or by management. Exploring the ways these difficulties play out in technical work is the most direct means for exploring the cutting edge that shapes safety.

These efforts to understand technical work in its organizational context are what is meant by a "research based approach to safety."

3. Productive discussions of safety avoid confounding *failure* with *error*.

Folk models that "explain" accidents confound these two distinct terms. The social processes that attribute responsibility are tightly bound to the technical evaluation of cause because of hindsight bias and complexity.

A. Our reactions to failure reveal our beliefs about why systems fail.

The dominant characteristic of reactions to failure is hindsight bias. This psychological process shapes the search for data, construction of stories, generation of explanations, and the attribution of cause. The consequences of this effect severely limit progress on safety and make debates unproductive:

- *Which outcomes are preventable is contested because of naïve attributions of cause.*
- *The issues seen as critical to safety evolve haphazardly and piecemeal.*
- *No basis develops for distinguishing between productive and unproductive strategies for improving safety.*

B. Unproductive first stories of failure are always about error.

Initial accounts of accidents are simple linear stories that end with 'error' as the 'cause' of failure. This process is socially satisfying and organizationally safe but the stories it yields are sterile because they inevitably focus on a narrow set of sharp end factors. These stories provide no understanding the vulnerabilities and strengths of the system itself and lessons derived from it are ineffective for increasing safety.

C. Productive second stories are deeper and more complex.

The deeper second stories are more complex and difficult to understand. They ultimately point to systemic vulnerabilities that produce failure and success. These stories point out the multiple contributing factors that lead to accidents.

4. Safety is dynamic not static; it is constantly renegotiated.

Risk and vulnerability change. At all levels of the system and at all times, people adapt to perceived risk and

vulnerability. These adaptations are only partly successful and the perceptions on which they are based are only partly calibrated. Trading off risk and hazard against other goals (e.g. production) is a requirement for all real world work. Systems under pressure move towards the edge of the performance envelope, shifting the tradeoff point.

> *… we are talking about a law of systems development, which is every system operates, always at its capacity. As soon as there is some improvement, some new technology, we stretch it…*[‡]

A. Treating safety as sacred threatens safety.
After accidents and while under public scrutiny, discussions of safety take on a moral character in which safety is treated as an absolute, non-negotiable object. This idealization of the word "safety" does not reduce the need for tradeoffs or make the objectives of the organization any less conflicted. Rather, it drives discussions of tradeoffs underground and eliminates learning. It also increases the pressure to identify culprits drives data about accidents and near accidents underground.

B. Adding complexity makes safety harder to achieve.
Economic, organizational and technological changes tend to increase coupling between system components. As resource pressure pushes systems to the edge of the performance envelope this coupling creates new forms of failure.

C. The most important safety issues are those of the future.
Improving safety requires understanding of the ways that economic, organizational and technological factors create vulnerabilities and paths to failure. But technological advancement and social forces drive continuous systemic change. This insures that the vulnerabilities and paths to failure are constantly changing. Improving safety, then, requires *anticipating the impact of change*.

5. Tradeoffs are at the core of safety.

No matter how much effort is expended, people will confront irreducible uncertainty, multiple hazards, and fundamental dilemmas. Understanding safety requires understanding how people act in the face of these challenges in the environment of technical work.

---

* David D. Woods, PhD. Cognitive Systems Engineering Laboratory, The Ohio State University, Room 210 Baker Systems, 1971 Neil Avenue, Columbus, Ohio 43210 USA. (e-mail: woods.2@osu.edu). Richard I. Cook, MD. Cognitive technologies Laboratory, University of Chicago, 5841 S. Maryland Avenue MC4028, Chicago, IL 60637 USA. (e-mail: ri-cook@uchicago.edu)

† Barley S, Orr J (1997). *Between Craft and Science: Technical Work in US Settings.* Ithaca, NY: Cornell U. Press, p. 18.

‡ Quote is from researcher Larry Hirschhorn during the NPSF Workshop on Assembling the Scientific Basis for Progress on Patient Safety, December, 1997 [report available at *www.npsf.org*]. This is a characteristic of complex system operation: systems under resource pressure move back to the edge of the performance envelope after some technological or organizational improvement. The safety issue is whether system operators at the sharp end have an opportunity to recover from proto-failures in the newer, more efficient, more complex system. The broad topic has been noted independently by several of the major researchers on complex systems (e.g. Rasmussen in *Information Processing And Human-Machine Interaction: An Approach To Cognitive Engineering*. Amsterdam: North-Holland, 1986).