



Training Error Management in Complex and Dynamic Work Fields

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What do we know about errors?

1. No definitions of errors used: obsolete

2. Use of main classifications

- considering error patterns
- error source (system-) oriented classification
- classification of human errors following Hollnagel (1998)
- environmental capture
- operational (cognitive) classification into error categories
 - 1a. unintended: slip (drill and routine)
 - 1b. unintended: lapse (drill and routine)
 - 2a. intended: mistake (transmission of knowledge)
 - 2b. intended: violation (transmission of knowledge, seldom punishment)

Categorizing human errors

1. SHELL model
2. IATA classification “Error”: a single event may be classified under more than one category
 - technical
 - organisational
 - environmental
 - human
 - insufficient data
3. Error Chain (a.k.a. Swiss Cheese model; Reason)

What else can we state about errors?

1. Errors: seldom result of singular factors, but of complex fate, which operators could hardly have foreseen
 - large amount of reasons
 - distribution of information across many participants
2. Errors seldom because operators consciously take high risk and loose, but because man cannot believe that currently developing problem could possibly happen: invulnerability
3. Errors are ubiquitous! Human activity in itself is erroneous! Error-free labour cannot be expected!
 - Problem: zero error management, zero error dictate and error prohibition

Critical situations are typical for acting in complex, dynamic systems

Four levels describe acting within these areas of reality:

1. Complexity of contents (wide scope, interconnections, time lag, systems own dynamic, irreversibility). Marks: missing transparency, informational complexity, plurality of goals, not always standardized solutions available, mutual dependencies and connection points
2. Steering of problem solving processes as organisation of action and of work: generation of goals, information management, generation of models, planning, decision making
3. Self regulation: individual mental processes, motivation and emotion, stress, distribution of attention
4. Social complexity and its balance: differences in knowledge, endeavour for power, communication barriers etc.

Neuro-socio-biologic aspects of human error

1. Human brain not suitable to capture reality objectively:
 - Brain constantly constructs (possibly fallible) cognitive, emotional and action-oriented patterns, meanings, hypotheses etc., based on inherited, socialized and learned schemes
 - Brain regularly looks for rule, not for exception
 - simple demands: thinking; complex demands under time pressure: intuition (stockbroker experiment, but little error only!)
2. Archaic error anticipation system: anterior cingular cortex gives signal when error could be about to occur
 - Still fallibility, because speed-accuracy trade-off cannot willingly be shifted under time pressure
 - Inter individual differences when man is working on inadequate level of competency
 - different error tolerance, dependent on demand

Philosophic aspects of human errors

1. Error-hostile techno structure interdicts failure: the less human failure is tolerated, the more man becomes interference factor
2. Genetically determined experience knowledge becomes increasingly helpless in mastering increasing loads of knowledge from virtual worlds
 - Load of experience free knowledge grows as fast as digital acceleration of all areas of life: sensual expropriation
3. Life is lived in prospect and understood in retrospect only (Kierkegaard)
4. From Libet to Singer: Determinism ... end of error responsibility?
5. Mutations and biologic errors are regular programs of evolution

So, do we see bad operators
in safe systems...

... or willing and able operators
in less perfect systems?



What are we then doing about it?

Identified error problematic areas in flight training

1. Reduced accuracy in selection
2. Training deficits
3. Deficits in documentation and reconditioning
4. Typical error management chain: commit an error - gloss over - deny - look for guilt - blame a dummy
5. Reduction of safety nets
6. High workloads, possibly alternating with long phases of boredom
7. (Expected) time pressure: Haste makes waste!
8. Unpractical procedures leading to private procedures
9. Competence and complacency
10. Error socialisation and job socialisation

1. Not error avoidance is aimed at but error minimization, coming as close as possible towards error free action by developing an error tolerant system made up of knowledge distribution, procedure and control
2. Systems and procedures are designed to minimize the effects of human error instead of assuming, these errors would not occur
3. Risk- and error management is brought down to operators level:
 1. error avoidance
 2. error trapping
 3. error mitigation
4. One other goal: change western society of teaching into society of learning (see „Andon“-principle by Toyota)
 - Errors as indicators of lack of know how: no individual blame, no sense of individual guilt
 - Success: rate of errors below 1%!

Identifying reasons and supporting the operator

1. Identification of relevant factors and reasons: who, when, why, which error?
2. Risk management
3. Technical support, ergonomic design of workplace and work
4. Selection and training: company- and job socialisation
5. Ability and will to continuous and stringent improvement, willingness to learn and initiative
 - Whoever works in complex systems and proves not to be willing or able to continuously update and revise own knowledge, has no chance to control the system!

Definition of standards, company culture and climate of work

1. ...Through (check)lists and procedures (SOPs) as legal norms, which have to be applied emotionless and rational; sense does not necessarily have to be obvious to everybody.
2. Continuous re-enforcement by everybody working within the system
3. Coordination (MCC) and cooperation (CRM)
4. Dimensions of error culture: orientation towards learning, transparency of norms, error friendliness, fear of errors
5. Cultures of communication, sanctioning and rewarding
6. Safety and security cultures
7. Reduction of hierarchies
8. Will and ability to judge (and change) corporate cultures

Feedback systems and CIRS

1. Non-punitive (and anonymous?); guard reporters from being prosecuted by superiors or in court!
2. To increase quality, it is not enough to make error a topic. It is vital to connect error discussion with a culture of trust
3. Make learning from errors a principle: confess - lay open - analyze and discuss error chains
 - Remembering an error does not necessarily lead to its future avoidance
4. Encourage open discussions!
5. No (unjustified) assignment of guilt: look for reason, not for guilt!

Errors as a means of learning

Who discovers will make mistakes, but who errs will be able to
Omit future errors. As little errors as possible, but

1. Reduce fear of errors
2. Find solution through own action (90% of ideas based on errors)
3. Early errors are valuable chances to learn: error prohibition = prohibition of personal development
4. Encourage and promote self reflection and self correction
5. Encourage development of tolerance out of an understanding, that we all are fallible
6. Learning without errors is memorization of standardised solutions
7. Error as orientation aid for instructor: gives information about misconceptions: error as indication for advantage within the learning process?
8. Still: different approach towards errors in situations of application!

Errors as instruments for judgement

1. Error willingly vs unwillingly?
2. Potentially able or not?
3. Ability applied or not?
4. Error in path to result or in result itself?
5. Error out of incomplete knowledge: guilty vs innocent
6. Mistake vs misunderstanding vs (external) failure vs deception
7. Error as inability vs listlessness vs by mistake
8. Cognitive concepts vs practical experience
9. Reflection of own influence on error vs attributing error on external factors only

1. Does it help to stumble if you do not remain lying on the ground?
2. Pandora's box: does the quality of errors change?
3. Are our procedures still sufficient to judge the error component in increasingly risky, complex and dynamic systems?
4. Does the danger mount, that our rational procedures from the normal western educational systems are not suitable any more to master these ever complex systems and their error risks?
5. Which influences will generation changes and intercultural aspects have on team construction and leadership?

Reprimanding the guilty is like peeing in your pants: you feel warm and comfortable first but soon you will end up looking like a fool!

(Sidney Dekker, 2006)

1. Has error friendliness already become a new obligation?
2. Errors are a by-product of the normal world.
3. Complex, risky and dynamic socio-technical systems are seldom safe.
4. Behind every simple explanation there are complex circumstances to be found.
5. New technologies change the human error instead of removing it.
6. There will always be differences between rule and application.
7. Errors will not be punished, but success will be rewarded.
8. We have to understand why a certain behaviour made sense to a specific operator at a given time in a given situation!

