Procedural Reliability

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Participants	

- Definition
- Metrics
- **Best Practices**
- **World Class Performance**
- **Best-in-Class Recognition**

I. DEFINITION

Product Reliability is . . .

"A reliable Procedure is:
A set of steps that will ensure that any user with the appropriate skill set can complete the correct task without error."

NOTES
A Reliable Procedure definition may not include the full scope of Procedural reliability.

Procedural Reliability is not . . .

Aspects/Related Issues:

- A measure could be that the procedure is repeatedly reliable
- Need to measure complexity appropriate to user level
- Can minimize but not eliminate the human element
- Minimize human intervention - reduce human interaction required to perform procedure (there is a fine line between automating to much or to little)
- Procedures must be written via user centered design practices
- Procedural reliability needs to be considered through out software/product design/development
- Many procedures are done in the maintenance window (development and testing of procedures must be done in real world conditions)
- Multiple procedures performed in parallel introduce a possibility of outages/errors
- One reliable procedure for user 1 may not be reliable for user 2.

- Need a distinction between procedural reliability and end user knowledge
- Skill set needs to be defined.
- A defined skill set may not be include prior experience with the procedure
- Experience with procedure contributes to Procedural reliability
- Experience does not guarantee procedural reliability
- Is the procedure recoverable when a mistake is made?

Goal:
Make all documentation perform like a salt shaker. Use it incorrectly and nothing happens.

II. METRICS

Procedural Reliability can be measured by . . . the number of procedural caused outages vs. the total number of outages

But we need additional metrics to measure procedure reliability.

They could be:

Field metrics: The number of failures over time as the number of incidences/opportunities
The number of user induced errors vs. total errors

Items that require more investigation/work and RECOMMENDATIONS:
- We need control metrics for executions in the field.
- To resolve Procedure Related problems requires a broad indication of related data/root cause analysis
- We do not have a process to identify the number of times a procedure works correctly
- We need to model procedural failures to begin to build a database of procedural attributesthat contribute to outage/errors
- We need a more rigorous decomposition of Root Cause analysis for incidents that are classed as Procedural Errors.
- We need a grading procedure for individual procedures
- We need to create a predictive procedure reliability model to grade procedures
- We need to engage the developer and the provider in data collection
- A key point for evaluating procedures should be the impact of an error.

Material from 1999 Workshop:

- Procedural Reliability Metrics *might include*:
  1. *Near misses*. We must develop processes for capturing near-misses, particularly in brink-of-outage incidences (e.g. running in simplex mode for an extended period of time is a brink-of-outage condition). Despite the potential reluctance of service providers and vendors to provide "near miss" data publicly, we should pursue the study of near misses and provide measures and reporting methods that allow for individual companies and vendors to capture the data and begin to understand it. In every near-miss is an opportunity for the discovery of an effective new countermeasure for procedural error.
  2. *Operational data*. Number of times a task is performed overall compared to the number of times it is performed with an error. Procedural reliability can be measured by the number of outages caused by procedural error vs. the total number of outages. It can also be defined by the number of failures over time vs. the number of incidences for opportunities for failure. With regard to the second definition, we will need a way to define/capture the "number of incidences/opportunities".
  3. *Execution/Impact Scores*. Every procedural should have a standardized level of difficulty (execution) and criticality/risk (impact) associated with it. From these two dimensions, an overall score for each task is determined. Technicians are assigned to work tickets based on the effective matching of appropriately-skilled technicians to skill-level certified tasks. Note that this is not a complete solution because some "simple" tasks produce procedural errors/outages; simplicity is not a guarantee of error-free performance. Still, we need to pursue rating procedural difficulty – we can then use the difficulty ratings to predict the probability of errors and then use controlled design approaches to reduce the probability by improving the design. Open question: should we develop an industry-agreed upon task complexity scale?
  4. *Other non-traditional data*. Look for potential correlations between procedural errors and other data. We can look, for example, at the relationship between errors and time-of-day and/or errors and pre-existing brink-of-outage conditions. We should also look at the potential relationship between errors and employee satisfaction, sick days, predisposition, etc. It is, initially, not important to understand why there is a correlation; we must first identify the correlations.

  - Note: the working group agreed that the industry needs a *collection* of metrics associated with procedural reliability rather than one "perfect" metric.

Procedural Reliability Best Practices *should* include:

- the study of and sharing of information related to the office conditions and technician characteristics typically associated with error-free days. Best Practices should reflect the conditions and characteristics that are statistically correlated with error-free (yet procedurally intense) days.
- the contributions of perspectives from error-free/Best-in-Class Technicians.

- the integrated combination of both engineered and administrative controls. Engineered controls are those that are designed into the system and can most generally be found under the umbrella of "software controls"; administrative controls are those contained in procedural documentation and product/office warning signs and labels.
- the assimilation of relevant knowledge from other industries. The nuclear power, aviation, and manufacturing industries as well as the armed services sector have, by virtue of the life-death consequences associated with failure, studied procedural reliability and developed best practices that are ripe for reuse by the telecommunications industry.

Follow-up Actions Agreed Upon by Conclusion of Working Group Session:

- Define an RQMS submission for the definitions of "outages", "procedural errors" and "procedural reliability". Metrics to be associated with these definitions must be determined. Should, for example, procedural reliability be measured by the frequency of outages caused by procedural error in relation to the frequency of all outages? Metrics must be normalized to some constant for comparison purposes (e.g. total number of outages attributable to procedural error per system per year). Eve Perris of Telcordia agreed to convene an internet working group to determine the RQMS submission. Other members of the working group will be Denny Miller, Ken Walling, Dan McMenamin, Elaine Dreyer, Kathleen Atwater, Ali Moshleh and Anil McQwan. This work should be completed by July 1, 1999.
- Convene a working group (either using the same resources and leader of the RQMS submission working group or an intersecting set of participants) to evolve the RQMS/NRIC categorizations of procedural errors (currently limited to the broad categories of "supervision" and "documentation" and "vendor attributable" and "supplier attributable") and develop a consistent taxonomy of procedural error root causes. The goal of this effort would be to develop a more robust, specific, and industry-agreed-upon taxonomy that helps address root causes and countermeasures associated with procedural reliability more effectively than the current taxonomy. This work should be completed by December 31, 1999.

While the preceding text supplies the major conclusions/directions produced by the 1999 working group, the following bullet list summarizes the group's major other discussion points:

- One of the primary causes of work errors is skipping steps or taking shortcuts in an effort to complete all work tasks assigned on a particular day. Technicians have limited time and too many work tickets. Should we pursue work order assignment systems or processes that evaluate the complexity of procedures, estimate the time needed to complete the procedure error-free and then assign only the appropriate number of work items to any given technician on any given day?

- Study training as a function of procedural errors/reliability. Other industries, particularly the military, have excellent knowledge of effective training methods and tend to include "high tech" simulation techniques in their training curriculum. What are the benefits to pursuing such an approach where training is as state-of-the-art as the product is and where user interface design and training are more fully integrated as part of the procedural reliability solution.
- Clarification of what is meant by procedural error. Some discussion about human intervention – we're focused on any event when humans interact with the product. We're really talking about human reliability but in order to be politically correct and aware of the punitive association of "human reliability" with "human error", we focus instead on procedural reliability. Somewhere in all of this, the industry **must** move away from the blame/punitive dimension associated with procedural errors.
- The industry is coming under potentially closer OSHA scrutiny – we must focus some attention on errors that are directly tied back to operator safety issues.
- How do you construct procedures so that people will actually follow them? What are the constructs of good procedural *design*. The procedure must make sense and reasons for following each step must be clear in the documentation. The fundamental question is when do people use documentation? When they're new, when they believe something is too complex for their level of experience, and when they are in trouble? Is there a predictive opportunity here? If we put all our documentation online (i.e. someone has to log on each time they want to access the document), we could then track when technicians are accessing the documentation, we would know who is using the documentation, and we could correlate the use of documentation with any subsequent event of an outage.
- Procedures must be comprehensible and there must be some software constructs in place such that performing a procedure incorrectly is not allowed. Procedures should contain appropriately placed and spaced warnings – used the Microsoft warning message of "are you sure you want to throw this out?" analogy to be sure early warnings are placed throughout the system. For hardware maintenance procedures, make physical equipment more difficult to misuse (e.g. design plugs that will not accept a wrong card).
- If someone violates procedures, what is the appropriate business practice? Should they be pulled off the train and retrained? Should the industry adopt a three strikes you're out program? Can companies afford turnover in the technician population. If someone makes an error, are they (or should they be considered to be) more likely to produce another error? The analogy here is the insurance industry – if you have an accident, your rates increase because of a supposed predisposition to accidents. Do we have data that actually suggests that this is true of the maintenance work force? If we do, is some of that data attributable to a related business practice by which the most complex procedures are typically assigned to the same group of highly experienced people who end up having potentially "high" error rates simply because they are always working on the most complex procedures?
- The group talked about licensing technicians and/or instituting a certification program. Technicians would have to be certified to operate on the switch and/or perform certain

(high risk) procedures. Should we require certification? Is it reasonable to try to certify the workforce in various segments of procedures? Note: there was some dissension in the group about whether or not certification is reasonable.

- How much of the trend in procedural reliability is a record-keeping issue? Are we experiencing these kinds of error rates because people aren't being held accountable for making errors? There was a report of British Telecom stiffening up their record keeping efforts and then experiencing a much improved performance rate. If anyone in the working group can speak more directly to this report, it should be shared with the larger group so that we can understand what exactly happened in British Telecom and what the reasonable, data-driven conclusions are for the new record-keeping approach.
- Reward error-free performance. One way to drown-out the "punitive" voice typically associated with procedural error data collection study efforts is to balance the voice with rewards/bonuses based on error-free performance. Do we have a methodology that rewards work groups/technicians that don't produce any outages and/or shifts that don't have any procedural errors? Should we adopt a common factory practice of posting "error/injury free day" counts throughout an office?

III. PARTICIPANTS

The working group participants consisted of the following industry professionals.

NAME	TITLE	COMPANY	STATE/ COUNTRY
Aduskevicz, P.J.	Division Manager	AT & T	New Jersey, U.S.A.
Ahmed, Hanan	System Engineer	Ericsson Research	Quebec, Canada
Atwater, Kathleen	Director, Strategic Bus. Development	Nortel Networks	North Carolina, U.S.A.
Blue, Richard	TCQR Workshop Treasurer.	Siemens ICN	Florida, U.S.A.
Canaday, Richard	Manager	AT & T	New Jersey, U.S.A.
Carlucci, Edward	District Manager – Network Ver.	AT & T	New Jersey, U.S.A.
Chubb, William	General Manager	Pacific Bell	California, U.S.A.
Dreyer, Elaine	Technical Manager	Lucent Technologies	Illinois, U.S.A.
Harrison, John		British Telephone	Suffok, England
Hoberg, William	Dist. Mem. Tech. Staff	Lucent Technologies	Illinois, U.S.A.
Macwan, Anil	Mem. Tech. Staff	Lucent Tech.	Illinois, U.S.A.
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McMenamin, Daniel	Specialist – Energy Sys.	Bell Atlantic	Penn., U.S.A.

Miller, Clyde	Vice President Cust. Tech. Services	Nortel Networks	North Carolina, U.S.A.
Mosleh, Ali	Professor	University of Maryland	Maryland, U.S.A.
Parkinson, David		British Telephone	Suffok, England
Pascaud, Barbara	Dependability Engineer	Alcatel Space Industries	Toulouse, France
Perris, Eve	Senior Consultant	Telcordia Technologies	New Jersey, U.S.A.
Stavroulakis, Peter	Director	Telecomm. Systems Institute	Greece
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Young, Stanley	Gen. Sys. Engineer	The Mitre Corp.	Virginia, U.S.A.