Expert Performance Transfer: Making Knowledge Transfer Count

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Abstract. "Knowledge Transfer" is a high-priority imperative as the nuclear industry faces the combined effects of an aging workforce and economic pressures to do more with less. Knowledge Transfer is only a part of the solution to these challenges, however. The more compelling and immediate need faced by industry is *Accomplishment Transfer*, or the transference of the *applied* knowledge necessary to assure optimal performance transfer from experienced, high-performing staff to inexperienced staff. A great deal of industry knowledge and required performance information has been documented in the form of procedures. Often under-appreciated either as knowledge stores or as drivers of human performance, procedures, coupled with tightly-focused and effective training, are arguably the most effective influences on human and plant performance.

1. INTRODUCTION

We employ this rule to formulate a General Problem Statement:

General Problem Statement	General Problem Statement — Applied
HURT (Usually an ACCOMPLISHMENT *not* being produced satisfactorily)	Large numbers of job vacancies from the wave of "baby boomer" retirements
RESULT (Immediate negative EFFECT)	must be filled in a short time-frame;
CONSEQUENCE (Ultimate negative effect)	with the consequence that many inexperienced personnel are unable to meet job performance standards.

The data from various sources show that America is facing a demographic juggernaut from the large wave of retirements that is forming. Some call it the "silver tsunami."

- ONE-THIRD of the population will be over 50 by 2010
- ONE in FIVE will be over 65 by 2010
- Experience and institutional knowledge leave when the people leave
- Knowledge and skill retire with the "boomers"

The education foundation of replacement personnel in the United States is not encouraging either:

- 95% of junior college graduates (only 55% of those who start) are in some sort of remediation course their 1st year in college

- 53% of those in 4-year colleges graduate in SIX years

- Only 52% of students in nation's 50 largest high school systems graduate in four years

- Graduates at all school levels are generally unprepared to meet job performance requirements

Employers in the United States report inconsistent progress in preparing for the challenge.

- 60 percent of employers report that recruiting competent job applicants is their biggest human resources challenge

- More than 25 percent of U.S. businesses have done little to plan for the effects of an aging workforce

- There exists a relatively small pool of new workers and fierce competition for new talent is likely to result

- Emphasis on improving human performance often concentrates on "support" and "controls" rather than the business value chain – knowledge management endeavors tend to ignore business processes and procedures

- Many employers assume the current environment of guidance and training will be effective with new recruits

- Traditional approaches to "knowledge management" are highly conceptual

The overall weakness in the current approach is that the focus is on recruiting and YOU CAN'T RECRUIT LEGACY KNOWLEDGE!

We introduce Expert Performance Transfer using an Accomplishment-Based Performance approach. "Performance Transfer" is the ultimate goal.

There is a need for a process that is predictable and repeatable:

- Analytic model for analysis, design, development which virtually guarantees success
- Cost-effective to use without jeopardizing results
- Comprehensive documentation for consistent, predictable and reproducible accomplishments
- Capture legacy knowledge investment before it leaves the company

Our investigation shows these findings for the general case:

- Many knowledge management efforts are "conceptual" or focus on IT-based solutions. They do not have systematic procedures to guide the effort. The goals and processes are often open to wide interpretation. IT-based solutions thus suffer from "Garbage-In, Garbage-Out".

- Within the same organization, knowledge management efforts are often fragmented. There is an absence of precise goals and objectives. There is an absence of a common model and language. Efforts tend to act independently, and sometimes in opposition to one other.

These findings seem to explain the specific cases for the variability of success among organizations committed to other methods in vogue. No one can argue the conceptual intent; but actual practice has

resulted in huge expenditures of resources without directly predictable outcome in terms of successful PERFORMANCE ON-THE-JOB.

1.1. There is a need for a system that is systematic.

We considered characteristics that would be "ideal" for Expert PERFORMANCE TRANSFER system and for its training sub-system. These are the criteria we used to develop an expert performance transfer system:

The system would target human PERFORMANCE directly via an analytic procedure that first specifies accomplished (high quality) performance for the jobs in the organization. Specifically, the system would:

- Be COMPREHENSIVE in scope. Targets all components in the organization whose work impacts each other as well as the ultimate receiver of the organization's goods and/or services.

- Involve workers at all LEVELS of the organization — top-down and bottom-up — toward agreed upon GOALS.

- Be driven from a single COHESIVE approach that welds all fragmented approaches into one effort.

- Be RIGOROUS and detailed enough so that high probability of success is assured. Differing interpretations of the goals and guidelines would be minimal.

- Consider all INFLUENCES on performance including: Personnel selection; skills/knowledge of performers; how the work is designed; the physical environment of the work; the ergonomic aspects of the work; the motivation, incentive, and attitudinal aspects of performance transfer.

- Contain rigorous and detailed guidelines that would cause analysis of performance transfer needs for both EXISTING performance and the planning of NEW performance required by changes in the organization's goals and work.

- Be a system that would be operated by INTERNAL personnel.

- Be FLEXIBLE enough to accommodate technical and cultural differences in organizations without harming success.

- Be EFFICIENT to operate such that the value received would be far greater than the resources consumed.

1.2. Expert Performance Transfer is a methodology based on proven research that was developed to produce guidance for on-job performance

User experience with the Expert Performance Transfer guidance shows

- More relevant and effective guidance is produced.

- Development time is very efficient.

- Guidance is produced without expensive re-do, extensive revisions and backlogs.

- Significantly less training support is needed.

- New developers produce as accurately and completely (not quite as proficiently) as experienced developers.

1.3. Expert Performance Transfer is a complete system for all phases of on-job guidance development with all components needed for a sophisticated capability including

- Standards and Criteria for the performance transfer development process.

- Guidance and Documentation mechanisms for all phases of development, delivery and evaluation — to an "expert system" level of detail.

- Training Support for developers and managers.

- Management Inspection Guidelines for monitoring projects.

- Coaching for the developers on an on-going basis.

1.4. Expert Performance Transfer is a process that is

- Based on a systems approach. The outputs of one phase become inputs to subsequent phases.

- Based on a systematic approach, as opposed to a random, eclectic, or "artistic" approach.

- Grounded in a description and analysis of expected on-the-job accomplishments.

- Front-end-loaded. The emphasis is on analysis and design.

- Derived from proven behavioral theory producing logically consistent, accountable and reproducible results.

- Designed to ensure that decisions are rule-based with detailed algorithms and decision tables.

- Designed to achieve maximum effectiveness AND efficiency.

- Expert Performance Transfer may differ from other knowledge management systems in these ways:

- Emphasis is placed on performing the type of Front-end Analysis applicable to the project (Two major types of Front-End Analysis are performed, depending on the project: a Planning Front-End Analysis or a Diagnostic Front-End Analysis.)

- Emphasis is placed on the possibility of developing Performance Transfer guidance (Decision Tables, Checklists, Algorithms, Cookbooks, etc.) rather than storing all skills/knowledge/information in the memory of trainees. This possibility has considerable impact on reduction of costs and development times.

- The description of job-behaviors is not massed together in Expert Performance Transfer analysis, but distributed through the analysis and design phases, making the process more efficient.

- Expert Performance Transfer provides very detailed guidelines for all phases of the process.

- Expert Performance Transfer methodology is a true approximation of an expert system for an analysis, design, and development process.

1.5. What is an Expert System?

Our definition.

Expert System: Documentation of the overt and probable covert behavior of accomplished performers in the form of procedures, rules and decision tables/algorithms such that non-accomplished performers produce accomplishments/results that match exemplary outputs in all critical aspects.

Our definition also defines Expert Performance Transfer methodology. Note no mention of computing is included within our definition. Expert Performance Transfer methodology is intended to be paper-delivered since no bona fide need for automation is identifiable.

1.6. WHAT IS Expert Performance Transfer AND WHY?

WHAT we accomplish is the most important thing. With some notable exceptions, the concern seems to have been more with instructional strategies, techniques, and media rather than WHAT is to be produced on-the-job.

The majority of knowledge management development is based on the question: What do we want the people to KNOW? We suggest that this a low priority question at best. The question could lead to subject-matter-based content, and often, educational type designs. These designs are inordinately expensive, subject to constant re-do; because they never directly produce improved performance on-the-job.

Our Front-End Analysis model caused the content to be derived from the question: What do we want the performer to DO as a result of the Performance Transfer Guidance?

Until Expert Performance Transfer methodology, our model used the question as a prime guideline for deriving content. Follow-up and investigation of persons using other systems seemed to show:

- Inordinate amount of time spent on Front-End Analysis. (As much as 50% of total project time; and sometimes person-years.)

- Front-End Analysis performed on systems or pieces of equipment or generic "duties" or "competencies" rather than job PERFORMANCE.

- Much of the data collected were never used in the process.

- Subject Matter Experts reported behaviors they never actually performed on the job, and/or concentrated on rare or esoteric behaviors.

- Subject Matter Experts tended to omit behaviors fundamental to the job, and often omitted behaviors thought too complex to analyze. (Diagnostic behaviors, for example.)

- Many designers, even having performed Front-End Analysis, did not use the output to design the knowledge management systems.

- It was assumed that "soft skills" were not amenable to technological models for knowledge management.

The literature was revisited to look for clues. As has been the case with may of the things in Performance Technology, Tom Gilbert provided the fundamental basis in his book Human Competence – Engineering Worthy Performance.

Gilbert has preached for years: The acquisition of knowledge and behaviors is not the important thing. What is to be ACCOMPLISHED is where value lies.

1.7. We first revised our progression for Front-End Analysis

- What is the basic GOAL of the organization requesting our services?
Examples:
  - To produce power to meet customer demand in a safe manner.
  - To produce profits from making and marketing products.
  - To be combat-ready.

- What does an accomplished performer PRODUCE to help meet the goal? (What desired ACCOMPLISHMENTS?) And, which Accomplishments is/are deficient or new?

Example:
  Job: Sales Rep.
  Major Accomplishments:
    - Prospect appointments.
    - Potential customer has knowledge of benefits and features.
    - Order for the product.
    - Arrangements for delivery and installation.

- How does an accomplished performer BEHAVE to produce valued Accomplishments? (What are the actual TASKS for each Accomplishment?) And, which are deficient or new? Which are of most VALUE?
Example:
Major Accomplishment: Customer has knowledge of benefits and features of products.

Tasks:
  - Set up product demonstration.

- Present benefits.
- Demonstrate features.
- Answer questions and objections.
- Etc.

- Which tasks are DEFICIENT/WILL BE DEFICIENT because the performer does NOT KNOW HOW to perform them? And, which of these are deficient due to NON-skills/knowledge reasons?

- Which OVERT and COVERT behaviors the novice/deficient performer must acquire to perform the tasks to produce the Accomplishments to meet the Goal?

- WHERE should the overt and covert behaviors be STORED? (In the MEMORY of the performer or in Expert Performance Transfer or some COMBINATION?)

1.8. Results of accomplishment-based FRONT-END ANALYSIS for Expert Performance Transfer

Experience with this new, accomplishment-based Front-End Analysis progression generated data that surprised us:

- Relatively inexperienced users produced Front-End Analysis which often exceeded the quality of experienced users of other, older Front-End Analysis models.

- The time to perform Front-End Analysis was significantly reduced.

- Difficulties in eliciting behavior and data from Subject Matter Experts were reduced when a goal-driven, accomplishment-based approach was taken before trying to describe behavior.

- How to unitize Performance Transfer became apparent. (An age-old problem; and, one for which there is a dearth of literature.) For example, it became apparent how to define in a precise way WHAT guidance elements are necessary for Performance Transfer on-the-job.

Inspired by the success of accomplishment-based Front-End Analysis, attention was turned to improvements in the Design-Development-Testing-Implementation-Evaluation progression for Performance Transfer. We wanted to see if comparable increases in quality of output and decreases in total project time would also accrue.

To do this, the literature was examined on learning and we examined our 30 years of experience as developers.

This was also an opportunity to revise our analysis, design, and development approach to a significantly more detailed level — to be closer to an EXPERT SYSTEM.

The result is the Expert Performance Transfer methodology.

1.9. Expert Performance Transfer COMPONENTS

We sought to produce a more comprehensive and detailed system for performance transfer analysis, design, development, implementation, and evaluation than before. We synthesized the research and our own experience into a progression that would be state-of-the-technology; and, to add sub-systems to make the process more effective and efficient.

The resulting Expert Performance Transfer methodology is made up of these sub-systems.

- Standards and Criteria for the entire process.

- Management Inspection Guidelines for the outputs and process.

- Performance Transfer Guidance. Step-by-step procedures (sequences, decision tables, rules) keyed to worksheets and at an expert system level of detail.

- Documentation. Series of worksheets and checklists.

- Training Support. Instructional texts, simulation exercises, and visuals.

- Coaching Support. Consultation on application to actual projects during and after the development.

1.10. What are STANDARDS and CRITERA and Why?

To develop the Expert Performance Transfer methodology we examined the state-of-the-technology regarding the implementation of knowledge management technologies.

We found:

- Most organizations did not have a comprehensive set of OBJECTIVE STANDARDS for work practices, much less for good knowledge management.

- Thus, developers behaved eclectically and without commonality.

- The vast majority of developers still took a "topic" or "subject-matter" or "knowledge"-based approach to deriving knowledge management content.

- The majority of development personnel seem to regard knowledge management as essentially a "creative" act (rather than technological), or, at best, act without a discernable model or set of rules.

- Without standards and criteria, without a discernable model and set of rules, there was little accountability for developers and little basis for evaluation of projects.

- Management was often unaware of the powerful procedures and requirements of performance technology.

Thus, as part of the overall Expert Performance Transfer methodology we developed and keyed the process to a comprehensive set of STANDARDS and CRITERIA.

Tests of the Expert Performance Transfer methodology show that Standards and Criteria go far in reducing the randomness and eclectics which seems to characterize knowledge management.

1.11. Expert Performance Transfer Maximizes Value of Knowledge Management

In general terms, Expert Performance Transfer maximizes Value by:

- Prescribing performance transfer guidance only when it is needed; and NOT trying to use a knowledge management solution for problems/needs when some other prescription is appropriate.

- Basing the content of performance transfer guidance directly on desired on-the-job PERFORMANCE, making sure that end-user possess guidance on WHAT they need to do to produce accomplishments.

- Making sure the end-user has, in fact, what is needed via the use of proven strategies and tactics built into the guidance.

- Maximizing confidence by maximizing competence.

- The test of any analysis, design, development, delivery process is: To what degree does it achieve cost-effective on-job-performance?

1.12. Expert Performance Transfer Minimizes Costs

Some of Expert Performance Transfer methodology tactics in rough order of importance to cost-reduction:

- Avoids training when a lack of skills/knowledge/information is NOT part of the problem. That is, the ultimate cost-minimization occurs when unneeded training is avoided.

- Selects for performance transfer only those persons who have the need for skills/ knowledge/information.

- Expert Performance Transfer Guidance is always on-the-job, does not miss work, doesn't get hangovers, or have a bad day.

- Seeks to use expert performance transfer methodology rather than solely training which stores skills/knowledge/ information in the memory of students. The effects of this strategy are shorter delivery time and shorter design and development time — studies show expert performance transfer can cut development time by up to 4 times, and cut delivery time by a factor of at least 4 times.

- Bases content on desired job performance rather than "subject-matter" — performance-based content is shorter in delivery time than knowledge-based content.

- Uses efficient delivery techniques such a well-designed content where the format is based on the performance characteristics involved. This characteristic has profound effects on:

  o Reduction of personnel error
  o Positive influence on use and adherence to procedural guidance

- Uses the considerable number of behavioral design rules which have been demonstrated to be efficient while enhancing overall effectiveness.

2. SUMMARY: EXPERT PERFORMANCE TRANSFER METHODOLOGY PRODUCES HIGH WORTH ON-JOB PERFORMANCE

Expert Performance Transfer accomplishes cost-effective (high Worth) performance transfer by attacking head-on both Worth variables, Value and Cost.

The Expert Performance Transfer methodology maximizes Value because it

- Causes discovery of exactly WHEN to perform and WHO must perform.

- Causes precise specification of exactly WHAT to develop; and, guarantees the content, when used, will result in performers who perform the tasks on the job.

- It causes the design of Expert Performance Transfer to emphasize

    o Transfer of relevant skills/knowledge/information via rigorous guidance.

    o Minimization of loss of retention by the use of special tactics.

Expert Performance Transfer minimizes Cost without harm to Value because it

- Gives high weight to the possibilities of avoiding unnecessary and low priority training

- Causes precise specification of WHO should use Expert Performance Transfer guidance so that the resources are minimized

- Causes shorter development times because it is a lean system in the analysis, design, and development phases

Our research and experience has shown us that the author-organizations of "systems," "models," "guidelines," etc., are among the very last to actually use their own guidance in the execution of their own practice. Where used, the examples are relatively trivial. Which leads us to ask this question to discriminate other "systems" from ours: Do you actually use your own system to develop your system?

If we use our system to DEVELOP our system, then you should inspect to see that we use expert performance transfer within our system. In fact, there should exist expert performance transfer guidance, if we practice what we preach.

We practice what we preach: we USE Expert Performance Transfer guidance, worksheets, and training that were developed meeting Expert Performance Transfer criteria.

Expert Performance Transfer is a methodology, accomplishment-based and expert-system-based. The tasks are subject to the accompanied inspection guidelines.

Expert Performance Transfer is

- A System that is Systematic.

- Logically defendable, accountable and reproducible methods and results that exceed any known standards while being efficient and effective to use.

- A system that may be INTERNALLY OPERATED so that need for additional resources is minimized.

- A System that is BOTH Proactive and Reactive.

Two compelling case studies follow.

3. CASE STUDY #1: ABOVE ALL, CAUSE NO CONFUSION

In this case study, we find an example of guidance which is clearly meant to be used contemporaneously with work on-the-job; because it calls for data to be collected and recorded. We find that parts of the procedure as structured are confusing at best. The performance in many cases calls for decisions, but the instructions are written as sequence and sub-subsequence.

The performer must be required to use recall, trial and error or excessive time and effort for interpretation or combination. We find that guidance in this format is associated with error from "place-keeping error," "fatigue from logical interpretation," or pure trial and error; major contributors to USE & ADHERENCE issues.

ExPerT presents an information format which matches the structure of the performance. Examples:

- Sequential performance is in sequence
- Decisions appear as a decision table or algorithm
- Rules are structured as rule tables or algorithms
- Calculations or data collections are presented as worksheets

The following example is an extract from a maintenance procedure for a feed pump followed by an improved ExPerT version.

4. EXAMPLE OF INSTRUCTIONS USING "LINEAR" LOGIC

Governor Drive Disassembly

IF over-speed trip linkage (Attachment 7) must be disconnected for intended task, THEN disconnect linkage as follows:

IF not previously closed, THEN manually close trip throttle valve (MS-465 or 2FWE-TTV22) using handwheel.

Disconnect overspeed trip linkage.

IF governor was not previously removed, THEN remove governor as follows:

Record the As Found position of the governor speed knob per one of the following as applicable: [I.4]
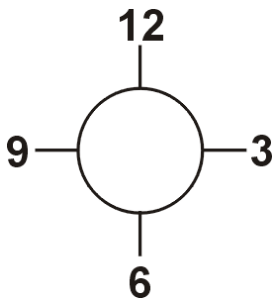
IF the knob has a numbered dial, THEN record indicated dial setting.

Dial Number Setting _____ As Found

IF the knob does not have a numbered dial, THEN the knob should already be matchmarked.

IF not already matchmarked, THENmatchmark knob to governor.

Draw below the approximate orientation of the knob and governor matchmarks.

Measure and record as found linkage dimensions "C" and "D" on Attachment 13.

Loosen locknut and remove linkage pin at disconnect point "A" on Attachment 13.

Remove the four governor to pump bracket capscrews.
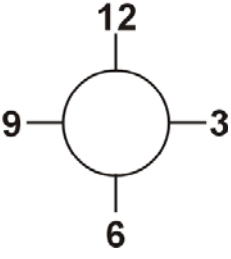
Removegovernor.

EXAMPLE of Instructions Improved by Using ExPerTAnalysis and Design: (non-linear logical performance requires non-linear logical instructions.)

Governor Drive Disassembly

1.

IF the intended task:	THEN:
Does NOT require trip linkage (Attachment 7) to be DISCONNECTED	Proceed to Step 2.
Requires trip linkage (Attachment 7) to be DISCONNECTED	<table><tr><td>IF trip throttle valve (MS-465 or 2FWE-TTV22) is:</td><td>THEN:</td></tr><tr><td>OPEN</td><td>a. Manually shut trip throttle valve using handwheel. b. Disconnect overspeed trip linkage</td></tr><tr><td>SHUT</td><td>Disconnect overspeed trip linkage</td></tr></table>

2.

IF the governor:	THEN:		
Has been REMOVED	Proceed to Step 3.		
Has NOT been REMOVED	Record the As Found position of the governor speed knob per one of the following methods as applicable: (I.4)		
	IF the knob:	**AND the knob is:**	**THEN:**
	Has a numbered dial		Record indicated dial setting HERE. Dial Number Setting _____ As Found
	Does NOT have a numbered dial	Already match-marked	a. Measure and record as found linkage dimensions "C" and "D" on Attachment 13. b. Loosen locknut and remove linkage pin at disconnect point "A" on Attachment 13. c. Remove the four governor to pump bracket capscrews. d. Remove governor.
		NOT already match-marked	a. Matchmark knob to governor: Draw the approximate orientation of the knob and governor matchmarks HERE. **12** **9 — 3** **6** b. Loosen locknut and remove linkage pin at disconnect point "A" on Attachment 13. c. Remove the four governor to pump bracket capscrews. d. Remove governor.

4. CASE STUDY #2: WHEN IT COMES TO "CONFINED SPACES," WHAT YOU DON'T KNOW CAN KILL YOU

Although confined space incidents are rare, the consequences are death and serious injury; and the OSHA statistics on occurrence have shown little improvement. As many as 60% of the fatalities have occurred when heroic, but tragic attempts at rescue were made by ill-prepared rescuers. Sometimes multiple rescue attempts have all resulted in injury or death.

A training industry has grown as a response to the apparent need for training confined space emergency rescue. Nevertheless, there has been no reduction in the fatality statistics.

The fact that emergency rescue attempts not only failed but also resulted in additional fatalities has led people to believe that the problem is poor emergency rescue training; and it might in fact be a problem. It is NOT root cause.

The most frequent causes of confined space incidents are failure to properly IDENTIFY the existence or to IGNORE its existence.

By "ignoring" the existence of confined space, we have experienced this or equivalent statements in any number of circumstances: "Do you know how much extra time it takes to do the job if we treat it as a confined space?" The point has to be that it is NOT extra time to do the job — it IS the job. This case study does not address this cause.

This case study does address circumstances when confined spaces are not properly identified. The obvious ones are not usually the problem. People naturally have an aversion to getting themselves into cramped, inaccessible, uncomfortable, dark, smelly places. Confined space conditions are not always so obvious and these can be insidious and deadly.

We have developed the following ExPerT system — *GUIDELINES for Determining "Confined Space."* The optimum use of this ExPerT system is during the work assignment process; i.e., work authorization/work control and the like. When planning assigned work, requirements for "permitting" such as welding, burning, grinding, flame-cutting, radiography, radiation work permit, excavation, and confined space, etc. should employ a suitable ExPerT systemas applicable.

GUIDELINES for Determining "Confined Space"

Is the Area/Space a POSTED *Confinement*?
OR
Is the Area/Space identified in ATTACHMENT as *Confined*?

→ YES

↓ NO

Is the Area/Space that is NOT designed for continuous occupancy similar to any of the below listed components? If "YES", place a √ next to the appropriate one:

AIR RECEIVER	HEAT EXHANGER	STEAM LINE
CASING	MANHOLE	SUMP
CAVITY	PIPE	SUBFLOOR
CONDENSER	PIT	TANK
CONDUIT	SHAFT	TUNNEL
DEMINERALIZER	SILO	VAULT
EVAPORATOR	STACK	VENT DUCT
HOUSING	STEAM GENERATOR	VESSEL
		WATERBOX

OPEN-TOPPED SPACE MORE THAN 4 FT. DEEP

One or more Items Checked →

↓ NO items checked

Answer these questions about any other enclosed space that is not designed for continuous occupancy by placing a √ in the appropriate column:

COULD the Area/Space be subject to…	NO	YES
Conditions IMMEDIATELY DANGEROUS to *life and health*?		
ACCUMULATION of TOXIC GASES?		
ACCUMULATION of FLAMMABLE GASES?		
STRATIFICATION?		
INERT CONDITIONS?		
OXYGEN DEFICIENCY OR ENRICHMENT?		
Inadequate VENTILATION?		
Entry REQUIREMENTS SPECIFIED by work group supervisor or department/plant POLICY?		

One or more YESes Checked →

All NOs checked

Area/Space IS Confined:

Prepare a Confined Space Entry Permit Request

OR

Followed posted Confined Space Entry Permit Instructions.

Area/Space is NOT Confined:

Proceed with planned work activity.

DESIGN CONSIDERATIONS such as physical configuration or material composition?		
Unusual ODORS?		
Ready ESCAPE DIFFICULT? (*e.g.,* prevents egress in a normal walking position)		
RESTRICTS entry for RESCUE purposes?		
Periodic CHANGES in CONDITIONS?		
TOXIC ANIMALS/PLANTS or their products?		