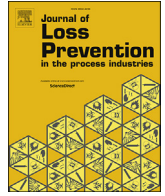




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A summary and synthesis of procedural regulations and standards—Informing a procedures writer's guide

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ABSTRACT

Well-written procedures are an integral part of any industrial organization for safe operation, managing risks, and continuous improvement. Regulatory bodies around the world require industries to have current, accurate, and appropriate procedures for most processes. Although the importance of procedures is recognized by all industries in general, significant incidents still occur due to procedural breakdowns. Some of the procedural breakdowns come from obvious problems such as the procedure not being available or the procedure being wrong. However, some incidents have occurred when correct procedures were available and the operator used those procedures. In these instances, the reason workers do not follow procedures correctly may be attributable the procedure being presented or designed in a manner that does not sufficiently communicate the information in a manner that is easily and quickly understood. This indicates that procedure writers may need more guidance on how to write and design procedures so they accomplish this. To effectively manage risk, procedures need to be technically correct (and regulatory compliant) and usable. As part of this, the current work is focused on developing a systematic approach to a procedure writer's guide that includes a regulatory compliant component. The work presented here consists of an effort to identify procedure-writing practices necessary to ensure regulatory compliance by summarizing a large sample of regulations and standards from several industries. The regulations and standards were organized to reflect common ideas and the implications in terms of human factors needs for procedure design were identified. This information will be used as part of the development of a writer's guide that accounts for human factors (HF) that includes explanations of HF implications and empirical support for each of the guidelines. The novelty of the method and information presented here is in the idea of leveraging the cumulative information available regarding procedures in regulations and standards. Incorporating this information into a procedure's writers guide in this manner may not only facilitate procedure being regulatory compliant for facilities in different geographies of the world, but could also support their being written with considerations for human performance.

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1. Introduction

Following the correct procedure for performing tasks in high-risk work environments (e.g., chemical plants, drilling rigs, nuclear power plants) is associated with safe, effective, and efficient operations (Jamieson and Miller, 2000). The methods used to

provide procedures to workers can differ widely across industries and companies. For instance, in the nuclear industry, the steps for some procedures are integrated into the console where the workers perform the task (Niwa, Hollnagel, and Green, 1996). In other domains, it is more common for workers to use hand held, paper based procedures (Noroozi, Khan, MacKinnon, Amyotte, and Deacon, 2014). Regardless of the presentation, effective procedures not only mitigate risks but also are important for the transfer of knowledge from the engineers of the system to the workers of the system and for training purposes.

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However, analyses of root causes for incidents and accidents in high-risk industries have found procedures use (or rather misuse) is one of the most frequently occurring root causes (Bullemer and Laberge, 2010). The importance of procedures and work instructions is further emphasized by a study done on data in the Finnish industry that found that 63% of the incidents could be attributed to defective work instructions (Lind, 2008). A study conducted on improving communication and coordination problems in the hydrocarbon industry covering 11 sites from across the world recommended that better procedures are one of the solutions to this important factor which may impact safety performance (Laberge and Goknur, 2006).

Problems with procedure use vary from the procedures not being available or correct to the procedure being unclear or difficult to follow. While the availability and correctness of procedures is a management issue, the clarity of the presentation is essentially a design challenge. A bad procedure presentation design can cause confusion, result in missteps, or possibly result in a worker not using a procedure simply because it is difficult to follow (Embrey, 1998). Further, the “best” procedure presentation design has not clearly been established. Specifically, although there are many procedures writer’s guides available, most of them are not based on results from peer-reviewed studies regarding how presentation impacts human performance. The importance of procedures is further amplified by the fact that most regulations and standards have elements regarding procedure development, management, and availability. However, most writer’s guides are not structured in a manner that will facilitate adherence to these regulations and standards associated with procedure development and use. A 2004 study of procedures use in chemical plants and refineries found that the sites with the most consistent implementation of the procedures in a usable format also had the most comprehensive guidelines for writing procedures (Bullemer and Hajdukiewicz, 2004). The quality and adherence of procedures can also be improved if the capabilities and constraints of the human are accounted (Peres et al., 2016). Hence procedures writing guidelines need to be comprehensive, accommodate various principles of human factors, and have information about regulation and guidelines.

A major drawback of the current state of the art in procedure writing is its lack of evidence backed guidance to improve human performance and safety. Further, while current guidance documents are based on heuristic rules and guidance to address minimum requirements, they lack a systematic method of addressing regulatory requirements and more importantly do not leverage inter-disciplinary knowledge on effective procedures design to lead to better written procedures and ultimately improved process safety performance. The first step towards resolving this gap is to develop a framework used to assess regulatory requirements regarding procedures which can then be used to develop guidance’s resulting in compliance with these requirements. Given the globalized state of many of the process industries, it is important that guidance’s be independent of geography, and be more directly associated with human performance. Hence it is important to relate elements across regulatory entities to develop a common platform for guidelines. This is the approach that we have taken with our efforts toward building a procedures writer’s guide—integrate information from: human performance science (i.e., Human Factors); a synthesis of international procedure requirements; and information from workers, procedure writers, and current procedure writer’s guides. This approach differs from many existing approaches, which have the procedure documents focus on documenting workers’ behaviors for compliance (regulatory and legal) and accountability. In contrast, our approach is focused on improving procedures’ ability to be useful tools to workers and thus

more effective safety barriers.

The work in this paper is the first step in the advanced procedures research initiative (<http://advancedprocedures.tamu.edu>). One of the goals of the initiative is to create a writer’s guide that is based on peer-reviewed scientific findings on human performance that facilitates procedures being written in a manner that adheres to relevant regulations and standards and increases the likelihood of procedure comprehension and compliance. To accomplish that, the objectives of the work presented here are:

- Review and summarize regulations and guidelines from different industries and countries
- Categorize the elements to identify common themes to develop guidelines
- Develop a framework for applying human factor principles to formulate guidelines
- Develop a method for integrating compliance requirements and human factor implications into a procedure writer’s guide

This paper presents a detailed description of the analyses of the regulations and standards related to procedures. These analyses involved not only identifying which of them had information about procedures but also identifying common themes (or elements) across the different agencies. These elements were further grouped into categories to reflect the current state of regulations and standards with regard to procedures. This analysis of the content of these regulations and standards facilitated the development of a writer’s guide that supports regulatory compliance. Additionally (and possibly more importantly) when these analyses are combined with information about attributes of procedures that impact human performance and risk mitigation, this information can be used to identify potential gaps in the guidance being provided to industry regarding procedure development, presentation, and use.

2. Methodology

Fig. 1 illustrates the overall methodology for the integration of the regulations and standards analysis into the Human Factors Application to Procedures (HFAP) writer’s guide and includes identifying and reviewing regulations and standards; identifying common elements across them; grouping the elements into categories based their functional relationships; and finally, using this information to identify the guidelines needed in the HFAP writer’s guide.

2.1. Review of regulations and standards

In order to have a holistic view of the current regulatory requirement for procedure development and usage, a global cross section of policies was used for the regulatory analyses. Regulations from three agencies of United States of America (US) were reviewed: the US Occupational Safety and Health Administration (OSHA)(HSE), the US Environmental Protection Agency (EPA) (EPA, 2004), and the Bureau of Safety and Environmental Enforcement (BSEE) (BSEE, 2013). One agency from the United Kingdom was reviewed (HSE) (HSE, 1992), as well as one from Qatar (Health and Safety Regulations and Enforcement Directorate) (HSE), one from Australia (National Offshore Petroleum Safety and Environmental Management Authority - Commonwealth Australia) (NOPSEMA, 2006), and one from Saudi Arabia (Presidency of Meteorology and Environment) (PME, 2001). Three international agency’s materials were also reviewed: International Organization for Standardization (ISO) 9002 Model for Quality Assurance in Production, Installation, and Servicing; ISO 14001:2004 Environmental Management Systems (ISO14001, 2004), and Occupational Health and Safety

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