

IS IT TIME TO PURGE LEGAL CONSTRUCTS FROM SAFETY INVESTIGATIONS?

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ABSTRACT

This inquiry investigated legal constructs that have been adopted by or adapted for safety investigations, and their influences on safety investigation practices, work products, and uses. After such legal constructs were identified, their observed or reported influences were documented. Some of those legal constructs were found to have discernibly detrimental influences on safety investigations, their outputs or uses. Those consequences seem to justify purging them from safety investigation constructs and practices. The report suggests possible approaches for purging those detrimental legal constructs from safety investigation practices.

1. Background

Safety investigations are undertaken primarily to address societal and operational desires to improve safety by preventing unintended accidental occurrences. Users ranging from individuals to large organizations, each with different purposes, utilize safety investigation work products. Observations of some unusual aspects of these processes motivated this inquiry.

1.1. Motivations for inquiry.

This inquiry was motivated in part by observations of investigations of two aviation accidents involving both safety and judicial entities. (TWA 800, Air France 4590) In the TWA 800 crash, conflicting witness reports raised questions about whether the crash was an accident or willful destruction, and who would do the investigating. In the AF 4590 crash, the safety and judicial investigations resulted in different outcomes. (BEA 2012, BBC 2012) Additional motivating observations included the amount of legal actions following accidents, the continuing discord among safety, judicial and media entities about the use of safety investigation information developed during safety investigations, (BBC 2012) the duplication of investigations indicated by the number of requests for reconsideration of safety investigation reports published by the National Transportation Safety Board, which has a reputation as a superior accident investigation entity, (NTSB 2000) the unsuccessful results of a study that attempted to replicate accident descriptions from published accident reports and find potential recommendations that might have been overlooked (Benner 1989) and reported impediments to learning lessons from accidents.(Werner 2005, Benner 2007)

This inquiry was initiated to determine if and how adopted or adapted legal constructs might be influencing these issues, and if they had adverse effects, identify potential replacements.

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1.2 Inquiry approach

“Construct” is used in the sense of an abstract idea or theory consisting of various conceptual elements, typically considered to be subjective and not necessarily based wholly on empirical evidence. A constructs influence actions related to the construct. This inquiry set out to identify legal constructs that migrated into safety investigations, and their influences on safety investigations. If the influence was detrimental, options for purging those influences from safety investigations were investigated. The inquiry recognizes that all safety investigation processes are not uniform, but presumes that core elements common to all safety investigations can be discerned. It uses information acquired by direct observations during the management of, conduct of, or participation in all phases of over 50 diverse accident investigations, analyses of many investigation reports, investigation process research, safety recommendation assessments, published document reviews, designing investigation simulations and software support tools, risk analyses, and teaching investigation courses.

1.3. Development of constructs.

The practice of law has existed for many centuries to resolve issues involving accountability for deliberate or accident harm or loss. Over that time, the legal domain developed and adopted many constructs to support needs exposed by its practices. Many of these constructs involved investigations to acquire facts and evidence to support the process used to reach conclusions required by law. These investigations of crimes and civil wrongs, including accidents, became increasingly sophisticated, starting toward the end of the 19th century, with criminal investigations influenced by the arrival of Sherlock Holmes, then fingerprint analysis, chemical analyses and lately DNA analysis advances, among others.

The practice of safety emerged in Europe, the United States and elsewhere around 1900, motivated by the industrial revolution and transportation advances, and their accompanying accident losses. As the safety domain evolved, legal investigations offered a convenient investigation process model to adopt for safety investigations. Legal practices had developed a substantial body of constructs. Safety investigations evolved much later, without an independent base of safety constructs, so existing legal constructs offered easily transferable models.

Involvement of lawyers in the development of safety legislation, regulations and investigation programs likely influenced safety program designs. However, developments in the legal domain and the safety domain have diverged. In the legal domain, developments focused on resolution of charges or issues, penalties, and building a body of case law for judicial proceedings. Meanwhile in the safety domain efforts evolved toward finding ways to modifying existing practices and prevent recurrence. Uses of safety investigations involved both retrospective and prospective application by a variety of users of new knowledge investigations disclosed.

2. LEGAL CONSTRUCTS IN SAFETY INVESTIGATIONS

This inquiry disclosed that numerous legal constructs are employed in safety investigations. At least seven legal constructs in safety investigations were discerned, from the similarities of

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elements of safety investigations and investigations conducted to support legal proceedings. Those similarities reflect legal constructs adopted in safety investigations.

2.1. Investigation Purposes: Context for Examining Constructs.

The purposes of legal and safety investigations and their constructs must be recognized to provide context for this inquiry. In the legal domain, one main purpose of legal proceedings is to provide an impartial and consistent process to resolve legal questions about some alleged acts or omissions during an occurrence that caused loss, injury or harm. Legal investigations support legal proceedings.

Legal proceedings exist to satisfy several societal desires, including the affixing responsibility for causing harm, penalizing harmful behaviors, justly compensating for losses or harm caused, discouraging harmful behaviors, and bringing closure for victims' concerns about the incident. These proceedings use constructs designed to deal with any kind of allegations involving acts or omissions that produce harm or loss covered by law. Legal proceedings are designed to achieve a win/lose binary outcome in courts. Parties propose issues for the courts to accept for adjudication. Once accepted, participants' objective in court proceedings is to "win" their cases by persuading juries or judges of the superiority of their arguments. Their arguments are based on "facts," developed by "legal" investigations, and admitted as "evidence" to support participants' arguments, and on participants' interpretations of existing law and precedents. Investigators, experts and lawyers select and combine facts to develop the cause(s) of what happened, to support participants' arguments. Each side presents its evidence in testimony, with supporting exhibits, to a jury or judge, offering the jury or judge choices for their deliberations. Juries or judges decide whether or not a party is guilty, culpable or liable, based on applicable law and the evidence presented them. Then the jury or judge also decides on the personal or economic consequences to be imposed on the guilty or culpable. Verdicts of innocence or assignment of penalties for the guilty are viewed as the end points of a legal process. A written record of each court proceeding is then produced for potential use as a precedent to cite during future proceedings.

Safety investigations address two similar societal concerns: the removal or modification of harmful behaviors, expressed as "prevention of recurrences," and closure of concerns, expressed as descriptions and explanations of what happened and recommendations. They also serve other purposes for a variety of safety investigation work product users, such as insurers, system designers, researchers, risk analysts, trainers, procedures writers, code and standard developers, and governmental regulatory entities. Safety investigation processes are similar to legal investigations in many ways due to their adoption of many legal constructs.

2.2. The case admission construct.

One legal construct controlling the introduction of disputes into the legal processes is the case admission construct. Any society experiences many kinds of disputes among its citizens, ranging from simple differences in values or beliefs to disputes with substantial societal or economic consequences. Referring all to a legal system for adjudication would pose an impossible workload on any system. Therefore, legal systems have developed tiers of legal processes and

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sets of requirements that disputes must meet before they can be introduced into the judicial system for adjudication, based largely on their relationship to some aspect of law. The tiers range from local magistrates to local, state, national and sometimes “supreme” courts with final jurisdiction, each with different case admission criteria

Safety investigation entities cannot investigate all accidental occurrences, so a similar “case selection” construct has evolved over time. The safety community has a similar “tier” of safety investigations, ranging from individual investigators as in minor industrial occurrences to private team investigations as in medical or larger industrial incidents, to national investigations. Some case selection decisions are mandated by governmental regulation. (USCFR 2015) Safety entities’ case selection construct is based largely on their impact on safety losses and future risks.

2.3. The adversarial construct.

Legal proceedings utilize an adversarial construct, rooted in ancient times, in which one party accuses some other party or parties of some injurious or harmful acts or omissions, and the other party defends against the accusations. The outcome is determined within a system of rules prescribed by law and precedents pitting one party’s arguments against another’s. Court proceedings provide an “umpire” (judge) to ensure adversaries conduct themselves by the rules. The composition of juries also reflects this construct.

Investigations supporting those proceedings must determine what happened, in order to identify who and what was involved, their role in the occurrence, and the consequences of their actions or omissions. Those findings provide one basis for *judgments* of parties’ guilt¹ or innocence by juries, e.g., the *binary* decision. The findings are also used in determining the subsequent imposition of reimbursement for the harm or punitive damages prescribed by law on parties judged to be liable or culpable.

This adversarial construct is also evident in safety investigation team practices and procedures. Governmental safety investigation entities use teams composed of organizational representatives in investigations. This reflects the adaptation of the adversarial legal construct to determine what happened. For example, in commercial aviation accident investigations, participation of “parties” in investigative groups is formally enshrined an internationally accepted standards and recommended practices. (ICAO 2001) Team members are expected to contribute information within the scope of their knowledge to advance the safety investigators’ determination of what happened by ensuring their interests are adequately represented in the data relied on for the agency’s cause and recommendation decisions.

Industrial safety investigation teams or committees are often created to conduct safety investigations in the more widely used investigation practices, especially in investigations of occurrences producing injury or harm. The teams typically are composed of members from differing organizational entities, disciplines, and relationship to the occurrence, or with specialized system knowledge. Expectations of such team members are the same as party

¹ Depending on the proceedings, guilt may be expressed as culpability, liability, or other term.

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representatives, except they may also be part of the cause determination decision-making process, much like jury decisions.

Adaptation of the adversarial construct is further reflected in the safety investigation report review process construct, where reviewers have an adversarial role of critiquing of reports.

2.4. The cause constructs.

The legal construct of cause permeates the legal processes, being used in legal investigations to explain what happened. Cause is an abstract characterization or construct of an “event-effect” relationship between two or more related events, actions, omissions, conditions, or some combination thereof. It reflects our culture, as one historian has noted:

“It [the paranoid style mode of cause attribution and its assumptions] presumes a world of autonomous, freely acting individuals who are capable of directly and deliberately bringing about events through their decisions and actions, and who thereby can be held morally responsible for what happens. We are the heirs of this conception of cause, and its assumptions still permeate our culture.” (Wood 2011)

Thus the cause construct accommodates a cultural desire for accountability. A very extensive body of constructs about “causal” relationships has evolved for use in legal proceedings, including cases involving accidental occurrences. (Honoré 2010) Outcomes of legal proceedings such as guilt or culpability findings are intimately tied to findings of causation.

Safety investigations adopted the cause construct in their earliest days. The cause construct remains a fundamental driver for safety investigation instruction and basis for recommendations. (Manuele 2014, USC 2004) The content of a Wikipedia article reflects the widespread perception of the role of causation in safety investigations

“**Accident analysis**² is carried out in order to determine the cause or causes of an accident or series of accidents so as to prevent further incidents of a similar kind. (Wiki 20143)”

Its significance is also discernable in the numerous “accident causation models” found in safety literature.³ It is also a discernible underlying concept in almost every currently used and proposed safety investigation methodology the author has reviewed. (JRC-IE 20122) In safety investigations, the cause construct is implemented in various ways, such as reported causes, probable causes, root causes, contributory causes, immediate cause, deeper cause or causal factors. Fixing causes or causal factors is a major goal of safety investigation recommendations.

2.5. The language constructs.

Language constructs used in legal proceedings have relatively high levels of abstraction as defined by Hayakawa’s ladder of abstractions (Hyayakawa1984). For example, the word “fact”

² Accident analysis is often used in lieu of accident investigation

³ A Google exact search for “Accident Causation Model” returned about 5000 hits.

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is an abstract construct assigned to selected and documented observations about what happened or is happening, as opposed to conjectures. Words like fact, evidence, negligence, culpability, accountability, fault, issue, admissibility and proximate cause are examples of abstract legal language constructs. Each is subject to individual interpretive judgments about meanings decided in individual proceedings.

Safety investigator's language is similarly abstract, resembling abstract legal constructs in many ways. Beside causes, it includes words and phrases such as fact, evidence, unsafe acts, unsafe conditions, factors, failed or failed to, human error, situational awareness, safety culture, inadequate, etc. (Benner 1995) Many correspond closely to the abstract legal language constructs.

2.6. The fact processing construct.

Another legal construct is the manner in which "facts" are processed in legal investigations. The sequence of gathering all the facts, then analyzing them, and then arriving at conclusions or summations, ultimately determined by a jury or judge, has been the fact-processing construct for many years. Investigation phases have been described as shown in Figures 1 and 2 below. (Johnson 1980)



Figure 1. Representation of classic phases of investigations

Alternatively safety investigation phases have been represented to illustrate each phase but slightly differently as shown in Figure 2.

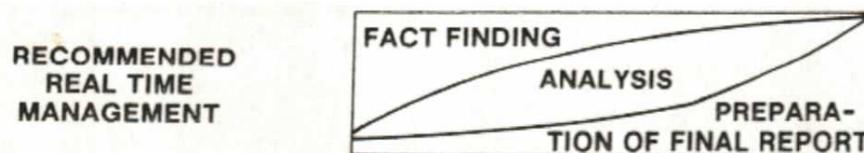


Figure 2. Allocation of time to investigation phases

Fact processing for presentation as evidence to juries by parties requires a series of judgmental decisions by investigators. When investigators observe an object or what a person is saying or has said, the first judgment required is whether to consider what they observe as relevant to their case. If so, a second set of judgments involves how to acquire the fact, within legal constraints for introduction of facts as "evidence." The next set of judgments involves the words in the legal lexicon that the investigators select to document their observations of such source data, which results in a statement of a "fact." The next set of judgments involves how the investigator analyzes and integrates each documented observation (fact) with other documented observations to prepare their description of what happened. The next set of judgments involves analysis and decisions about how to present the evidence as testimony describing what happened to juries or judges. These include constructs such as acquisition constraints, chain of custody requirements,

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and relevance, for example. Importantly, in each instance, the investigators' selection of words they use affects how faithfully they represent objective reality.

“Facts” sections in safety investigation reports, and the way data on accident reporting forms are accepted as factual illustrate the influence of this legal fact-processing construct on safety investigations. Safety investigators make the same judgments when dealing with “facts” but do so informally – and sometimes they too are challenged as in legal proceedings.

2.7. The fact admissibility construct.

The legal admissibility construct prescribes a form of “truth tests” for facts before they can be incorporated into arguments. The validity and utilization of facts is subjected to adversarial arguments during legal proceedings. The construct provides a filter for false, extraneous, spurious or unqualified facts before they are admitted for consideration as evidence during court proceedings.

This construct is not formally present in safety investigations, because they have no comparable *formal* admissibility rules construct for qualifying investigation data inputs before they are incorporated into descriptions of what happened. However it exists informally, when investigators personally exercise such data-qualifying judgments about what is a usable fact.

2.8. The work product constructs.

Courts prepare reports memorializing judges' and juries' decisions. Another work product from courtroom proceedings is a verbatim transcript documenting what was said as it was said during courtroom proceedings. Others prepare case reports with information such as a case header, a summary description of the issue(s), facts introduced into or excluded from evidence, issues about the application of law(s), the conclusions reached, and when applicable, damages or penalties imposed, or affirmation of prior decisions. All use natural language and sentence structure. Case reports are mostly in narrative format, prepared for archiving and search purposes by outside entities.

Safety investigations adopted the natural language and narrative report construct as one of the two constructs for reporting safety investigation results. This natural language legal construct influences safety investigation report structure, content, archiving volume, archiving search and retrieval ease, relevance determination, and analysts' interpretations. The other is accident-reporting forms. When forms are used, entries may include taxonomies and characterizations of data from narrative reports.

2.9. The archiving construct.

The constructs for legal case archiving and use vary with individual court systems. Once printed in bound volumes, legal archives have largely transitioned to digitized files, facilitating their access and retrieval. Court decisions by a court are archived at the court. Court case summary descriptions are indexed and “published” by other entities in hardcopy or digitized archives for

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public access and retrieval, typically for a fee. Generally, verbatim transcripts of court proceedings are available from court reporting entities, for a fee.

A similar archiving construct is used by public safety investigation entities: some provide public access to their investigation reports by anyone, while others offer access to their archives for a fee. When public hearings are part of a safety investigation, verbatim transcripts of the hearing are usually publicly available from the reporting entity. Investigating entities or data services may also archive extracted or characterized data in searchable data base format. Non-governmental entities that conduct safety investigations have not generally adopted the archiving construct for public access, except as required by governmental regulations.

3. EFFECTS OF LEGAL CONSTRUCTS IN SAFETY INVESTIGATIONS

The adoption or adaptations of legal constructs in safety investigation processes and their influence do not seem to be widely recognized or studied in safety literature. They do have discernable consequences.

3.1. Investigation Purposes

Legal and safety investigations both reflect efforts to address societal desires for ending of harmful behaviors and practices, as well as closure of concerns. Each depends on an understanding of what happened, but each uses that understanding in different ways.

Legal investigations are expected to support binary decision choices and imposition of restitution or punitive actions on the guilty. Safety investigations are expected to support a range of corrective or preventive actions. They also support other users, such as insurers, the media, regulators, litigators, trainers, legislators, and designers, for example, who would use safety investigation results to support their activities. These different users and purposes affect the constructs needed to serve their intended uses.

3.2. Case Selection

Until relatively recent years, the construct for safety investigation case selection decisions was narrowly defined, similar to the legal construct. Case selection depended primarily on physical harm, e.g., the casualties and damages involved, similar to the requirement for involvement of some unlawful act or omission for judicial case admission. This had the effect of minimizing investigations of “near misses” or perturbations where successful reactions or intervention interrupted the progression of the loss-producing process. After such occurrences, survivors could report their actions and rationales to investigators. As a consequence, much useful understanding and control knowledge of risk raisers during accident phenomena was delayed or lost, as evidenced by new insights into man-machine interactions, system design roles and socio-technical influences, for example, achieved in recent decades.

3.3. Adversarial Proceedings

Safety investigations involving two or more entities reflect the adversarial construct of legal

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processes. Because of the cultural association in social climates of conflating blame with cause for accidents, and with the pervasiveness of causal thinking in present safety investigation methodologies, each party participating in the investigation has an understandable incentive to avert the attribution of causation to any of its actions. This has the same potential detrimental effects on determination of a valid and complete descriptions of what happened as legal proceedings, particularly when legal constructs of facts, evidence and causation dominate. Parties can employ various tactics to avoid being assigned causation. For example they can do so by introducing extraneous hypotheses or facts during an investigation, which must be filtered out subjectively by someone leading the investigation. Among other defensive techniques, they can withhold full disclosure, coach witnesses before they give their statements, argue interpretations of source data, ask for alternative wording to raise the level of abstraction, or use passive voice. Meanwhile they can – and often do - undertake their own closed investigation to serve their investigation information needs. (Benner 1980a)

3.4. Attribution Of Cause(s)

Safety investigations are mandated, by law or treaty, to make cause determinations. (NTSB 2014, ICAO 2001) In safety investigations, cause determinations under the legal construct are by their nature subjectively defined, which can lead to different opinions and consequences. For example in a recent helicopter crash investigation, differing conclusions of causation were observed. Investigating agency staff recommended the Board cite the "punitive safety culture" of trooper commanders overseeing aircraft operations as part of the cause for a 2013 crash, but the Board voted unanimously to remove the word "safety" and point to simply a "punitive culture." (Alaska Dispatch News 2014) The change in scope of the cause from an intra-organizational function to the entire organization is readily apparent, illustrating how such subjective judgments can influence cause attributions and affect their impact in safety investigation work products

From a safety investigation *users* ' perspective seeking an understanding of occurrences on which they can act, difficulties arise when users attempt to use reported statements of causation, such as causes, probable causes, root causes, contributory causes or causal factors to determine if the occurrence is relevant to their activities, and what specific actions they could take in their activities to reduce future risks or other actions to satisfy their needs.

From safety investigator's perspective, the attribution of a cause to events, actions, omissions, conditions, or some combination thereof ultimately is an arbitrary abstract conclusion decided by investigators (like juries) made retrospectively, based on analysis of what happened, and heavily influenced by hindsight biases applied to known outcomes. Assignment of cause is a *de facto* analytical task, as contrasted with an occurrence reconstruction task. The same is true for the use of terms like failed to, inadequately, and human error in descriptions of what happened. Thus one of the detrimental effects of the legal cause construct is the conflation of analytical tasks and occurrence reconstruction tasks, comingling descriptions of objective reality with subjective judgments or conclusions.

Causation judgments can differ, as in the helicopter crash example. Cause attribution has become increasingly controversial in safety investigations, as the deficiencies of causal thinking for

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providing complete reconstructed descriptions of undesired outcomes of accidental processes have been identified, and for other reasons. (Macintosh 2010, Pruchniki 2014) They will continue to become more problematical as complexity and use of engineered entities and robotics increases

Other detrimental influences of the cause construct include but are not limited to

- linearity or “chain of events” thinking
- “but for” thinking applied to complex occurrences,
- prematurely terminated investigations,
- incomplete descriptions of occurrences and
- tolerance of ambiguous or highly abstract words and terms,
- oversimplification of descriptions and explanations of complex occurrences,
- acceptance of conclusions based on hindsight bias, and
- the potential for turning unintentional acts or omissions in crimes (Dekker 2003)

3.5. Language

Certain words, phrases and terms can undermine attempts to provide objective and complete reconstructed descriptions of occurrences. Examples include ambiguous words and terms like plural pronouns, group names, generic object names, and subjective conclusions or judgments based on hindsight. Or description detail can be masked as adjectives with words like inadequate, careless, inattentive, unsafe, failed, human error, etc. Such words or terms lack the specificity required to identify safety or risk raising behavior sets and context on which to base future actions. (Dekker 2008) If future occurrences are to be prevented by changing the behavior of some persons, objects or energies, specificity of words used to describe and explain what they did is essential. For example, what must one do differently to fix “inadequate” actions or requirements without providing an explanation for that judgmental statement? This problem was discussed in more detail in *Investigating Accidents With STEP*, (Hendrick 1986) including a list of words that can “poison” safety investigations.

3.6. “Fact” Processing

All investigations require the identification of relevant source data, and its transformation into data inputs used in the occurrence description. The facts-analysis-conclusion legal construct impedes safety investigators’ input data selection, documentation and integration into the description because inputs are not processed in a iterative interactive manner. This has the detrimental effect of making development of reconstructed descriptions difficult, similar to unassembled jigsaw puzzle pieces on a table. It leads to inefficiency because it enables a poorly focused “vacuum cleaner” pursuit of data. It is lengthy because of the time required to gather, analyze and assemble the collected data and pursue missing data revealed as the description evolves.

3.7. Fact admissibility construct

This fact admissibility construct is one legal construct that did not find its way formally into safety investigations. In the absence of such a formal construct, safety investigators make such

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judgments individually. This lack an objective quality assurance tool for facts they integrate into their reports, or for their reconstructed description, compels reliance on team dynamics. This undermines potential replicability for reconstructed descriptions.

3.8. Work product architecture

The legal work product architecture construct is incorporated in large measure in safety investigation work products. That construct uses natural language for reporting court proceedings including investigation results, and for case summary reports. Natural language describes what happened in a linear manner, stringing words together to tell a story or describe an occurrence. Legal proceedings are conducted orally, in natural language, and documented using natural language to report court proceedings. Those reports follow the facts-analysis-conclusions structure.

The architecture of narrative safety investigation reports generally follows the basic legal case reporting structure, but embellished with subparagraphs and illustrative content. Reports are usually expanded to include recommendations advocating certain actions, which are somewhat akin to verbal closing arguments advocating certain actions by juries or judges in court proceedings. This architecture requires agile readers, able to understand everything that happened and why it happened during the occurrence, and to connect that to the recommendations, because the reader must sequence and integrate overlapping events mentally, and then try to apply that interpreted information to the recommended future actions.

3.9. Work product archiving and sharing

Carrying over legal language and narrative constructs into safety investigation archives creates difficulties for both investigators and users. Ambiguous terms and characterizations used in the investigation reports and archives complicate search, retrieval and analysis tasks. The most objectionable consequence is that such terms require users to manually de-abstract or disambiguate contents to arrive at definitive reconstructed descriptions of what happened, or the issues, problems, lessons learned and actions they can use. Such terms also frustrate efforts to replicate the investigation results. (Benner 1989)

The use of accident reporting forms evolved as an alternative archiving tool for safety investigations. They pose other investigator judgment challenges described above. While data on forms lends itself to statistical analysis methods, it ignores or masks the specific data needed for users to select relevant problems to fix in their activities, and find deterministic ways to fix them.

The influence of legal adversarial, causation, language, fact processing, and reporting structure constructs impedes universal or even widespread sharing of safety investigation work products and data. (Benner 2012) Resistance to widespread public sharing of private safety investigation data exists for several reasons related to those legal constructs. One of the main reasons is concern about turning accidents into crimes or civil litigation alleging various legal constructs such as manslaughter, negligence, liability, standard of care, etc., with their emphasis on simplified descriptions. This is the source of continuing discord between the legal and safety domains. Concerns about the privacy rights of individuals involved, or protection of their safety,

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reputation, mental health or future cooperation are other concerns. Other occasional concerns are the perceived potential of other parties to use the shared data to generate adverse publicity for the entities involved, and potential revelation of trade secrets.

Lurking in the background is the question posed by Dekker: when does an accident become a crime, and who decides? (Dekker 2003) The answer is unresolved, due in part to the present influence of legal constructs on safety investigations, and in part to the demand for accountability for losses sustained in accidents, associated with cause attribution.

Even if present investigation results were all widely disseminated in full detail, the legal influences described above on the available report contents can result in contents too abstract, logically incomplete, flawed or judgmental to enable rigorous application of shared results. This suggests another motive for purging legal constructs from safety investigations.

4. PURGING DETRIMENTAL LEGAL CONSTRUCTS FROM SAFETY INVESTIGATIONS

Past safety investigation improvement research, including the author's (Benner 1980,1985) have focused primarily on improving *methodologies* within the existing investigation and safety paradigms, with only modest success. Today, about 20 investigation methodologies exist; each has reported investigation shortcomings. (JRC 2011) Consequences of the influence of several legal constructs on safety investigations noted during this inquiry indicate a need for safety investigation program managers, designers, investigators, and users to explore how those detrimental influences might be purged from safety investigation. Actions to accomplish that might include the following:

4.1. Safety investigation purposes.

Explore redefining present safety investigation purposes and purging of the causation determination construct. Consider changing the investigation focus from causal determinations and causal factor or cause-based recommendations to focusing on complete non-causal reconstructed descriptions of what happened, including all actions or behaviors that influenced what happened during the occurrence. Explore how to make safety investigation outputs suitable for all users of investigation information. This will require decoupling safety investigation purposes from accountability findings; such findings can be derived from reconstructed descriptions of what happened, but belong to other entities.

4.2 Case selection.

The safety investigation case selection construct which from its beginnings focused on physical losses for its selection of cases to investigate, has been changing in recent years to place greater emphasis on the safety investigation of "near miss" and operational anomalies without physical loss. Thus this detrimental narrow legal case selection construct is gradually being purged from safety investigations.

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4.3. Safety investigation processes.

Explore shifting to an alternative investigation process. Consider adapting a systems-based input/output framework for reconstructing descriptions of occurrences, to replace the adversarial construct and its detrimental effects with a more technically reproducible systems analysis methodology, as has been done in other domains like software development. This might contribute to resolving the discord between safety and legal domains about the use of safety investigations by developing criteria for safety investigation outputs that could be used for both safety, legal and research processes.

4.4. Beliefs about accidental occurrences.

Explore redefinition of accidental occurrences in processes terms to more closely reflect the true nature of these phenomena. Consider viewing accidental occurrences as processes during which interactions among people, objects and energies over time produce unintended and undesired interference with, disruption of or harm to intended activities and outcomes.

Today, the safety domain recognizes that actions and interactions during accidental occurrences can occur simultaneously or in parallel, which linear chain of events thinking is unable to accommodate. If accidental occurrences are recognized as processes, various tools can be employed to overcome this constraint. For example, a French investigating agency produced an integrated graphic display of known events over time in a report of a complex aviation accident. It laid out the interactions among each person or object involved, and their timing so the relationships could be visualized and tested. (BEA 2012)

4.5. Safety investigation language.

Explore the purging of all possible abstract, ambiguous, characterizations and judgmental terms and vocabulary from reconstructed descriptions of occurrences. Consider the goal of striving for greatest specificity of terms and words at the lowest level of abstraction for safety investigation reports. For example, focus on actions of people, objects and energies during occurrences, rather than factors, or culture or “did nots.” This step could facilitate users’ determination of occurrence relevance, and facilitate their implementation of appropriate responses. This step could also support occurrence reconstruction methods amenable to objective quality assurance, and diminish the influence of legal constructs like cause, culpability, blame, fault, etc., on safety investigations, thus encouraging collaborative investigative efforts. Informal experiments substituting other words for “cause” in all its forms for 30 days indicate it can be done easily. For another example of how this can be accomplished, see Table 1 in Miller’s paper. (Miller 1991)

4.6. Fact determination and processing.

Explore formalizing a safety investigations input data admissibility construct that does not mimic the legal admissibility construct. Consider standardizing specifications and criteria for safety investigation data inputs used in reconstructed descriptions of occurrences, to formalize present practices. Exploration of input data processing might include the transformation of empirically observed data into minimally biased, specifically worded building blocks for reconstructing a

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description of what happened. Another objective for exploration would be development of specifications for input data integration tasks, to support improved investigation efficiency, verifiability, and utility.

Recognition of these challenges and inefficiencies, combined with the legal construct's ambiguous vocabulary attributable to the adversarial fact processing model and cause attribution has already stimulated development of alternatives for safety investigation fact processing, and iterative integration of investigation inputs. Developments include arraying, linking and testing graphical representations of input data to develop reconstructed descriptions. These graphical representations enable investigators to identify relevance and relationships among the input data *efficiently as acquired*, so accumulating inputs can drive subsequent investigation tasks as the investigation progresses. They also provide for the temporal and spatial ordering or sequencing of input data as acquired, and linking to show interactions, thus displacing such determinations by juries in judicial proceedings. In addition, they further facilitate machine processing of such data.

4.7. Collaborative investigation processes.

Explore purging of all vestiges of the adversarial safety investigation process construct. Consider methodological alternatives with a technical "truth-testing" safety investigation construct and practices that would encourage collaborative inputs, input integration, and consensus on the reconstructed description ultimately developed. This would require purging of incentives for using defensive tactics when participating in safety investigations, which might be accomplished if previously suggested initiatives are successful.

4.8. Work product architecture.

Explore purging of legal constructs from safety investigation work products. For example, consider reporting the reconstructed description separately from a report of any analyses or interpretations of what happened. Any reconstructed description should be

- at the lowest possible level of abstraction,
- devoid of statements of causation judgments, interpretations based on hindsight or a priori experiences and
- dissociated from analyses of what happened and recommendations for future actions or other conclusions dependent on the description, reported separately.

It might include descriptions of the objects involved, and innovative investigation techniques.

Also, consider expanding the structure of reconstructed descriptions to the use of interactive graphic displays and related tools, using internet capabilities for frequent dissemination of updates during safety investigations to participating investigators, to help drive investigation tasks more efficiently, and present reconstructed descriptions in a more readily visualized, comprehensible and validated form. A revised construct could provide for safety investigation users to develop separate reports to describe results of their analyses of what happened, and perhaps add a list of risk-raising behavior sets. Users would be able to analyze reconstructed descriptions to satisfy their specific needs.

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4.9. Safety investigation data archives.

Explore purging the natural language and narrative archive construct and replacing it with the storage and dissemination of the building blocks and links used in reconstruction of the description of what happened. Consider developing an archiving construct to enable machine input processing, concatenation, dissemination and retrieval of individual and aggregated reconstructed descriptions or parts thereof by archived safety investigation data users. This could significantly enhance machine data search, retrieval and relevance determination for safety remediation, research and other purposes. Consider the development of machine-generated glossaries for people or object designations, to enable use during investigations and promote the depersonalization of such data to reduce data sharing reluctance. If new constructs increase safety investigation archives' value to more users, perhaps some arrangement for cost sharing of archives might deserve consideration.

4.10. Research considerations.

The suggested explorations will require supportive planning, talent and funding. Existing entities that could undertake such research challenges are not readily identifiable. The required talents to perform the work may exist in some academic, non-profit or private entities. Entities who could benefit from the research or are unsatisfied with present safety investigations could be likely financial contributors. Options for some of the steps are available as the result of the author's and others' prior investigation process research (ISASI 2014, IPRR 2014, Hendrick 1986, Benner 2007, 2010) and other places. Interested researchers can find examples and ideas in works posted at the author's web site. (Benner 2012a)

5. CONCLUSIONS

This inquiry identified several legal constructs that were observed in safety investigation constructs. Influences exerted by legal adversarial, causal, language, fact processing, work product and archiving constructs seem sufficiently detrimental to justify an effort to purge them from safety investigations. Recognition and acknowledgment of the influences of these legal constructs and their social implications for safety investigations is a necessary first step if such detrimental influences are to be purged. Purging them will require changes to present safety investigation thinking, purposes, processes, language and work product constructs. Some research suggesting some potential options for replacing purged constructs is available, while more research will be required to discover and define other options and prioritize changes. Entrenched interests and pervasive societal perceptions coupling accident causes with fault and blame will be difficult to change, requiring a lengthy sustained effort. Much work will be required to devise new safety investigation constructs that will enable achievement of improved investigation work product usage and value, and diminish tensions between the legal and safety communities.

Much of this inquiry involved safety investigations of transportation incidents. The inquiry results suggest that further examination of legal constructs and their influences safety

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investigations by other researchers in other fields could produce significant new understanding of such constructs' roles in and influences on safety investigation processes in all domains.

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