When Good Workers Ignore the Rules

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EXECUTIVE SUMMARY

There is a significant safety threat, which has, until now, been largely unstudied within Alberta's occupational health and safety community. Originally identified in high-reliability organizations (HROs) like aviation, the threat is called *procedural intentional non-compliance* (PINC).

Procedural intentional non-compliance is a term used to describe a condition in which well-trained and safety-motivated workers wilfully choose to ignore known rules and procedures. Such practice is also known by such colloquial terms as "procedural workarounds", "shortcuts", or "bending the rules". The phenomenon has gained significant attention within *High Reliability Organizations* (HROs), who have engaged in unobtrusive field observation of workers. It was observed that even in the most reliable organizations, PINC occurred in nearly half of all day-to-day operations (Helmreich, R., Klinect, J., & Wilhelm, 2010). Workers who engage in *"intentional"* non-compliance are two to three times more likely to experience *"unintentional"* errors (Ibid, 2010).

A critical finding of PINC research is that most workers tend to be safety conscious and not apathetic about the rules they must follow, nor do they act in a negligent manner. Quite often workers are highly motivated to do the safest job possible. As such, PINC often stems from problems with the procedures themselves, or the work environment, or the training, or the operational or peer pressures, or any host of factors that set the stage for wilful rule violations. With this logic, the degree to which PINC can be seen in an organization can be a measure of the organization's safety culture.

With full attribution, the research project incorporated portions of a PINC measurement methodology, first authored by the *Human Factors Research Group* at the University of Nottingham in the mid-1990s (HSE, 1995). At that time, the principal means for administering research was with paper and pen surveys. Today's modern technology has made available means of online anonymous surveys, which this project utilized.[1]

While the study of PINC is comparatively new in non-aviation circles, for nearly two decades the aviation industry has been leading the charge in studying PINC and its characteristics, with the *Federal Aviation Administration* (FAA) having identified PINC as one of the most significant human factors themes in major aviation incidents and accidents. Despite PINC's role as the dominant contributor in adverse events within high reliability organizations, it has garnered little attention outside of aviation environments. The lack of investigation around PINC in Alberta industry, or even its acknowledgement, is surely not because it is absent; more likely it is because it is a relatively new term in non-aviation industries, the study of which is long overdue.

[1] There are various terms used for procedural intentional non-compliance, such as procedural violations, ignoring the rules, willful disregard for the rules, procedural workarounds, procedural deviations, rule breaking, shortcuts, intentional non-compliance, or simply violations. In this report, they are used interchangeably.

The authors of this research project searched for methods to measure PINC in Alberta industry. The resulting online tool included 48 true or false questions and was completed anonymously by workers. The following are the study's key points:

- An important tenet for this project was that workers are motivated to avoid harm to themselves and others, and as such, would be inherently safety conscious. This was incorporated directly into the title of the study, "When Good Workers Ignore the Rules". The study validated this assumption. Workers did, for the most part, exhibit very high levels of safety motivation. This is a critical observation as it means that blaming workers for safety procedural deviations may be too simplistic and may be omitting opportunities to identify root causes of safety lapses and trends.
- The findings indicated that procedural intentional noncompliance occurs with great regularity and frequency in the test group and that there are several different reasons why it may be occurring.
- The presence of routine rule breaking can become increasingly normal within the workplace, particularly when peers do not speak up or correct such deviations amongst themselves. This is called "procedural drift". Such drift can metastasize throughout the organization and fundamentally alter the safety culture. This study supports the concept that understanding the degree to which good workers are ignoring the rules, and why, may be a reliable metric for understanding an organization's safety culture.
- The survey tool demonstrated utility in being able to identify solutions for various forms of PINC. This was a significant finding as few tools offer guidance on intervention.

Significant stakeholder-specific takeaways:

- ***For decision-makers***, the findings of this report offer an introduction to procedural intentional non-compliance, its characteristics, and its threat to safety. The report offers sufficient evidence that PINC should become a strategic focus within a wider human factors approach to safety culture and OHS incident investigations. Moreover, the study indicates that "blame and shame" approaches to safety incident analysis may be missing critical root causes of worker behaviour.
- ***For unions and workers***, the research supports the understanding that most workers are highly safety motivated and that forces exterior to the worker are often triggers for procedural workarounds. More importantly, the study emphasizes the importance of peer influence in ensuring procedural compliance to avoid procedural drift, in which deviations from procedure become normal.
- ***For government***, the study provides incentive to build focus on the analysis of human factors within safety programs and OHS investigations, with an educational program around PINC and its characteristics. Utilizing metrics, like the survey tool in this study, would also help in understanding the scope and depth of PINC in Alberta industrial sectors. Finally, there should be an awareness by OHS Alberta that many organizations seem hesitant to understand the degree to which PINC may be present in their organization – particularly if it challenges the "scapegoat" method of blaming procedural missteps on the individual who committed them. PINC and its role in understanding safety culture means turning the microscope inward, and as much as this is a better route to identifying real safety issues, non-HRO industries may not be accustomed or comfortable with this level of introspection.

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LIST OF ACRONYMS AND ABBREVIATIONS

HFRG: Human Factors Research Group
HRO: High Reliability Organization
LOSA: Line Operations Safety Audit
NTSB: National Transportation Safety Board
PINC: Procedural Intentional Non-compliance
ICAO: International Civil Aviation Organization
FAA: Federal Aviation Administration

INTRODUCTION

Many safety-conscious organizations in Alberta, and the world over, are aspiring to achieve a safety metric of "goal zero", identified as a safety target that seeks no workplace harm: be that injures or fatalities. Yet, despite this ambitious goal, one of the leading known ingredients of adverse events and incidents is being largely omitted from the safety calculus within Alberta organizations. Although comparatively absent from the safety lexicon in non-aviation industries, procedural intentional non-compliance (PINC) is one of the leading human factors concerns within aviation safety research. Even though PINC is commonly experienced outside of aviation – colloquially described as procedural workarounds, taking shortcuts, or bending the rules – the study of PINC in non-aviation settings is comparatively limited (Hale, and Swuste, 1998; English and Branaghan, 2012; Phipps et al., 2008).

The problem of procedural violations has been cited in numerous studies, dating back nearly three decades (Lawton, 1998; Helmreich, Klinect, and Wilhelm, 1999; Alper, 2009; Giles, 2013). While it has become a much more prominent theme in aviation psychology circles, and in particular, airline pilot training, it is evident in a variety of industries (Alper, 2009; Fogard and Shaw, 2010). Essentially, *intentional* non-compliance is a willful deviation from established procedures. In aviation, a distinction is made between *Procedural Intentional Non-compliance* (PINC) and *Procedural Unintentional Non-compliance* (PUNC) (Helmreich, Klinect, and Wilhelm, 1999; Huntzinger, 2006).

Currently, one of the most widely used methods for analyzing PINC is the line observational safety audit in aviation, which is known by the acronym *LOSA*. A single company may pay hundreds of thousands of dollars (and perhaps up to a million dollars) to have one LOSA study done; a commitment that is usually repeated every few years. As this may be out of reach for many Alberta organizations, this project sought to discover a quick and economical way for Alberta companies to identify and remedy PINC in their organization.

Hence, the objectives of this study were several:

1. To test the efficacy of the online survey tool for detecting the presence of procedural intentional non-compliance, within an organization.
2. To assess the degree to which procedural intentional non-compliance is occurring in Alberta's non-aviation industry sector.
3. To understand the utility of the tool in providing interventions to improve occupational health and safety in Alberta.

Much of what we understand about procedural intentional non-compliance and its threat to safety comes from aviation, simply because, to date, there have been very few research studies outside of aerospace.

The aviation industry, which is the gold standard for safety research, has put willful disregard for procedure, cutting corners, and procedural workaround, at the very top of the list of human factors impacting safety. Beginning in 1996, aviation safety researchers began observing aircrew on normal flights (using the aforementioned LOSA program) and discovered that nearly 50% of those flights had some degree of wilful deviation from procedure, shortcuts, or procedural workarounds. By the mid-2000s, those observations totalled nearly 20,000 flights, on over 70 airlines from around the world (FSF Staff, 2005). Aviation safety analysts now believe that intentional non-compliance was a contributing factor in 40% of the accidents worldwide (NBAA, 2015). Observations of well-trained crews showed that intentionally deviating from procedure could be a costly decision and typically results in a near 300% increase in "unintentional" errors (Werfelman, 2013).

Indeed, aviation research indicates that about 35% of all operations end up in an unintentional and undesirable situation that started with intentional procedural non-compliance. A study by Boeing discovered that some 80% of all aviation accidents since the late 1970s had contributing factors tied to procedural intentional non-compliance (PINC) (NTSB, 1994).

The literature identifies five distinct ways in which PINC manifests in an organization, as defined below (FSF, 2018; Reason, Free, and Parker, 1994); Reason, Parker, and Lawton, 1998). The HFRG also identifies various ways in which "violations" tend to manifest and evolve (HSE, 1995).

The first type is an ***unintentional*** violation and is very similar to what is commonly referred to as a "mistake". Such a deviation may arise from confusion, complexity, or some other factor that affects decision-making.

A second form of non-compliance is called ***routine*** and is tied to a progressive metastasizing of wilful non-compliance in a workforce. Over time, deviation from procedure becomes increasingly acceptable, primarily because no direct harm has yet been experienced by committing the non-compliance.

The third form of non-compliance is ***situational***. It refers to environments or circumstances in which following the rules is difficult, perhaps because of weather, lack of adequate or necessary equipment, personnel, or time.

Optimizing is the fourth form of procedural non-compliance. This form tends to appear when workers wish to engage in procedural workarounds or shortcuts, particularly during types of work that are otherwise time consuming or monotonous.

A final and fifth form of violation is called ***exceptional*** *and* refers to unique and unusual situations such as emergencies or abnormal circumstances in which the individual may wilfully choose to deviate from the rules because he or she feels it necessary to do so.

The Human Factors Analysis and Classification System (HFACS) characterizes "violations" as a Level 1 (Unsafe Act), along with "errors". The HFACS taxonomy, which was designed by the US Navy, is now readily used in both aviation and non-aviation circles. Using this taxonomy, researchers now know that human factors, and within that broad title, human error, are responsible for 80% of all aviation incidents and accidents (Rankin, 2007). A study of the oil and gas industry, using HFACS, showed that human factors are the most common cause of catastrophic accidents (Nwankwo, et al. 2021). In addition to a host of human factors, such as mental states, fatigue, motivation, the HFACS taxonomy includes "routine violations" (RV) and "exceptional violations" (EV) (HFACS, 2021). Of course, HFACS is not the only analytical taxonomy or investigative method available. Indeed, there are over forty common templates for human factors safety investigations (Benner, 2019).

Of the various forms of human error, intentional non-compliance constitutes nearly 25% (Shappell, et al., 2006). A study of the nuclear industry and offshore oil and gas industry demonstrated that intentional non-compliance accounted for 16% of all accidents (Gordon, 1998). Moreover, in these industries, 92% of all accidents could be traced back to human factors – to the decisions and actions of people – rather than mechanical or machine fatigue or failure (Gordon, 1998).

Despite PINC being the number one human factor under investigation in high reliability organizations, at the time of this writing, there were no references to PINC on the Alberta Government OHS website. Investigation reports on Alberta's OHS website were also void of "human error analysis" sections, which are a matter of routine in investigative reports for high-reliability organizations.

When PINC is absent from investigations, the risk is that reports may focus on a sequence of events for an incident as a means to ultimately unearth blame. Typically, employees tend to have high regard for personal and team safety outcomes, and as such, the question of why otherwise conscientious and safety-motivated workers might choose to wilfully deviate from the rules can be confounding. This presents an apparent paradox, and it is one in which the authors of the study have chosen to write directly into the project title: *When Good Workers Ignore the Rules.* The emphasis on "good workers" underscores the complexity of the issue and also avoids the trap of simply blaming workers for the problem – a route that serves little purpose in organizational learning. As this study will demonstrate, the issue of procedural non-compliance is highly nuanced and can be the result of a variety of factors, even unrealistic or overly cumbersome procedures, which of course, are no fault of the worker. In many respects, workers are the eyes and ears of the organization's safety culture, and we would do well to listen and observe, in order to orient policies and practices accordingly.

Despite expressed interest in improving safety cultures, many organizations remain reactive in nature – assuming that workers will follow the rules, and should they not, administer disciplinary action toward the offending individual. However, in many such cases the individual's actions are often symptomatic of an organizational culture that has become outspokenly tolerant of day-to-day intentional rule-breaking. Putting it bluntly, the hunt for "bad apples" approach may well be missing out on opportunities to prevent future harm by ignoring the presence of a contaminated safety culture.

Outside of aviation (and other HRO) circles, the assessment of procedural intentional non-compliance is conspicuously absent from the safety calculus. This is odd indeed, given procedural non-compliance's emergence as one of the greatest threats to occupational safety. Alberta corporations and organizations whose stated aims it is to bring adverse events and workplace fatalities to zero are, in most cases, not including analyses of one of the most significant and abundant contributors to incidents and accidents.

While other industries may be late to the party with respect to the investigation of PINC, there are some studies that indicate how the problem is manifesting in non-aviation settings. One such study looked at intentional violation of procedure when delivering medications in healthcare settings (Alper, et al., 2006). The study discovered that nurses routinely sidestepped medication administering protocols up to 30% of the time – and up to 53% of the time in emergency situations. Once again, we employ the phrase "good workers" and ask why such violations may have been chosen? A study of pharmacists revealed that violations occur in that vocation as well, but deeper analysis revealed that many of the pharmacists believed that specific cases in which the procedural non-compliance was carried out actually benefitted safety (Jones, Phipps, and Ashcroft, 2018). In this approach, the authors of the study made a distinction between Safety-I violations and Safety-II violations.

With respect of PINC, Safety-I sees the violation as primarily negative and as wilful disregard for safety procedures. (Safety-I is the dominant philosophy in healthcare, where protocols are established to mitigate harm and blame is given for procedural violations that lead to adverse outcomes). Safety-II sees the violation as situational and potentially safer when the user is faced with unusual complexity. Safety-II allows for flexibility and is often judged by what went right, rather than what went wrong (Hollnagel, 2015).

It is important to note that highly trained and safety-motivated workers can be among those who deviate from the rules. In some cases, it's the rules themselves which are unrealistic or outdated. In fact, negligence of duty is exceedingly rare. This is the reason why it can be so difficult for organizations to pin down why good workers, who, by all measure, are conscientious, may choose not to follow procedure, take shortcuts, or engage in workarounds. This study starts from the assumption that any procedural deviations are being done by safety-motivated employees.

At a deeper level, systemic PINC can become normalized as workers increasingly accept the taking of procedural liberties as normal. This "procedural drift" can ultimately redefine the safety culture of the organization (Helmreich, Klinect, and Wilhelm, 2010). Such drift has also been studied in healthcare (Amalberti, et al. 2006). Indeed, procedural drift was cited as a significant contributing factor in the Space Shuttle Challenger disaster, during which NASA had also adopted the "goal zero" mantra.

Procedural drift requires widespread complicity beyond the individual level. It feeds from a gradual and increasing acceptance that deviation from procedure is the norm – not the exception. Consider a simple example of workers driving a company truck at 60 km/h in a 50 km/h zone. If the particular stretch of road is free of construction, is straight and clear, and there are no perceived threats, then the driver may deem the risk associated with bending the rules as very low and acceptable. The literature discusses a number of moving parts in this scenario.

First, there are several ways in which the driver may perceive the risk. One of the most common and useful understandings is risk homeostasis theory (RHT), whereby we evaluate the threats around us and adjust our behaviour accordingly (Wilde, 1998). If the above driver was driving in a winter storm, she may see the conditions as a threat and so as to maintain her risk comfort level (her risk homeostasis), she may adjust her behaviour to drive more cautiously. This was also seen in Sweden, when the country switched from left-lane driving to right-lane driving. Experts expected a spike in car collision rates but were surprised when collision rates dropped – again due to drivers operating their vehicles with exceeding caution after the change (Barrett and Francescutti, 2020). Interestingly, the opposite is also true in risk homeostasis theory. Although still debated, when we deem our environment as lower risk, we tend to adjust our behaviour to become more aggressive or daring so as to maintain an ideal level of risk (Pless, 2016). This was noted with the introduction of new ABS (braking) systems in cars, after which it was noted that drivers seemed to adjust their behaviour to follow the car in front more closely.

In our example of driving 60 km/h in a 50 km/h zone, RHT would suggest that the driver adjusted her behaviour to compensate for the low-risk environment. Taken to an extreme, driving 80 km/h might be perceived as too risky, adding an element of legal penalty or worse, so RHT would suggest there is an ideal risk level that is perceived by the individual and supported by peers.

Continuing with this example, if this driving over the speed limit was common, then it could be characterized as a "routine" form of PINC. Procedural drift occurs when this work community accepts that rules can be broken as a matter of routine and begins to expand on the ways in which this cultural behaviour is applied.

The literature discusses three criteria that facilitate PINC. First, the individual must assess the intentional non-compliance as having some sort of reward ("This will save us a lot of time"). Second, the individual can reference examples of favourable outcomes with similar deviations or deems their skills adequate to do it ("I've done it before, and we saved time with no one getting hurt. I can do it"). Third, peers do not speak up or they encourage the non-compliance ("Everyone does it and no one seems to mind") (Barrett and Francescutti, 2020).

In short, the three ingredients of intentional non-compliance: 1) a perceived reward, 2) a perception that the risk is acceptable, and 3) some form of peer support (Huntzinger, 2006; Giles, 2013).

PINC can also occur at the organizational level. NASA's experience with the Space Shuttle Disaster is one of the most famous cases. Using the above three criteria we now know that NASA had extreme pressure to not delay the Challenger launch further. Second, despite known O-ring issues on the main rocket boosters, they had successfully launched 24 times and thus had examples of successful outcomes. Third, there was a culture in which individuals and teams felt constrained in speaking up and that it was easier to go along with the greater organizational consensus (Rogers, 1986).

This study sought to bring the concept of procedural intentional non-compliance to the non-aviation industry in Alberta. To do so, the research group adopted a known investigative platform, first developed by the Human Factors Research Group (HFRG), at the University of Nottingham. The study, originally a pen and paper research program, was adapted to an online format. The questions that were asked provided guidance as to the degree of intentional non-compliance. From this, a weighting of responses provided direction as to the type of non-compliance, and by what means the non-compliance could best be addressed. As such, the study provided methods for determining the type of intentional non-compliance, the reason for it, and the paths of intervention. At the time of conducting the research, and to the best of our knowledge, no other project for understanding procedural intentional non-compliance was in place in Alberta, despite its role as one of the single biggest contributors to adverse events. The other challenge for Alberta organizations and companies were cases in which the operator acknowledged a problem with rule breaking but did not know why it was happening, nor how to correct it. This was precisely the scenario that the online tool in this study was designed to address.

The aim of this investigation was twofold. The first was to understand whether the original HFRG pen-and-paper protocol could be adapted to an online format and function as a tool to understand PINC in non-aviation settings, in

Alberta. The second, was to understand to what degree PINC was evident in Alberta industry and whether any discernible patterns existed – findings that could ultimately assist in intervention.

On the first point, the study provided evidence that the tool did function as expected, illuminating operational areas in which workers were intentionally deviating from procedure. On the second point, the analytical methodology proved useful in translating the raw data answers into meaningful reasons for the deviations and also points of corrective action.

While the study ultimately obtained a suitable test population, a challenge in administering the study was the rather unexpected unwillingness of Alberta industry (in general) to engage in a program that could potentially highlight safety culture issues was notable; this, despite the widespread expressed interest in safety culture as a priority. This general hesitation is markedly different from HROs, which spend a great deal of time and money willingly examining their own cultures for any potential deficiencies. Despite the known significance of this theme, many organizations expressed tentativeness when provided a tool that could understand the degree to which intentional non-compliance was impacting their safety culture.

Those in the business of injury and accident prevention tend to spend a great deal of time looking at two fundamental antecedents of workplace accidents: procedural issues and human error. We know, anecdotally, that by and large, Alberta workers are well intentioned, conscientious, and that they wish to avoid injury. Indeed, the priority given to frontline safety during this researcher's visits to Alberta worksites was clearly visible, and yet one common problem seems to be raising concern amongst worksite supervisors: when workers ignore the rules and procedures.

Regardless of why someone feels there is good reason for their non-compliance – such as feeling that the procedures are outdated, are inadequate, that they know the job better than those who write the rules, that the procedures are too slow, that they are only written to satisfy legality issues, that they are for new hires only – researchers know that once PINC is committed, the worker is up to 300 percent more likely to suffer an *unintentional* error (Werfelman, 2013). In research, the relationship is linear: the more PINC that is noted, the more unintentional errors increased (Werfelman, 2013).

The problem facing industry in Alberta is that the prevalence of PINC is unknown. Where it is measured on a regular basis is in aviation, one of the least risk-tolerant industries in the world. There, studies indicate that a PINC event will likely occur on 50% of all commercial flights (Werfelman, 2013). The US *Federal Aviation Administration* report indicates that 75% of all accidents can be attributed to human error, and of these, the number one leading cause was pilot "disdain for the rules" (2012). If these numbers represent aviation, one wonders what the statistics are for Alberta industry?

METHODOLOGY

RESEARCH QUESTION: What are the factors leading to procedural intentional non-compliance (PINC) in the Alberta industry sample? What are the key areas of intervention?

Research Design

The research design was quantitative and diagnostic in nature, employing a structured survey to unearth the incidence of willful procedural non-compliance in the subject cohort, the reasons for the non-compliance, and the possible points of intervention. Forty-eight true or false questions were asked in the survey. Each question (or more than one question) corresponded to one or more of thirteen possible reasons for procedural non-compliance (A through M). Some questions pertained to more than one reason.

The research design replicated some of the methodology developed by the University of Nottingham *Human Factors in Reliability Group* (HFRG) (now Human Factors Research Group). The HFRG research methodology was first published in 1995 under the title *Improving Compliance with Safety Violations: Reducing Industrial Accidents* (HSE 1995). The HFRG methodology borrows its “violation classification system” from the work of safety icon, Professor James Reason, who first outlined the classification system in his landmark book, *Human Error* (1990).

This original HFRG project is well documented as a “Project Handbook” (HSE, 1995) and provides a detailed open-source template, which HFRG refers to as a “guide”. Of course, in 1995 the use of the Internet for research was extremely limited and the original HFRG was done with pen and paper. This provided an opportunity to move the survey online.

The project was conducted with full attribution for the fine work the University of Nottingham’s HFRG, as well as Professor James Reason, did in creating the measurement tool and open-source guide.

Data Collection

The research employed online surveys administered amongst several different operational departments within a large Alberta organization.

Individual worker-participants were invited to volunteer through the parent organization. Any workers who elected to complete the survey did so anonymously. This extended to any identifiable features of the respondents such as the departments in which they worked. A decision was made to treat all of the various departments as one single cohort so as to preserve anonymity, as well as boost statistical representation.

A forty-eight-question survey was promoted and administered. Both online and paper versions were offered. Approximately forty surveys were completed on paper and were transcribed to the online platform by the research team. In total, 205 surveys were completed.

The original HFRG guide identified thirteen (A-to-M) reasons for possible procedural non-compliance (HSE, 1995, p.28). This project called these thirteen reasons, “constructs”. (See Table 1). Examples include: “rules and procedures – aims and objectives”, “rules and procedures – application”, “job design”, “supervision”, and “logistic support”. These represent target areas in which organizations can focus their intervention efforts.

The thirteen constructs were placed in graph format (solutions across the top and the forty-eight questions down the side). Where the solution and question intersect, they were either relevant or they were not (using true or false). For example, “rules and procedures – application” would be relevant to the questions: “I sometimes can’t get the equipment needed to work the rules” and “some rules are very difficult to understand”, but it would not be relevant in terms of the questions: “schedules seldom allow enough time to do the job according to the rules” and “there are financial rewards to be gained from breaking the rules” (HSE, 1995, p. 27).

While the original HFRG was being used as a template, this research project differed from the original HFRG guide insofar as the research survey here contained “true or false” options, while the original HFRG guide used a Likert Scale.

Survey items were written so that endorsing them as “true” indicated more likelihood of making a safety violation. Thus, higher scores on surveys corresponded to an environment that fostered more safety violations.

The 48 items “crossover”, capturing multiple constructs. For example, Item 1: “My work procedures are not always the best way to do my job” is part of construct A (Rules and Procedures – application), C (Training – rules and procedures), D (Training – hazards and risks), I (Plan and Equipment Design and Modification) and K (Work Conditions).

Sample Study Population

Prior to analysis, the characteristics of the sample were reviewed. There were 206 respondents listed in the initial file. However, one participant had no responses, so this case was deleted giving a final sample size of 205. The survey was 48 items in length providing a total of 9,840 data points. Responses were "true" coded "1" and "false" coded "0". Of the 9,840 data points there were 46 non-responses. These were randomly distributed throughout the data set and constituted less than 0.5% of the total. Thus, mean substitution (i.e., 0.5) was used to replace these missing values.

The reported gender of respondents was: 70% male, 4% female, and 26% preferred not to say.

Protocol for Data Scoring

The 48 items in the survey capture 13 different constructs regarding safety procedures as described by the *Human Factors in Reliability Group (HFRG) Violations Subgroup* of the Health and Safety Executive (1995). The constructs are listed in Table 1.

Table 1: HFRG Constructs

Label	Description
A	Rules and Procedures - design
B	Rules and Procedures - application
C	Training – rules and procedures
D	Training – hazards and risks
E	Safety and Commitment - workforce
F	Safety and Commitment - management
G	Supervision – monitoring and detection
H	Supervision - style
I	Plant and Equipment Design and Modification
J	Job Design
K	Work Conditions
L	Logistic Support
M	Organization

Providing scores for these constructs was carried out by associating the responses to items with their various constructs as per Table 5 in the *Human Factors in Reliability Group (HFRG) Violations Subgroup*. Specifically, the following protocol was adopted:

1. Total scores for each item across all 205 participants were generated.
2. These totals were divided by 205 to give a mean value for each item ranging from 0 – 1.
3. Each average value was assigned to the constructs to which it had been associated as per the Human Factors in Reliability Group (HFRG) Violations Subgroup.
4. Construct totals were generated.
5. Because the number of items making up each construct varied from 7-20, the construct totals were divided by the number of items assigned to the construct.
6. This rendered a final score for each construct that reflected a standardizing of both the number of participants responding “true” to the statement as well as the number of items that constitute the construct. These scores can range from 0 – 1, with higher scores indicating that the factor is more problematic from a safety violation perspective.

Interventions

The aim of any OHS research should be to reduce injuries and fatalities. The researchers employed the HFRG intervention methodology, which contains “recommendations for solutions” (HSE, 1995, p. 29). In this section, the HFRG authors outlined thirteen solutions for constructs A through M (see Table 1). In this study, the areas identified as significant constructs were used to articulate interventions (or solutions).

RESULTS

Construct Scores

The construct scores provide the most useful information for users of the survey. These constructs represent areas which show evidence of intentional non-compliance, and as such, the themes in which intervention efforts should focus. In Table 2 we see how each question along the side matches with a particular construct (A through M in Table 1) along the top. As a reminder, only the constructs that are applicable to the question have a score. If the field is blank, it means that the construct is not applicable to the question.

For example, Question #1 asks, “My work procedures are not always the best way to do my job” (True or False). The constructs that are applicable are A, C, D, I, and K. Another way of stating this would be: if a worker believes that the company procedures are not ideal or somehow inappropriate when compared with the reality of the work, then the problem could be the design of the procedure (A), the *on-the-job training* (C), the *training of managing hazards and risks* (D), *how the equipment is designed* (I), or *work conditions* (K). These constructs are most relevant to the first question of why a worker may feel that the company procedures are not the best way to do the job.
These constructs may also be relevant to other questions as well. For example, the design of rules and procedures (construct A) is also measured by questions 1, 2, 3, 4, 9, 11, 12, 13, 14, 15, 17, 19, 25, 28, 32, 33, 35, 41, 45, 48. With 13 constructs (A-M) and 48 questions, the resultant scoring can indicate a trend as to which constructs are most pertinent.

Not all constructs had the same number of questions pertaining to them. For example, construct A had 20 questions that offered metrics, while construct K had 7 pertinent questions. To handle this disparity, the total construct scores for each column was divided by the number of applicable questions to provide an average. This was recorded at the bottom as “construct score”. The higher the construct score, the more applicable the construct to addressing intentional non-compliance. While one could feasibly rank all the constructs from high to low, in this study any constructs that had a score over 0.5 were highlighted as areas of priority action.

The construct scores ranged from a low of 0.43 (J Job Design) to a high of 0.57 (L Logistic Support) (see Table 2).

The 5 highest construct scores were associated with:

1. A: Rules and Procedures – design
2. G: Supervision – monitoring and detection
3. I: Plant and Equipment Design and Modification
4. K: Work Conditions
5. L: Logistic Support

These are the areas on which the subject organization should focus to reduce the likelihood of safety violations.

The Utility of the Survey Tool

Apart from the specific results for the subject organization, the project team was also interested in understanding the utility of the survey tool for use in Alberta industry. To date, very few tools have been devised that can help companies and organizations understand PINC in a timely and economical way. Airlines often pay hundreds of thousands of dollars to do an audit that assesses procedural compliance – and they do it often in order to identify corrective trends. Arguably, this is an economic barrier to many Alberta companies and a barrier that could be costing lives. This study has provided some evidence as to the effectiveness of an alternative. Importantly, the internal analysis of the tool, during the study, provided some level of confidence that the tool was measuring what the research team expected it to do. A psychometrician assisted in providing these measures.

Internal Consistency Analyses

Internal consistency analyses (Cronbach's alpha) were carried out on the sets of items comprising each of the 13 constructs (see Table 3). These indicate how well the items "hold together" in terms of a single construct.

The construct scores as well as the internal consistencies of each construct and the number of items comprising each construct are noted in Table 3. Internal consistencies ranged from a low of 0.51 to a high of 0.84. Moderate values are about 0.70. Constructs with larger numbers of items tend to have higher reliabilities than those with fewer items, thus the constructs with fewer items tended to have somewhat lower internal consistencies than those with more items. The utility in interpreting these results is that the scores associated with them will be more/less reliable based on their internal consistency.

Principal Components Analyses

Principal components analyses were conducted on the 13 different sets of items comprising the constructs. These also indicate the degree to which the items form a unified single construct. It also provides information as to the contribution of each item to the constructs.

Component loadings associated with each construct are presented in Table 4. Loadings above 0.30 are considered substantive. The analyses suggest that most of the items comprising the constructs are relatively good indicators of that construct. However, items 2 (Management recognizes that deviations from the rules are unavoidable) and 38 (There are financial rewards to be gained from breaking the rules) had low loadings for all constructs with which they were associated.

Solutions Identified in the Study

The aim of the research is to arrive at recommendations or solutions that can ameliorate the threat posed by procedural violations. The HFRG outlined several points of potential intervention according to which construct was identified in the survey (HSE, 1995). The following points were identified in the study Results and are expanded in the Discussion.

As noted, the research pointed to the following as being significant constructs:

1. A: Rules and Procedures – design
2. G: Supervision – monitoring and detection
3. I: Plant and Equipment Design and Modification
4. K: Work Conditions
5. L: Logistic Support

Each construct (A, G, I, K, and L) have varying possible interventions. The scope of this study did not include enacting the interventions, to test their effectiveness. As these avenues for solution were not directly observed in the study yet ultimately hold significant value as a product of the research course, they will be expanded upon in the Discussion section.

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Table 2: Items and Construct Scores

Item	A	B	C	D	E	F	G	H	I	J	K	L	M
1. My work procedures are not always the best way to do my job.	0.55		0.55	0.55					0.55		0.55		
2. Management recognizes that deviations from the rules are unavoidable.	0.46					0.46		0.46	0.46		0.46		
3. Sometimes I don’t have enough time to do the job according to all the rules.	0.47					0.47			0.47			0.47	
4. Some rules make the job less efficient.	0.81				0.81				0.81		0.81		
5. Sometimes I can’t get the equipment I need in order to follow all the rules.		0.44					0.44		0.44			0.44	
6. Some rules are impossible to follow.		0.44							0.44	0.44	0.44		
7. Sometimes it’s necessary to bend the rules in order to get the job done.			0.56	0.56	0.56	0.56							
8. The rules are not written in simple language.		0.28	0.28										
9. Some of the rules are difficult to understand.	0.42	0.42	0.42										
10. Some rules reference other rules.		0.81										0.81	
11. Some rules are factually incorrect.	0.39												0.39
12. I have found better ways of doing my job than those given in the rules.	0.61			0.61					0.61	0.61			
13. Sometimes the rules are too restrictive.	0.65			0.65						0.65			
14. I often encounter situations for which there are no specific rules.	0.67											0.67	0.67
15. There are no guidelines for situations in which rules don’t apply.	0.50		0.50	0.50				0.50					0.50
16. Sometimes I don’t know why I have to follow rules.			0.15	0.15				0.15					
17. Some rules do not need to be followed to get the job done safely.	0.47			0.47									
18. Some rules are only for inexperienced workers.				0.16	0.16								
19. Some rules are so complex that I lose track.		0.34	0.34										
20. Some rules are only of value to 'protect management's back'.	0.56					0.56							0.56
21. Sometimes conditions at the workplace stop me working to the rules.						0.51	0.51		0.51		0.51		
22. No system exists to check that employees understand the rules and procedures.			0.42			0.42	0.42						0.42
23. Workers often break the rules.				0.57	0.57	0.57	0.57	0.57					
24. There are hidden benefits, like doing more, or finishing earlier, when some rules are ignored.						0.43	0.43			0.43			0.43
25. I can get the job done quicker by ignoring some rules.	0.57			0.57	0.57		0.57		0.57		0.57		

26. Deviations from rules are not always corrected by a superior.						0.68	0.68	0.68					
27. Shortcuts are acceptable when they involve little or no risk.				0.38	0.38		0.38						
28. There are circumstances where management will support rules bring broken.	0.42					0.42							
29. Management sometimes pressures people to break rules.				0.24		0.24			0.24				0.24
30. Other workers sometime pressure people to break the rules.				0.64	0.64		0.64						0.64
31. Staff shortages sometimes result in rules bring broken to get the job done.						0.59	0.59					0.59	
32. There are some rules where your natural reaction would be to break them.	0.55								0.55				
33. Contractors are allowed different safety standards.	0.37					0.37							0.37
34. There is no efficient procedure to monitor that rules are being followed.						0.53	0.53						0.53
35. Supervisors rarely discipline workers who break the rules.	0.51					0.51	0.51	0.51					
36. It is unlikely that somebody would be detected if they broke the rules.					0.43	0.43	0.43		0.43	0.43			
37. There are no benefits for workers who strictly follow rules or procedures.				0.53				0.53		0.53			0.53
38. There are financial rewards to be gained from breaking the rules.						0.04							0.04
39. I am sometimes tempted to do work that is not my responsibility.				0.64			0.64			0.64			
40. I am not given regular break periods when I do repetitive and boring jobs.										0.13	0.13		
41. Working to the rules can reduce skill.	0.15									0.15			
42. Deviating from some rules demonstrates knowledge of the job.				0.32	0.32		0.32			0.32			
43. I sometimes have difficulty getting hold of written rules and procedures.						0.39		0.39				0.39	
44. I sometimes come across a rule I did not know about.			0.79									0.79	
45. I have rules for tasks I will never have to do.	0.54	0.54	0.54										
46. I have not been trained in rules to be used in unusual circumstances.		0.46	0.46										
47. I often come across situations with which I am unfamiliar.			0.37							0.37		0.37	
48. I sometimes fail to understand which rules apply.	0.45	0.45	0.45										
CONSTRUCT SCORE	**0.51**	**0.46**	**0.45**	**0.47**	**0.49**	**0.45**	**0.51**	**0.47**	**0.51**	**0.43**	**0.50**	**0.57**	**0.44**

Table 3: Construct Scores, Reliability and Number of Items Associated with Each Construct

Label	Description	Construct Scores	Internal Consistency (Reliability)	Number of Items
A	Rules and Procedures - design	.51	.83	20
B	Rules and Procedures - application	.46	.74	9
C	Training – rules and procedures	.45	.80	13
D	Training – hazards and risks	.47	.82	19
E	Safety and Commitment - workforce	.49	.73	9
F	Safety and Commitment - management	.45	.84	18
G	Supervision – monitoring and detection	.51	.84	15
H	Supervision - style	.47	.67	8
I	Plant and Equipment Design and Modification	.51	.75	12
J	Job Design	.43	.71	11
K	Work Conditions	.50	.51	7
L	Logistic Support	.57	.72	8
M	Organization	.44	.76	12

Table 4: Principal Component Loadings

Item	A	B	C	D	E	F	G	H	I	J	K	L	M
1. My work procedures are not always the best way to do my job.	.432		.435	.474					.462		.572		
2. Management recognizes that deviations from the rules are unavoidable.	.106					.070		.160	.075		.126		
3. Sometimes I don't have enough time to do the job according to all the rules.	.500					.536			.575			.600	
4. Some rules make the job less efficient.	.542				.534				.561		.620		
5. Sometimes I can't get the equipment I need in order to follow all the rules.		.560					.456		.621			.687	
6. Some rules are impossible to follow.		.497							.525	.479	.573		
7. Sometimes it's necessary to bend the rules in order to get the job done.			.609	.662	.628	.597							
8. The rules are not written in simple language.		.584	.541										
9. Some of the rules are difficult to understand.	.554	.735	.610										
10. Some rules reference other rules.		.339										.247	
11. Some rules are factually incorrect.	.495												.515
12. I have found better ways of doing my job than those given in the rules.	.617			.579					.623	.559			
13. Sometimes the rules are too restrictive.	.638			.640						.614			
14. I often encounter situations for which there are no specific rules.	.496											.560	.564
15. There are no guidelines for situations in which rules don't apply.	.475		.501	.410				.504					.530
16. Sometimes I don't know why I have to follow rules.			.424	.434				.394					
17. Some rules do not need to be followed to get the job done safely.	.558			.668									
18. Some rules are only for inexperienced workers.				.458	.501								
19. Some rules are so complex that I lose track.		.687	.624										
20. Some rules are only of value to 'protect management's back'.	.713					.662							.668
21. Sometimes conditions at the workplace stop me working to the rules.						.670	.594		.711		.710		
22. No system exists to check that employees understand the rules and procedures.			.479			.556	.463						.631
23. Workers often break the rules.				.528	.641	.571	.650	.706					
24. There are hidden benefits, like doing more, or finishing earlier, when some rules are ignored.						.481	.600			.614			.478
25. I can get the job done quicker by ignoring some rules.	.488			.556	.637		.599		.484		.487		

26. Deviations from rules are not always corrected by a superior.						.658	.706	.702					
27. Shortcuts are acceptable when they involve little or no risk.				.481	.479		.340						
28. There are circumstances where management will support rules bring broken.	.471					.605							
29. Management sometimes pressures people to break rules.				.348		.478			.534				.534
30. Other workers sometime pressure people to break the rules.				.505	.562		.575						.529
31. Staff shortages sometimes result in rules bring broken to get the job done.						.642	.617					.706	
32. There are some rules where your natural reaction would be to break them.	.568								.555				
33. Contractors are allowed different safety standards.	.293					.317							.292
34. There is no efficient procedure to monitor that rules are being followed.						.613	.614						.596
35. Supervisors rarely discipline workers who break the rules.	.357					.552	.575	.650					
36. It is unlikely that somebody would be detected if they broke the rules.					.514	.520	.562		.373	.486			
37. There are no benefits for workers who strictly follow rules or procedures.				.603				.691		.614			.620
38. There are financial rewards to be gained from breaking the rules.						.131							.157
39. I am sometimes tempted to do work that is not my responsibility.				.464			.544			.562			
40. I am not given regular break periods when I do repetitive and boring jobs.										.263	.322		
41. Working to the rules can reduce skill.	.400									.471			
42. Deviating from some rules demonstrates knowledge of the job.				.533	.544		.365			.537			
43. I sometimes have difficulty getting hold of written rules and procedures.						.481		.504				.628	
44. I sometimes come across a rule I did not know about.			.602									.690	
45. I have rules for tasks I will never have to do.	.497	.503	.487										
46. I have not been trained in rules to be used in unusual circumstances.		.533	.567										
47. I often come across situations with which I am unfamiliar.			.505							.302		.438	
48. I sometimes fail to understand which rules apply.	.518	.638	.712										

DISCUSSION

Limitations

Limitations include a smaller than planned sample size, largely due to participation hesitancy by prospective subject organizations and companies, some of whom suggested that they did not wish to unearth findings may highlight the need for corrective action. Despite discussions as to the proactive and preventive benefits of understanding procedural problems as a metric for improving safety culture, many companies seemed more content not to know. As will be explored in the discussion, this view may differ between the executive branches and the safety management branches.

Key Points of Discussion

The project confirmed that procedural intentional non-compliance does occur in Alberta's non-aviation sector. The survey tool demonstrated utility in identifying where PINC was occurring, to what degree, and how to ameliorate it. These findings satisfied the first and third objectives of the study. The second objective, which was to assess the degree to which PINC is occurring in Alberta's non-aviation sector was limited by the number of subjects in the study. With a greater number of subjects from various industry sectors, the research could, with confidence, confirm the wider incidence of PINC across several Alberta industries. Regardless, it is promising that the survey tool exhibited significant effectiveness in the research setting.

The success of the survey tool in identifying PINC is important as it provides evidence that the survey could be an economical human factors tool for Alberta industries.

In summary, the objectives of this study were several:

1. To test the efficacy of the online survey tool for detecting the presence of procedural intentional non-compliance, within an organization.
2. To assess the degree to which procedural intentional non-compliance is occurring in Alberta's non-aviation industry sector.
3. To understand the utility of the tool in providing interventions to improve occupational health and safety in Alberta.

The primary objective of the survey was to understand why a worker may willfully deviate from procedures so that an organization can articulate interventions appropriately. If one regards the constructs (A through M), it becomes apparent that none of them suggest that a worker is insubordinate, uncaring, lazy, or lacks safety motivation. Yet, it is not uncommon for companies to assess "violations" of procedure as willful disregard for safety or dereliction of safety duties. While this may seem a valid and prudent determination by the organization – as we know (from the literature review) that any willful deviation from procedure can create a condition ripe for unintentional error – chronic deviation from procedure indicates a systemic problem, and one that is almost surely linked to the organization's safety culture, not merely individual actions.

Alberta's most recent (pre-Covid) provincial summary on illness and fatalities describes the current statistics on the incidence of workplace harm and fatalities (OHS, 2021). Among the strategic recommendations is increased education. The document provides a link for education which takes the reader to the OHS Alberta educational publications to help facilitate and foster education. Yet, among the many downloadable documents, there are none on human error analysis or procedural intentional non-compliance – themes that dominate the work of high-reliability industries.

Organizational Learning

Too often, the easiest road in attempting to understand why an injury or incident occurred is to hunt for a trail of neglect. It is, perhaps a part of the human condition that we wish to categorize stakeholders into easily definable boxes of guilt and innocence. This is particularly true of severe outcomes in which we wish, and sometimes need, a party to blame. While "blame and shame" finger pointing may offer some degree of closure in the short run, it rarely elicits system or cultural change.

In viewing the public *Investigation Reports* on the Alberta OHS website, one can read about the details and the "sequence of events" pertaining to incidents with fatal outcomes (Alberta, 2021) but there is little with respect to the question of "why" the incident may have happened? Indeed, the reports are nearly void of analyses. Compare this to an aviation incident report, where all conceivable variables are included in an analysis, including procedures (and violations) and human factors like organizational safety culture, workload, fatigue, stress, communication, leadership, and team dynamics. We know that these latter components are what cause the majority of incidents and accidents today (Helmreich, Klinect, and Wilhelm, 2010; FAA, 2012; Chizaram, et al., 2021). Therefore, any incident report that concludes by saying "recommend better hazard identification" is simply missing the point that such shortcomings are most often due to human factors.

To use this example of hazard identification, in nearly all field operations there are standards in place to identify and assess workplace hazards. Simply concluding that "workers need to do a better job of hazard assessments" avoids the more complex task of understanding why workers may not be doing a good job of it? What is happening behind the scenes that is promoting this behaviour? This deeper level of analysis is needed to help improve the "system" and allow organizations to learn from each other's adversity, so they do not have to make the same mistake.

While there is most often a host of external and internal human factors that routinely threaten safe operations, this study focused on one specific area: procedural non-compliance. In keeping with the theme of analysis, it's important that we recognize that procedural violations can be a symptom of much deeper safety culture issues. It can also be the symptom of bad rules, or quickly changing work conditions that render procedures impracticable, or many other possible factors captured in the thirteen constructs (A through M) noted in this study.

Importantly, this research offers an alternative to simple "blame and shame" approaches that seek to find a guilty party.

The HFRG (provided considerable detail as to the potential avenues for intervention under each construct (HSE, 1995). The top five constructs were:

1. A: Rules and Procedures – design
2. G: Supervision – monitoring and detection
3. I: Plant and Equipment Design and Modification
4. K: Work Conditions
5. L: Logistic Support

The following illustrate the possible themes that are informing each construct and constitute means of solution for the subject organization.

A: Rules and Procedures – Design

1. Generally, this construct indicates that there is a mismatch between the rule and practice.
2. Rules may conflict with each other or be less than realistic for daily field work.
3. It is common that new rules may be hastily written in response to a report or incident and are sometimes seen as impractical by workers or simply put in place to show that action has been taken.
4. If rules are deemed inappropriate or outdated, workers (and sometimes supervisors) may even permit workarounds to get the job done.
5. The "design" of rules rests in the domain of management responsibility. While the workers may not be always following the rules, this construct suggests that it may be because the workers deem some of the rules as poorly designed when compared to the realities of the job.

G: Supervision – Monitoring and Detection

1. This construct suggests that workers may be committing procedural violations because they feel there is little oversight or confirmation that they are following procedure.
2. Rules are sometimes not followed if supervisors seem to ignore infractions as a way to expedite and complete tasks.
3. As the OHS investigations indicate, there is an emphasis on identifying workplace hazards with insufficient emphasis on workplace culture or behaviour. Workers may feel that this means that the most important task is getting the job done – not the means of doing it.
4. In extreme cases, supervisors may promote violations in order to save money and time.

I: Plant and Equipment Design and Modification

1. There are instances when the design of the machinery or controls are cumbersome in specific operating environments.
2. Equipment or facilities can also cause fatigue through vibration, noise, or prolonged postures that are stressful and tiresome, leading to distraction or error.
3. Equipment can be the wrong size, speed, or ill-suited for the operational terrain. Workers may feel forced to do workarounds in order to get the job done.
4. Difficulty accessing proper equipment in a timely manner can often cause workers to come up with shortcuts.

K: Working Conditions

1. Working conditions consider the environment, such as noise, vibration, long hours, or lack of proper rest or breaks.
2. Conditions can also be administrative or logistical in nature in which the rules are incongruent with the perceived needs of the workforce. Staffing levels, shifts, supplies, break times, and organizational stress can contribute to conditions in which workers consider creative ways to modify the rules.

L: Logistic Support

1. The timely access to proper tools and safety equipment are often cited in this category and precipitate workarounds or procedural violations.
2. The timely delivery of equipment if not carried out well can mean workers have to find ways to work around the missing materials or support.

It is notable that several of these priority constructs have very little to do with workers exercising wilful disregard for procedures in the face of safer methods. In this study, the subject group exhibited significant procedural violations but nearly all of these can be attributed to perceived lack of support. This is an important finding as it underscores the importance of avoid “blame and shame” approaches in which the reasons for the violations may well be missed. When we overlook such underlying themes in investigations, there are two significant risks: the first is that we may unwittingly omit the real reason for the intentional non-compliance, and second, workers may lose faith in the safety system when they feel forced to modify rules, and then are punished for it.

The findings show that the existing means of investigation with respect to incidents is likely missing crucial pieces of the puzzle with respect to “why” workers may fail to follow procedures. The evidence in this study indicates that simple conclusions of “do better” in terms of hazard identification or procedures are too parochial in nature and are not adequately serving the Alberta OHS community.

Considering the significant results of this survey, is anticipated that further applications of the survey tool will yield similar findings in other Alberta organizations. The application of the tool, as an efficient means of identifying procedural intentional non-compliance is promising.

Safety Culture and Procedural Drift

The literature discusses the concept of “procedural drift” (Helmreich, Klinect, and Wilhelm, 2010) as a process in which small violations, over time, become increasingly accepted as normal. The rising divide between “on paper” rules and daily practice can create a host of problems beyond the immediate errors that such practices might induce. The larger threat is the gradual contamination of the safety culture in which procedural violations become normalized and where opposition to rule breaking can be a social risk for workers. This was the case with the Space Shuttle Challenger disaster – and, arguably, if can happen at NASA, it can happen anywhere.

One of the contributions of this project is illuminating how and why safety cultures may slowly erode over time to the point at which unintentional errors can become a significant threat. With safety culture remaining a somewhat amorphous concept in the OHS world, having a concrete way of pointing to contributing factors may be an exceptional breakthrough.

CONCLUSION

High reliability organizations have long recognized procedural intentional non-compliance (PINC) to be one of the most significant threats to safety. Indeed, in these industries wilful procedural violations are routinely measured. This is not so in non-aviation industries, including those in Alberta. The absence of this dominant human factors theme in Alberta’s OHS literature and investigation reports is notable.

This research was designed to replicate portions of an older pen and paper method of measuring procedural intentional non-compliance (HSE, 1995) using modern online survey platforms. Thirteen possible reasons (constructs) were employed.

The survey confirmed that procedural intentional non-compliance existed in the subject group. Additionally, the results provided sufficient data to rank the thirteen constructs, from most evident to least. The top five constructs were used to understand where intervention (solutions) is most likely to mitigate procedural violations.

Importantly, the findings support the idea that wilful violations of procedure can often be attributed to problems with the procedure itself, the work environment, or organizational culture or constraints, and not worker apathy or negligence, as is so often assumed. This may be one of the more significant findings of the study and supports the phrasing used in the study's title: "when good workers ignore the rules"; emphasis on good workers and not neglectful workers. The study finds that "blame and shame" approaches to incident or accident investigation are likely to be missing the root cause of the procedural violation.

The conclusions of the study are sufficiently substantive to provide recommendations that are likely to enhance safety in Alberta.

1. Organizational leadership and decision makers (including Government) should appreciate the presence of procedural intentional non-compliance and its characteristics. Moving beyond overly simple "blame and shame" approaches is instrumental in finding real solutions. Moreover, procedural violations should become normal lexicon in Alberta Government safety investigations as well. Deeper human factors analysis needs its own category in public OHS investigations, with an appreciation for the link between observed procedural issues, internal and external human factor threats, and organizational safety culture. Simply describing the sequence of events that led to an adverse outcome is falling short of the potential learning that close calls or actual incidents provide.
2. For field workers, their unions, and management staff, the study's conclusions provide evidence that most wilful procedural violations may have little to do with worker negligence, errors, or apathy. Most of the reasons for wilful disregard for rules are tied to organizational issues and perceived work environment constraints. Workers, unions, and management staff should incorporate the human factors narrative and PINC within their support of safety goals, if not insist on it. As most workers are highly motivated to work safely, they are in an ideal position to help address routine violations that can slowly contaminate a safety culture. Education and training in PINC and its link to culture, and the fact that procedural violations have little to do with individual blame, can go a long way to achieving these aims.

As this project introduces and validates procedural violations within Alberta industry, the opportunities for knowledge transfer are significant. As stated in the points above, the need cannot be overstated that there be a process of education with respect to the prevalence and characteristics of procedural violations and the associated human factors science. Such knowledge transfer will take place with the test subject organization in July of 2021 and similar workshop style presentations will ideally occur with other leading Alberta organizations. In addition, Alberta safety inspectors and investigators would also benefit from this form of outreach, so that they can best decide how to incorporate the research conclusions into their overall approach. The research team noted in this study is also willing to share the knowledge gained by this project and to discuss the importance of PINC and its effects, in workshops style seminars.

As the research limitations noted, the Covid-19 pandemic did reduce the willingness of some organizations to engage in research. Many companies undoubtedly perceived research as an extraneous activity in a time of emergency operations and reduced staffing levels. As such, it is recommended that further research be conducted around PINC as well as further testing of the survey tool, which has demonstrated its low-cost effectiveness.

Overall, the conclusions indicate that procedural intentional non-compliance is present and linked to organizational and cultural issues, despite its relative absence in Alberta's safety lexicon.

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