



# Seeking a scientific and pragmatic approach to safety culture in the North American construction industry

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## ABSTRACT

Safety culture remains a key concept in occupational safety management. In the North American construction industry, regulators are growing increasingly interested in safety culture as phenomenon, requiring a demonstrable 'good safety culture' for a license to operate. However, safety culture is arguably unable to deliver on such ambitions. It remains undefined and the field of safety science that surrounds it is fragmented and incoherent, unable to support theory building and the generation of universal knowledge. Although a variety of models and methodologies can be applied in the research of safety culture, they are often vulnerable to a fallacy of logic – they combine component safety parts and claim the whole as culture – or to more fundamental ontological and epistemological limitations around external validity. Considerations of the investments of time, money and resource for such examinations should also be considered. Here, we unpack these ideas further and make the case for increased coherence in 'safety culture research', with a focus on both scientific rigor and pragmatic application. We reflect on the theory, discussions and debates made to date with the ambition of illuminating areas of commonality and those of conflict within the safety science academic and practitioner communities. Ultimately, we argue for the elimination of safety culture from the safety science lexicon. Instead, robust research of its various component parts, and their relationships to safety performance, will be better able to support the generation of valid and reliable knowledge that also enhances the development of the field of safety science as a whole.

## 1. Introduction

It is unlikely that the authors of those three little words – 'inadequate safety culture' – written in the summary report of the 1986 Chernobyl nuclear disaster (International Atomic Energy Agency 1986) quite realized the extent of the consequences that would result for the field of safety science. Deceptively simple and neatly abstract, it was through this first formal recognition that safety culture as a concept has become, in Bisbey et al's (2019:89) words, 'an enigma that has plagued the literature with debate.'

And what voluminous debate there has been. Academically, myriad frameworks and models have been developed to demonstrate the components, emergence, and perpetuation of safety culture, both construction-industry specific and generic (e.g., Cooper 2000; Choudhry et al 2007; Feng and Trinh 2019), there have been equally numerous attempts to develop effective approaches for implementation (e.g., Hudson 2007), measurement, and monitoring (e.g., Molenaar et al 2009; Probst et al 2019; Churrua et al 2021), supplemented by meta analyses

(e.g., Deepak and Mahesh 2023) and more philosophical musings on theory, utility, and practice (e.g., Antonsen 2009; Hopkins 2016; Schulman 2020; Le Coze 2020). In industry, a 'positive safety culture' endures as a corporate goal, safety professionals tasked with its establishment and improvement, as captured through the ubiquitous safety culture survey (Alruqi et al 2018), the results of which are ultimately valorized through Corporate Social Responsibility (CSR) or Environmental Social and Governance (ESG) Reporting (Hallowell et al 2024). Safety culture remains a topic of ongoing debate in many professional forums and is seeing growing regulator interest through its inclusion as a required demonstrable competency for licenses to operate (e.g., California Office of Energy Infrastructure Safety 2023).

However, as Bisbey et al (2019) also go on to note: 'One would think a construct of such persistent dispute would eventually assume its place in the past, rather than continue to propagate through future research...' The fact that safety culture has *not* assumed its place, nor shows any inclination to do so, raises some critical questions for the safety science community.

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The maturity of any field relies on the agreement of the definitions of key terms and concepts used therein, which can then be applied precisely and consistently to any empirical work to ensure resultant findings and data are equivalent and thus comparable. Without such agreements, safety science, when addressing safety culture at least, becomes fragmented and incoherent, theory building falters, and the generation of universal knowledge stalls. And all of that which has gone before has been delivered without an agreed definition as to what safety culture actually *is* or *is not* (Hopkins 2018). This is where we currently find ourselves as academics and practitioners. As Hale (2000) succinctly put it: ‘confusion reigns.’

We should also concurrently reflect on the *utility* of safety culture as a scientific concept for both academia and practice. When looking to agree on a scientific definition of a phenomenon, a level of pragmatism is required to ensure research is practically achievable and appropriately resourced. If, for example, we accept safety culture to be a socially constructed phenomenon (e.g., Blazsin and Guldenmund 2015) and define it as such, then appropriate relativist methodological tools such as ethnography or discourse analysis should be employed in its evaluation. Yet such research approaches take considerable time and resources to deliver effectively, which may explain why they remain relatively rare, despite the popularity of the conceptualization. Alternatively, if we accept safety culture to be the manifestation of the values and beliefs of the workers (e.g., Fang and Wu 2013), we must either methodologically accept quantitative self-reporting from realist ontological perspectives (as we do through safety climate surveys which are themselves not unproblematic, see Guldenmund 2007), or seek to unpack them through rationalist ontological means and interpretivist approaches to qualitative data, for example through the application of grounded theory. Fundamentally, if we do not look to philosophical foundations in our considerations of safety culture and in the development of a standard and practical definition, we are at a very real risk of becoming unscientific when research of same is undertaken in the field using inappropriate methodologies.

Rather than lament this current predicament, we should consider this a serendipitous position for action.

If it is to endure and support scientific advancement, safety culture must be defined and the definition subsequently governed and applied consistently. We can and should create a definition that inherently makes research effective and pragmatic. We ought to take this opportunity to create a foundation that enables research to be efficiently undertaken and which generates findings readily able to inform enhancements in practice. Pragmatic methodologies (as distinct from pragmatism) and methods of safety culture evaluation should help inform its scientific definition, and vice versa. Yet to our knowledge this relationship, necessarily symbiotic to effectively enable scientific research of safety culture, has to date been largely overlooked within the literature.

It may be the case that safety culture should not be defined, nor even used as a key concept in our understanding, knowledge, and research of safety. It may simply be too tainted and problematic for any future utility. As Hopkins (2018:35) noted, it is only a relatively recent ‘Johnny-come-lately’ to the field of safety. An alternative approach may be that some of its many suggested ‘components’, such as safety climate, are instead defined, agreed, and put into the safety management and research toolkit individually, with appropriate methodologies ascribed for scientific evaluation in the field. Indeed, given the melee that has gone before, the fragmentation and ultimate destruction of safety culture into some of its more useful and utilizable aspects may be the catalyst needed to bring enhanced rigor to its research. Rather than seeking the holy grail of a ‘universal theory’ of safety culture with an agreed scientific definition and prescribed methodological approach for evaluation, it could well be preferable to simply let it explode into its component parts, which would enable the full palette of methodologies to be applied as appropriate for the research question or hypothesis. This would support good research.

In this paper, we develop these ideas further and make the case for increased coherence in ‘safety culture research’, with a focus on both scientific rigor and pragmatic application. We reflect on the theory, discussions and debates made to date with the ambition of illuminating areas of commonality and those of conflict within the safety science academic and practitioner communities. Our own industry of interest is construction, one of the most dangerous in the world (ILO 2024) because of its high hazard, dynamic workplaces, and peripatetic workforce (Sherratt 2016), and one in which a ‘good safety culture’ unsurprisingly remains a popular goal. We share empirical work in the form of data generated by expert informants and the wider community of safety professionals to unpack how safety culture is currently perceived, managed and operationalized in the North American construction industry to add color to our theoretical considerations. Despite this focus on construction, which has unique idiosyncrasies all its own, we also hope our discussions find meaning and resonate for all industries across the world. Ultimately, we suggest a way forward for safety culture able to support the generation of valid and reliable knowledge that also enhances and supports the development of the field of safety science as a whole.

## 2. Theoretical reflections: The problem with safety culture

Papers about safety culture are often rather formulaic. They begin with the requisite nod to the 1986 Chernobyl incident and citation of the report from which safety culture first emerged (which we duly followed ourselves in tribute), rapidly followed up by a firm statement that despite this, and considerable subsequent research into the phenomenon, there is no clear agreed definition (e.g., Hale 2000; Guldenmund 2000; Edwards et al 2013; Hopkins 2016; Schulman 2020). A table showing many of the different definitions previously proposed by various academics often follows, with some discussion of the most notable among them before the authors either select one to follow or simply ignore all of them, set out their own, and rapidly turn to the important matter of their empirical work.

Given the volume of this body of work and *meta*-analyses previously undertaken by others (e.g., Guldenmund 2000; Biseby et al 2021), there is no appetite, desire or arguably even need for yet another *meta*-analysis of the body of safety culture research to date, and so we make no apology for not undertaking that particular venture again. Instead, our discussion will focus on the consequences of the body of safety culture research for the field of safety science, in line with our expressed focus on both science and pragmatism and the desire to catalyze a positive change in ‘how we do things around here’ (Guldenmund 2000).

### 2.1. Defining safety culture

As Bautista-Bernal et al (2024) summarize, amongst the melee of definitions of safety culture there are mentions of: ‘...values, beliefs, norms, attitudes, roles, practices, perceptions, assumptions, competencies, behavioral patterns, characteristics, priorities and organizational features along with employees, groups, systems, managers, organizations and customers.’ To date, safety culture has been suggested to incorporate or encompass all these things and more, yet this is a significant vulnerability in both the scientific and pragmatic nature of safety culture itself as it then falls foul of the truism (att. Lencioni) that when something is everything, it might as well be nothing. If *all* things safety are also part of safety culture, are we not just talking about safety? With culture simply becoming a shorthand collective noun? And if *everything* is important for safety culture, then nothing is. This alone makes a good argument for the removal of the collective construct of safety culture from the safety science lexicon.

A further problem of definition emerges from the often bounded nature of safety culture conceptualizations. Hopkins (2018), for example, argues convincingly that, ‘the way we do things around here’ is an ideal definition for safety culture, being reflective of a collective ‘we’

that reflects the fundamental tenet of culture within the social sciences that it is a characteristic of a group. Yet Schulman (2020) critiques this same definition for omitting the ‘...attitudes, beliefs and assumptions, values and motivations that lie behind the behavior.’ Schulman uses the ‘individual context’ to help describe safety culture, noting that safety happens at the sharp end with the individual, and so personal engagement is also critical. Bautista-Bernal et al (2024) bring this together and go still further, noting that ‘Safety Culture goes beyond individual attitudes and beliefs, encompassing aspects such as preventive thinking, collective responsibility, effective communication, continuous training, proactive risk management and the adoption of safe practices at all levels of the organization.’ Thus, safety culture is part of the social collective, the individual, and the organization, spreading itself further into everything and becoming all the less relevant for doing so.

The safety community has yet to alight on a definition. Safety science often takes an extensional approach to safety culture that does not help its definition – seeking to define it by listing all the things it can include. Such an extensional approach sets out to list what various elements, factors, dimensions, or components (this terminology varies as much as the included content) make up safety culture – all of which can vary from definition to definition. This is fundamentally unhelpful for several reasons: It does not enable clear and simple communication between academics on the phenomenon, it negates meaningful comparisons between construction sites, firms, and sectors, and it prevents scientific evaluation in the truest sense. Mature scientific fields have agreed and shared definitions to enable scientific endeavors to be carried out effectively. For example, astronomy moved from an extensional definition of a planet (which was until that point simply a list of all the planets in our own solar system) to an intensional definition which was able to define a planet through just three applied rules (International Astronomical Union 2024). Following this change, Pluto was no longer classified as a planet in scientific astronomical terms, but astronomers can now converse much more precisely about their research of planets in the wider universe.

This brings us to a point of clarity on our current predicament. If something is everything – the social, the individual and the organizational – and we have not been able to meaningfully agree any boundaries within that space, to then attempt to list that ‘everything’ through an extensional definition becomes utterly quixotic. Indeed, given this complexity, a single workable scientific intensional definition is likely unachievable; a hypothesis reinforced by the bald fact that we have simply not been able to achieve it thus far. A set of rules for definition may be a workable alternative, however scope, boundaries, and the lack of clear definition for much of the ‘everything’ remain problematic. For example, ‘commitment’ of the worker, supervisor or leader is a commonly incorporated dimension/element of safety culture, but ‘commitment’ is just as messy a concept as culture itself with no accepted definition and myriad conceptualizations of its own (Klein et al., 2009) and thus defining ‘culture’ through ‘commitment’ does not help move us forward scientifically. Indeed, as many of the elements often used to define safety culture extensionally are themselves inconsistent, and often not easily measurable in scientifically valid ways, their incorporation within a ruleset is also problematic. If we require rules to explain the rules, then the rules are not really assisting proceedings quite as much as perhaps they should.

However, fundamental to discussion of definitions and how to move safety culture research forward scientifically, the pragmatic should also be taken into account. Thus, the methodologies and methods that surround the research of safety culture should also be taken into consideration when unpacking the concept as a whole.

## 2.2. Safety culture models and research methodologies

A fair place to start methodologically is with the various models of safety culture that have been proposed, which is a point on which we do as a community have a certain level of agreement. Grounded in the work

of Edwards et al. (2013), Guldenmund (2010), and Silbey (2009), three theoretical models of safety culture have emerged over time, with differing repercussions for definition and methodology. The three models are:

- Model 1 – engineered (Silbey 2009) and normative (Edwards et al. 2013). Safety culture is grounded in organizational management, processes, and procedures around safety.
- Model 2 – analytical (Guldenmund 2010) and pragmatic (Edwards et al. 2013). A safety culture revealed through measurable attitudes and behaviours.
- Model 3 – emergent (Silbey, 2009), anthropological (Edwards et al. 2013) and academic (Guldenmund 2010). A socially constructed safety culture revealed through shared understandings, meanings, and beliefs.

Methodologically, these models each find affiliation with a different ontological position, Model 1 with realism, Model 2 with rationalism, and Model 3 with relativism. This naturally leads to associated epistemological positions, through which we can see the mobilization of Positivist approaches for Model 1, Interpretivist for Model 2, and Constructionist/Constructivist for Model 3 (depending on any leaning towards the collective or individualistic). Within the realm of methods, again we can see naturally emerging relationships; Model 1 revealed through documentary data analysis and the mere presence of rules, policies, and procedures; Model 2 approached through proxies such as worker surveys, interviews or observations; and Model 3 which is the most difficult to ‘measure’ as such nuanced elements of safety culture require immersive longitudinal studies and ethnographic work that returns safety culture research to its social science origins (Dennison 1996). It could even be suggested the models follow safety culture through what is *done*, what is *thought*, and what is *felt* about safety.

These three Models can be found throughout safety culture research, even when they are not explicitly referenced. Here, we are using examples from recently published papers on the topic of safety culture to illustrate our further discussion of these Models. However, we want to be very clear that in no way do we feel the papers we have selected are themselves lacking scientific rigor or in their contribution to the wider body of work. Rather, this is research we have found highly valuable in our own studies, but which clearly mobilize safety culture in the form of one of the Models noted above. Here we are seeking to unpack the Models, not the specific research, through the illustrative examples provided by these studies. Thus, this work helps us illustrate the limitations of the Models within the wider safety culture context, and we would like to thank the authors in advance for allowing us to use their work to that end.

For example, Bautista-Bernal et al (2024) drew on 6 variables for their study involving safety culture from an ESG database: the presence of a health and safety policy; the presence of a policy to improve health and safety along the supply chain, the existence of a health and safety team; the provision of health and safety training; the provision of this training to the supply chain; and whether the firm has achieved OHSAS 18001 or ISO 45001 accreditation. This conceptualization of safety culture clearly falls under Model 1. Given the wider aims of their work – to evaluate long term safety performance and financial performance – this is a highly pragmatic approach given the public availability of this data and thus relative ease of its collection. Indeed, Bautista-Bernal et al (2024) make a welcome contribution in their findings that companies that undertook the above did have improved safety and financial performance. But this begs the question; can the mere presence of such policies/activities be deemed to reflect the existence of a positive safety culture? Particularly when it has long been argued that policy itself does not always equal practice (Zohar 2008). There remains an internal contradiction between Model 1 and the wider body of research which argues that it is what we actually *do* that matters, not what we are supposed to do (Hopkins 2016).

Model 2 is most commonly revealed through the use of surveys, which also tend to adopt an extensional definition and thus a component approach to safety culture. For example, the study by Tappura et al (2022) seeking to develop a 'satisfactory safety culture by developing its key dimensions' used a survey of two firms to unpack the relationships between safety culture and employee satisfaction. Their conceptualization of safety culture was structured around a number of familiar dimensions drawn from the literature: management commitment, supervisor commitment, training, employee commitment and communication. The tool used in this study was effectively a safety climate survey. It sought the opinions of workers on specific safety-related aspects of their work, and thus their opinions are used as proxies for the common attitudes and behaviors found in those workplaces. Although the use of surveys for culture work can be problematic (see Guldenmund 2007 for a detailed discussion), and there are some essential problems with 'commitment' as previously noted, Tappura et al were able to conclude that management commitment drives subordinate commitment and safety training, and as such 'it is unlikely that an organization can have a mature safety culture' without management commitment. This is a valuable empirical finding as management commitment, as defined specifically through the statements the workers evaluated of their behavior, is something that can be practically enhanced through training and new processes. However, again this raises a question – whether such positive changes in management commitment would have more impact on worker *opinions* about safety (as Model 2 directs us to measure) or on safety *culture* itself? The former is not without merit, as proponents of psychological safety would argue (Newaz et al 2019), and safety climate remains the one validated predictor of safety performance within the safety culture realm (Alruqi et al 2018) making it a useful predictive tool for any safety professional, and further highlighting the value of Tappura et al's work. Yet the case can still be made that Model 2 is not actually supporting the measurement of safety *culture*, instead it is measuring safety *climate*, and to some extent a level of psychological safety, which is of course perfectly acceptable – as long as any conclusions drawn remain honest to that end.

A further point of note for both Model 1 and 2 is that as both often look to a component-driven extensional definition of safety culture, they also fall prey to a fallacy of logic – specifically the fallacy of composition (Copi et al 2020). This fallacy is defined as '...reasoning fallaciously from the parts of the whole to the attributes of the whole itself' (ibid 2020:134). For safety culture, both Model 1 and 2 direct us to seek out a range of such parts – policies, training, commitment etc. – and through their combined evaluation argue that we have a valid evaluation of safety culture as a whole. Yet to borrow from Copi et al's (2020) example, logic tells us that a pile of bricks is neither a house nor a wall. We cannot and more importantly should not (at least continue to) proceed invalidly from the various parts to the whole. So, whilst Alruqi et al (2018) were able to determine that the safety climate dimensions of management commitment, supervisory safety rules, safety rules and procedures, training, and individual responsibility for health and safety statistically significantly correlated with safety performance, they do not necessarily combine to equate to safety *culture*. Nor indeed does any other list of parts.

Model 3 is more problematic to evaluate simply because it is also the most neglected. Although there is strong support for Model 3 among academics that safety itself is a socially constructed phenomenon (Simpson 1996), empirical work adopting methodologies able to unpack this meaningfully are few and far between. Once such example is the study by Blazsin and Guldenmund (2015) which took a social constructionist approach to safety culture within a large organization. However, the rarity of such opportunities is made clear in the opening to the introduction: 'The study presented in this article stems from the willingness of a major French gas distribution company to obtain a better understanding of its safety culture.' Without access to such spaces, and the commitment of the owner of that space to the project, Model 3 research becomes practically impossible. Which is unfortunate,

as findings from this work can and do provide meaningful insights to aspects of what can be considered safety culture in the 'everything' sense, with the most recurring and prominent characteristics of said safety culture coming to the fore. For example, Blazsin and Guldenmund's (2015) work revealed the organizational processes that reinforced distance between the management and field with regards to safety, providing novel insights relevant for both research and practice. Another example is the 3-year participant observation ethnographic study undertaken by Oswald et al (2020) which was also able to reveal various nuanced aspects of the 'everything' of safety culture through a Model 3 approach. This study produced a wide range of insights, including specifically the ways in which cost and production challenged safety on the jobsite and manifested in a variety of different ways (ibid 2020).

Yet neither of these Model 3 studies lays claim to the illumination of safety culture as a whole. Rather, they both appropriately bound their findings and conclusions to specific aspects of safety culture, and specifically those aspects of safety culture within these specific contexts (constructionist work inevitably lacking the same potential for generalizability that can be achieved through positivistic approaches, due to its fundamental ontological positioning), as they emerged and manifested within the studies undertaken. So, although we do have a model and methodology that arguably does work in furthering our knowledge and understanding of safety culture in its 'everything' form, it remains methodologically stymied and relatively impractical. Interestingly, Bisbey et al (2019) conclude that, from their position that culture is 'assumptions, values and norms (and not commitment to safety, or safety knowledge and skills) [their meta-analysis] might prompt novel research to target norm development or constructing shared values and assumptions, as well as spark new methods of measuring these difficult-to-assess pieces of culture.' Yet such methods already exist. The problem is not one of methodology. The problem is one of time, resource and long-term and freely given access to the spaces in which safety culture is created and constructed by those who work within it. This is where pragmatism about our predicament becomes critical.

Whilst we do have the models and tools to explore safety culture in a variety of different ways, we do not have the tools to measure it *as a whole*. Instead, we have tools to measure parts of it. Model 1 enables us to measure policies and practices, nothing more. Model 2 enables us to measure worker opinions, nothing more. Model 3 enables us to delve in more deeply, but we don't know what will emerge until we the research is underway, and the nature of such research inevitably focuses the researcher on certain aspects bounded by place and time. None of these models enable us to claim a measure of all attributes of safety culture. This must be acknowledged.

Given this predicament, it is interesting that, as a community, we feel the need to claim something we cannot even collectively define. Why are we striving for the 'safety culture' holy grail, when the elements, dimensions, aspects, or emergences themselves have obvious academic and practical value? Why is there seemingly less value ascribed to the components than the whole?

We would be on much firmer ground if we restricted ourselves to realistic conclusions given the methodologies that we have deployed. We could then ensure we are mobilizing the most appropriate methodologies, methods, and data for the specific parts of safety we are researching, rather than reaching for problematic proxies and claiming culture where we cannot. It is arguably a mature field that can self-critique in this way and given the lack of progress to date on safety culture, it may be in all our interests to rethink from more fragmented perspectives to enable the validity, reliability, and generalizability (and we use these traditional positivistic terms only as a shorthand here, they do of course require different applications in Model 2 and Model 3 work where, for example, reliability becomes dependability and internal validity becomes credibility (Lincoln and Guba 1985)) of our research to optimally align to the phenomenon under scrutiny for the betterment of safety science overall.



### 2.3. Practical considerations of safety culture

However, safety culture does not solely reside in the realm of academe; the seed planted by the nuclear industry back in 1989 has grown since to a sturdy and highly resilient plant in the practical realm. Despite academic problems of definition and methodology, safety culture outside the ivory tower stubbornly endures. Seeking a 'positive safety culture' is a common goal within larger organizations, it is something myriad safety consultants will happily sell you tools to measure, monitor, and improve, and it is even seemingly growing in influence and power.

Indeed, the motivation for the wider research project that sparked this paper is the increasing inclusion of safety culture as a factor in the regulation of utility providers in California USA ([California Office of Energy Infrastructure Safety 2023](#)). Their prescribed 'safety culture assessments' now form the basis of regulatory compliance and underpin the issue of licenses to operate. However, this situation is not without problems and concerns itself. An excellent evaluation of this situation was put forward by [Schulman \(2020\)](#) in his examination of organizational structure and safety culture motivated by utility regulator interest in the latter. His review is of particular interest here, as on reading it becomes increasingly clear that the regulator inclusion of safety culture within their sphere of influence and control was made with considerable presumption as to its rigor and robustness as a scientific concept. It is left to [Schulman \(2020\)](#) to illuminate the problems of safety culture definition ('currently suffers from conceptual under-development'), problems of definition of the safety culture components used in amalgamated definitions ('we cannot aggregate findings in a way that could allow us to discover the causal contribution of these organizational factors, at their current level of specification, as independent variables in relation to given safety outcomes') and problems with measurement ('it is difficult to learn about the impact of organizational and managerial factors...without some ordinal, if not interval, variables'). His conclusions rightly recommend action by both research and regulators to seek to resolve this messy situation, although the consequences of this have yet to be realized.

Without a standard definition and means of consistent assessment, the inclusion and even prioritization of safety culture among regulators is problematic. For example, the [Canadian Nuclear Safety Commission \(2018\)](#) specifically highlight safety culture within their guidance for management systems. They refer to the International Atomic Energy Agency's ([IAEA 2016](#)) Safety Report Series No83 – *Performing Safety Culture Self-Assessments* with regards to expectations for their membership in undertaking practical evaluations. In their report, the IAEA take several pages over the thorny issue of definition, unpacking various definitions and approaches and mobilizing various models before settling on what is effectively an extensional definition including: management for safety, actions, and practices, understanding and emotions. With regards to any evaluative methodology, the IAEA do note that 'adhering to a set of criteria ensures that safety culture assessments are consistent and subsequent findings are reliable over time' yet they do not go so far as to set that framework out at the industry level. Indeed, after suggesting external consultancy as beneficial for the process, they note that it is '...essential to use multiple methods' (*ibid* 2016:30) and go into considerable detail to explain and articulate research methods to safety practitioners. The [Canadian Nuclear Safety Commission \(2018:12\)](#) accordingly recommend that any self-evaluation adopts 'well-established social science tools being document review, surveys, focus groups, interviews, and observations' with analysis of the resultant quantitative and qualitative data being primarily thematic. This suggests alignment to a mixture of Model 1 and Model 2 conceptualizations, methods, and analyses. However, this approach not only again necessitates a fallacy of logic in the composition of this version of safety culture it also creates a further problem of false confidence through its 'regulation'. The mere existence of these reports and associated guidance perpetuates the notion that there is a clear definition of

safety culture and a clear set of tools for its measurement. Yet neither of these statements are true in a pragmatic sense. There is no one definition, instead the same discussion ensues as that found in the introduction to many an academic safety culture paper, and the methods for measurement become so complex that external expert advice is recommended: yet those particular devils remain in the details of the reports.

The Australian Institute of Health and Safety ([AIHS 2019](#)) are blunt in their evaluations of safety culture. They cite the work of Hofmann et al (2017:381): 'There is virtually no research specifically linking broader organizational cultural dimensions to more specific safety culture dimensions and safety outcomes.' This echoes the academic findings of [Bisbey et al \(2019\)](#) who also state that the '...link between safety culture and safety outcomes is largely inconsistent.' Reflecting on this lack of empirical evidence for the practical perpetuation of safety culture as a concept, the AIHS (2019:7–8) ask: 'why is it that in OSH, safety culture and climate are treated as 'things' to be managed, rather than as metaphors for the complex social systems within which work and risk arise?' They take this rather refreshing position even further, and argue for a holistic systemic approach, putting safety culture back within organizational culture instead of treating it as an entity in and of itself. This results in a 'shift of focus from worker behavior to the organizational systems that influence worker behavior' (*ibid* 2019:9) that they welcome, noting that this also underpins OHS legislation in Australia. This also finds a good resonance with the Human and Organizational Performance (HOP) approach to safety management, in which 'context drives behavior' ([Conklin 2019](#)) and the ways in which structure can build organizational, and thus safety, culture ([Hopkins 2016](#)). The AIHS conclude that we simply don't know how to define, measure, or change safety culture. They also highlight a large gap '...between evidence-based knowledge and industry needs' (*ibid* 2019:17). What they do recommend is the use of safety climate, given its validated relationship to safety performance. This is a pragmatic approach that does not claim 'safety culture' but rather explicitly acknowledges that workers are in the best place to judge if the way we do things around here is working for safety, or whether it is not (*ibid* 2019:22).

The ways in which safety culture is mobilized in and for practice are arguably as problematic as those found in academia, not least because of the variation found therein. Whilst some regulators have sought to establish frameworks for the management of safety culture, they remain messy with issues of definition and methodology emerging ([Schulman 2020](#)). Others have sought to refocus away from safety culture into areas where there is scientific validated evidence of relationships to safety performance. This is a more pragmatic approach drawing on a robust evidence base to support practice, but results in their stepping back from claims of safety culture measurement entirely.

However, it must be recognized that this situation is fundamentally unhelpful for an academic field seeking to progress the science of safety, and specifically the research of safety culture. Indeed, the very presence of some of these reports creates an assurance that safety culture is something definable, measurable, and manageable, when it is nothing of the sort. Yet pragmatism will define practice and regulatory requirements will be met, and the overarching goal of improving safety performance is itself certainly not to be derogated. However, the greater concern remains that practically positioning safety culture in this way creates a false reassurance that safety culture is a scientific concept, obfuscates fundamental problems of its scientific definition and evaluation, and serves as a not insignificant distraction for both academics and safety practitioners in the furthering of safety as a science.

### 2.4. Safety culture and the construction industry

As stated in its title, this paper specifically relates to safety culture within the North American construction industry. This is not only because that is our field of research expertise, but also because the construction industry is becoming ever more entangled with safety culture through both regulation and client expectations (e.g., [California](#)

Office of Energy Infrastructure Safety 2023). Not only are some organizations within the industry already within the scope of regulators demanding safety culture self-assessment, but construction’s clients are also growing more aware of safety culture as a concept and are seeking to optimize it on their construction jobsites.

However, safety culture is more problematic for construction than many other industries (Rawlinson and Farrell 2008). Construction is a project-based industry with a necessarily peripatetic and transient workforce able to deliver, maintain and demolish our built environments when and where needed (Sherratt 2016). This creates a unique place of work. It is not fixed or consistent; in fact, in construction if you are not physically changing your own workplace on a daily basis, you probably aren’t making any money! Not only are construction’s workplaces highly dynamic, the people working there also change on a regular basis as specialized trades come and go on the jobsite as their various work packages come online. It is this fragmented, inconsistent, and constantly churning environment that characterizes construction jobsites and differentiates the industry from others such as nuclear or manufacturing. These industries involve worksites that are fixed in place, with spaces that do not significantly change on a daily basis, and to which the exact same workers come to work each and every day. The stability enjoyed by many industries simply does not exist for construction. And these idiosyncrasies matter.

Notwithstanding the definition(s) employed, safety culture is generally agreed to be something that is shaped gradually over time (Schulman 2020) by various multilevel influences before becoming relatively stable (Bisbey et al 2019). Indeed, in his seminal work Schein (1984) notes that it is through stability and consistency, as well as shared workforce experiences, that safety culture becomes embedded in

an organization. This begs the rather fundamental question of whether the highly variable and inconsistent construction industry even has the capacity to develop safety culture within its normal scope of operations, no matter the scientific and pragmatic nature of the approach.

### 3. Empirical insights: Safety professionals on safety culture

To add some empirical understandings from practice into this predominantly theoretical discussion, limited empirical findings from a short survey are presented here. A deliberately simplistic approach to data collection was adopted to maximize returns, and no claims of generalization (external validity) are made accordingly. A survey was shared with the membership network of the Construction Safety Research Alliance (CSRA) via email and to its wider network via LinkedIn. The sample was therefore a self-selecting sample of convenience and ultimately comprised n = 516 respondents. The sample consisted of safety professionals (52 %), construction managers (19 %), field supervisors (11 %) and other construction professionals working mainly in the sectors of commercial construction (30 %), utilities (25 %) and oil and gas (20 %). 74 % had over 10 years’ experience working in their field.

The survey asked just one question: ‘What is safety culture?’ and the respondents provided a free text submission in return. Content analysis was applied to the resultant data which was further analyzed thematically to reveal the most common definitions, constructs and conceptualizations of safety culture currently found in practice.

#### 3.1. Findings

The resultant data, as associated with the models and methodologies

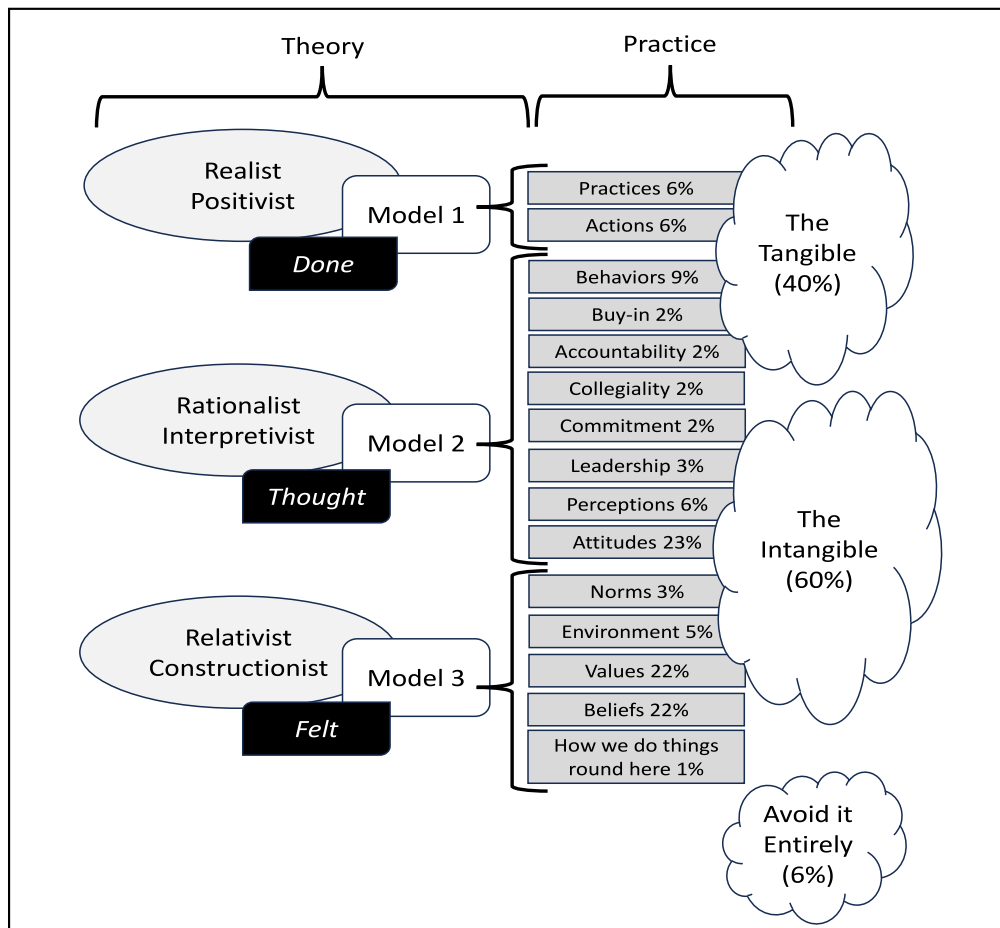


Fig. 1. Safety Culture Components Visualization Aligned with Methodological Considerations.

discussed above, are depicted in Fig. 1.

Within Fig. 1, respondents' conceptualizations have been broadly classified into the tangible and intangible, along with their associated 'elements' – a term used here for convenience only. The most common elements as revealed through content analysis are shown in the grey boxes. Many of the professionals drew on more than one element within their responses, and in all cases the percentage values shown reflect all mentions within the data, giving an overview of proportionality, yet they are not mutually exclusive.

As Fig. 1 shows, more professionals articulated safety culture to be intangible in nature than tangible. The intangible was associated with both Model 2 conceptualizations, for example whether all levels of an organization were committed to working safely and improving the safety of the workers, and Model 3, for example whether workers chose to work safely because they *have* to or because they *want* to. In contrast, the tangible was associated with behaviors and actions, as well as common safety management practices and motivations such as working safely, preventing injury, and minimizing risk. In some cases, elements were considered tangible through the ability to evaluate them through proxy measures requiring some level of interpretation in their analysis, for example the element of commitment which can in part be evaluated through the captured quantities of safety leadership engagements and tours (Xu et al 2023). Interestingly, the tangible focused more on the workers, their on-site behaviors, and how they follow processes and procedures, whilst the intangible elements were more universal and reflected things shared by everyone in the organization from workers to the C-Suite. Some elements reflected more ambiguous aspects that incorporated both the tangible and intangible, for example accountability or securing everyone's by-in. Despite its relative ease of measurement and practical evaluation, Model 1 found limited explicit reference throughout the dataset. This could be explained by the understanding that the normative elements of safety culture such as policies and practices are to some extent motivated by deeper held elements, and therefore it is possible that the professionals in our sample considered culture to be more closely associated with those more intangible motivators than their visible outcomes.

Six percent of the sample stated that they deliberately do not use the term and actively avoid it with regards to safety management, preferring in the main to consider safety culture as simply part of organizational culture and not something to be addressed separately.

No great claims are made of this data, beyond the fact that it has been included to demonstrate the fragmentation found within practice, and the areas of overlap, complexity and even rejection of safety culture as a concept within the field. Fig. 1 clearly illustrates a rather messy inconsistency, which resonates with the confusions currently found within academia and wider practice within regulators, as different elements manifest different models and methodological understandings of safety culture.

#### 4. Discussion: What to keep and what to throw away?

Safety scientists have, for several decades, heroically embarked on many a safety culture mission, and we are no exception. As a field we currently stand among a fragmented and incoherent mess of definitions, conceptualizations, and frameworks. Scientifically, this is highly problematic as we cannot combine or even meaningfully compare our various research findings of safety culture as currently undertaken. Each study remains unique and isolated and consequently the body of safety culture knowledge remains stunted and perpetually nascent, and a large gap remains between '...evidence-based knowledge and industry needs' (AIHS 2019:17). Given that the goal of safety culture research is to prevent workers getting hurt and killed, this academic infantilism is certainly not an ideal situation. It is now time for us to grow up and face the situation head on. We need to do something differently.

Bisbey et al (2019) note, '...the link between safety culture and safety outcomes is largely inconsistent. This may suggest the field needs a

unifying framework that can standardize research approaches to improve our understanding of safety culture and its relationships with other variables.' Whilst we fully agree that this link has not yet been determined, we struggle with their recommendation for a unifying framework to standardize the research of safety culture, as history has already shown that whilst admirable in its ambitions, such a thing is likely unachievable. This is not to say that safety culture frameworks per se are not achievable, indeed research is littered with such artefacts (for example see Vierendeels et al 2018, highlighted here for no better reason than their rather unique framework name for a Model 1 and 2 hybrid approach) but none of them have managed to stick. We would suggest that the reasons for the lack of an enduring framework *and* the lack of empirical evidence to link safety culture and safety performance are essentially the same: those of science and pragmatism.

Whilst frameworks can collate and structure complex phenomena, they still ultimately rely on definition for scientific evaluation. Scientific maturity requires collaboration, consistency, and clear communication, but for these to evolve at the fundamental core is a practical and workable definition. When the central tenet of the phenomenon remains undefined, as do many of the elements or components therein (such as commitment, engagement, accountability etc.) any approach will struggle. In fact, given where we are and what has gone before, we are inclined to agree with Hopkins (2018:44) whose Thesis 7 baldly states: 'The term safety culture is so confusing it should be abandoned'. Both scientific and pragmatic arguments can be made for the abandonment of safety culture as a concept.

The three relatively uncontroversial conceptualizations of safety culture emerge from three very different philosophical foundations, and therefore have distinct methodologies, methods, and resultant claims to knowledge. Many conceptualizations of safety culture actually take us into 'everything and thus nothing' space and leave only Model 3 really able to deliver scientifically, taking us closest to culture in the truest anthropological sense (Dennison 1996). Pragmatically however, such undertakings remain fundamentally impractical due to the heavy resourcing needed and overall cost. Model 3 is further thwarted by methodological foundations that bind such research to place and time and thus cannot be generalized. Whilst this is not in and of itself problematic – and some do get lucky such as Blazsin and Guldenmund (2015) did – Model 3 research is unable to move the concept of safety culture forwards in the 'traditional' scientific ways necessary to satisfy the wider body of work and, more importantly, those who fund it. Whilst a library of individual safety culture case studies would certainly be interesting, unless you *are* the case study organization, such research struggles to support the establishment of any universal truths about safety culture able to enhance safety in practice.

Although tools are readily available to evaluate safety culture through Models 1 and 2, these raise further scientific and pragmatic issues around what is being measured and thus what we can claim thereafter. Many of the elements evaluated under the auspices of these two models do have a validated correlation to safety performance. Model 2 and the safety climate survey is a great example of a research tool that does exactly what it purports to do – it measures worker opinions and perceptions of safety which have been validated to correlate to safety performance (Alruqi et al 2018) – but this does not equate to safety culture. Indeed, there is inevitably a historical body of work that strove to research 'safety culture', but which in fact revealed more specific and straightforward things about safety as a whole. Such research still has value for our field and should not be discarded out of hand, instead it should be refilled – for example, the work of Parker et al (2006) in developing expert opinions into an operational framework for safety remains valuable for organizational performance and worker engagement, but that is not culture.

However, given the fundamental variations between many of the combinations of elements, components, and aspects variously purported to combine into safety culture, it is strange we ever sought to measure them all, especially via a single worker opinion survey when other more

appropriate and robust methods are available. What people and organizations actually do for safety should be examined in ways that optimize the science (validity, reliability, and generalizability) of the research, rather than seeking one size to fit all. For example, rather than relying on a worker climate survey to evaluate the impact supervisors have on safety performance (often considered as ‘supervisor commitment to safety’), we could instead look at how many workers supervisors are regularly asked to supervise, how many hours they are working, how well-trained they are, the quality of their engagements with workers and so on. We could then develop better understandings of how supervisors are commonly put to work and how *that* affects safety performance. Commitment will be in large part shaped by capacity, and even the most safety-committed supervisor will struggle if they are not supported in the field. If practical conditions are cross-referenced with worker experiences as realized through a climate survey, this provides a much more useful evaluation of supervisors and safety. And more importantly, pragmatically, these are all things a company *can* change to improve their safety performance far more easily than seeking to change values and beliefs. As Hopkins (2018:39) notes, ‘Practices can be directly affected by management while values cannot...focusing on practices, therefore, is not a superficial strategy’ and perhaps it is one that as an applied field we should pivot more towards. As a community we should look to seek out, test and validate more relationships and correlations between X and safety performance through scientific and pragmatic ways. This would result in findings from our academic field that can readily generate impact through simple and straightforward applications in practice. There is no need to continue the quest for the holy grail of safety culture when we can actually undertake useful research of its components in ways that can bring positive change for workers. If the scientific evidence is there, industry can and does respond.

This is our call for safety science: we should abandon safety culture and instead direct our energy to researching the wide range of phenomena that contribute to safety management and performance uniquely, independently, and in appropriate ways. For example, valuable insights can be generated through a well-designed study of worker behavior as it relates to safety – noting the need for Model 2/3 insights as to the ways in which their context drives their behavior – but what we should not do is mix this up amongst leadership engagement, management commitment, and training – or worse, use the same methodology for all! Indeed, studying safety culture as its constituent parts may actually enhance the research and examination of safety in practice – freeing us from a fallacy of logic. It may force us to focus in and mobilize methodologies in better ways, able to empirically evidence of what works and what doesn’t and thus result in more frictionless translations into the field.

## 5. Conclusions

This paper has unpacked safety culture from scientific and pragmatic perspectives and found it wanting.

Despite decades of research of this phenomenon it remains highly problematic, and we are arguably no nearer a definition than we ever were. Ideally, and as with any scientific endeavor, we are seeking empirically tested, evidenced-based research to ensure what we’re doing is effective and optimal and actually keeps workers safer at work. Safety culture is just not helping in this mission and is arguably more of a distraction and resource sink than anything else. It has drawn the attention of both academics and safety professionals for many decades and has nothing more than a fragmented and incoherent body of work lacking in theory and universal truths to show for it.

It is time for safety culture to be retired from the safety science lexicon. We need to put it out with the trash. This would enable researchers to focus on the component elements that do have scientific and pragmatic interest, to research them and their relationships to safety performance in robust methodological ways, to ultimately develop findings with ready impact for practice. There is simply no need to adopt

a fallacy of logic to claim anything more. Industry is seeking empirical evidence of what works for safety and what does not and are keen to implement findings that have scientific and pragmatic merit. Safety culture has never had that pedigree, and we should perhaps accept it never will.

For the North American construction industry specifically, all of this applies and more due to the inconsistent, unstable, and transient nature of its operations. Given the number of serious injuries and fatalities caused by this industry, energy, efforts, and resources should certainly not be focused on an intangible and unscientific concept that has never been empirically proven to enhance safety in practice.

As a field we need to admit that safety culture’s time is over, and we can and certainly should do better in our shared goal of improving safety for workers across the world.

## CRedit authorship contribution statement

**Fred Sherratt:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Investigation, Conceptualization. **Emi Szabo:** Writing – review & editing, Investigation, Formal analysis, Data curation. **Matthew R. Hallowell:** Writing – review & editing, Resources, Funding acquisition.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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