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CULTURE ANALYSIS FOR INTERNATIONAL NUCLEAR TRANSPORT

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ABSTRACT

According to Edgar H. Schein, cultures exist wherever groups, such as professional organizations, corporations, occupations, and nations, exist. Cultures also exist in international industries and organizations worldwide. For example, international nuclear transportation for exports and imports exists as a subculture within the nuclear macro-culture of a nation. Globally, about 15 million packages of radioactive material are transported each year around the world, many as imports and exports across national boundaries. According to the World Nuclear Association, a significant majority, about 95%, are radioactive consignments not related to nuclear power. These transported radioactive materials are used extensively in medicine, agriculture, research, manufacturing, and nondestructive testing, and for exploration to find minerals, according to the World Nuclear Transportation Institute. The IAEA has convened consultants' meetings on nuclear safety culture and nuclear security culture and subsequently issued definitions, standards, and guidance for these two disciplines. However, the IAEA has not held a consultants' meeting or issued guidance or standards on culture for international nuclear transportation. This paper briefly describes a culture analysis for international nuclear transport within national nuclear macro-cultures, based on our earlier work on occupational cultures that identified standards, definitions, and guidance issued by the IAEA for "nuclear safety culture" and "nuclear security culture." This paper also applies Edgar H. Schein's 3-level concept of culture analysis to international nuclear transportation culture. Conclusions and recommendations are provided, particularly for the IAEA to convene a consultants' meeting to develop a working definition and issue guidance for international nuclear transportation culture. In a previous assessment of international interactions and interfaces for packaging and transport safety, security, and safeguards (3S), 25 topics were identified with potential conflicts and synergies, for which cultural bias or lack of familiarity with other nuclear cultures may be the root cause of potential conflicts in international interactions and interfaces among 3S. Recognizing and alleviating any cultural bias should help promote synergies and better achieve the goals for packaging and transportation of nuclear and other radioactive material.

INTRODUCTION

Edgar H. Schein, a noted behavioural scientist, observes that "Culture pervades everything," whether one takes the point of view of the macro-organization, like a nation, attempting to function in a complex environment or the point of view of the individual trying to learn to be productive and satisfied within a larger culture. [1] Safety, security, and safeguards (3S) during transportation of

nuclear and other radioactive material and equipment are receiving increasing attention as the trend grows for development of advanced nuclear reactor fuel cycles. [2] Since the 1950s, the International Atomic Energy Agency (IAEA) has brought together experts from its Member States to develop international standards, recommendations, and guidance for the three essential nuclear disciplines: safety, security, and safeguards (3S). These technical experts have come from the range of nuclear occupational cultures encompassing nuclear packaging, transportation, storage, and disposal.

Occupational cultures associated with transportation safety, security, and safeguards are nested within corporate cultures and within regulatory cultures, which in turn are nested within national cultures. These nested subcultures exist like nested matryoshka dolls. Overall, nuclear regulatory harmonization worldwide is an important element of nuclear culture. The former U.S. Nuclear Regulatory Commission (NRC) Chairman, Stephen G. Burns, has been leading an international initiative to harmonize regulatory practices [2]. At the recent WM Symposia 2023 conference, Rod McCullum, Senior Director at the Nuclear Energy Institute, noted that there needs to be a better culture for regulating [3]. At the same conference, the President of the American Nuclear Society, Steven Arndt, noted, “It’s not just technical knowledge that matters. Knowledge of culture is also important.” [3]

So, how does international nuclear transportation culture come into play during cross-border transportation? Why is it important? How do we figure this out? And what can we do about it?

This paper explores Edgar H. Schein’s organizational culture concept [1] and how it applies to international nuclear transportation, and in particular, to international transport across national borders where international technical and regulatory interactions interface extensively. The IAEA has published definitions, international standards, recommendations, and guidelines for nuclear safety culture and for nuclear security culture, although not for nuclear transportation culture. This paper concludes with recommendations, including for the IAEA to bring together experts from various national macro-cultures for a consultants’ meeting to develop a working definition and guidance for international transportation culture.

BACKGROUND ON NUCLEAR CULTURE

This section identifies previous work on culture guidance at the national and international levels and the related benchmark events that have triggered development of nuclear culture guidance.

U.S. Regulatory and Industry Culture Guidance

The nuclear industry and the NRC recognized the importance of management and organizational factors to nuclear facility safety in the aftermath of the accident at Three Mile Island Unit 2 in 1979, which became a benchmark event for nuclear safety culture.

Subsequently, two nuclear industry organizations, the World Association of Nuclear Operators and the Institute of Nuclear Power Operations, published guidance on nuclear safety culture that was in alignment with the NRC’s guidance for the commercial nuclear power industry [4, 5]. Because safety and security are primary pillars of the NRC’s regulatory mission, consideration of both is an underlying principle of the NRC Safety Culture Policy Statement [6].

IAEA Nuclear Safety Culture Guidance

“Nuclear safety culture” was first introduced internationally by the IAEA International Nuclear Safety Advisory Group (INSAG) in response to the benchmark Chernobyl safety incident in 1986 [7]. Since then, the IAEA has issued numerous reports that address safety culture and its definition. In particular, the IAEA published a report by INSAG that deals with the concept of safety culture as it relates to nuclear power activities [8].

IAEA Nuclear Security Culture Guidance

Nuclear security culture and its definition were first internationally considered at the June 2000 meeting of the IAEA Working Group of the Informal Open-Ended Expert Meeting, which discussed whether there was a need to revise the Convention on the Physical Protection of Nuclear Material [9]. In response to the resolution adopted by the IAEA General Conference in September 2002, the IAEA followed an integrated approach to protection against nuclear terrorism, recognizing the 11 September 2001 terrorism benchmark ("911"). In 2008, the IAEA issued IAEA NSS No. 7, "Nuclear Security Culture," which explains basic concepts and elements of nuclear security culture, including those for transport of nuclear and other radioactive material [10].

International Nuclear Safeguards Culture

Many publications address changes in international safeguards culture due to Iraq's benchmark violations of its Safeguards Agreement with the IAEA, which led to the development of INFCIRC/540; for example, see the book by Trevor Findlay [11]. The IAEA, however, has not published a definition or guidance for "safeguards culture." IAEA basic international safeguards documents INFCIRC/153 and INFCIRC/540 do not address "safeguards culture"; and the IAEA Safeguards Glossary makes no mention of "safeguards culture" [12-14].

ROLE OF CULTURE IN INTERNATIONAL NUCLEAR TRANSPORTATION

Why Address Nuclear Transportation Culture?

"Why address culture?" "How does culture play a role in international nuclear transportation?" The answers to these two questions can lead to a better understanding of the cultural interactions during transportation of nuclear material across nations' borders. Schein says culture is deep, wide, complex, and multidimensional. He notes that some major cultural "dimensions" have been proposed to help better understand culture when it involves different nations.

To start, Schein notes that nations can be categorized into some "dimensions" at their "basic assumptions" level. He bases this categorization of "dimensions" on a study performed by Hofstede et al. on IBM employees across all nations where IBM had offices [15]. These basic "dimensions" reflect beliefs, values, and ways of thinking that are largely taken for granted as assumptions and are out of the conscious awareness of the members of those nations. To help understand national cultural interactions, Hofstede identified five *Basic Dimensions of Culture*:

Individualism --- Collectivism: The degree to which society is built around individual rights and duties versus the group as the basic unit of society to which individuals subordinate themselves.

Power --- Distance: The social and psychological status and authority distance between the highest- and lowest-powered people in the society.

Masculinity --- Femininity Distance: The degree to which gender roles are differentiated and linked to work versus home and family.

Tolerance for Ambiguity and Uncertainty: The degree to which members of the society feel comfortable in uncertain and ambiguous circumstances; the need for clear structures, processes, and rules.

Short-Run versus Long-Run Time Orientation: The degree to which members of society plan for and fantasize about the distant future versus being concerned only about the near future.

Schein calls particular attention to one of the key basic dimensions of national culture --- "individualism versus collectivism." Countries studied can be compared with each other, and clusters of countries that are similar in their overall profile can be identified. For example, Hofstede showed that countries such as the United States, Canada, Australia, and the United Kingdom are more individualistic; whereas Pakistan, Indonesia, Colombia, Venezuela, Ecuador, and Japan are more collectivist. He adds that "individualistic societies" define roles in terms of personal accomplishment, license aggression through personal competition, put a high premium on ambition, and define intimacy and love in very personal terms. "Collective societies" define identity and role more in terms of group membership, license aggression primarily toward other groups, put less value on personal ambition, and funnel love primarily within the group.

The increase in international nuclear transportation across nations' borders highlights the need to better understand the basis for multi-cultural interactions at borders to successfully carry out effective and efficient international commerce and trade. "In practice, every society and organization must honor both the group and the individual in the sense that neither makes sense without the other. Where cultures differ dramatically, however, is in the degree to which the espoused behavioral norms and values do or do not reflect the deeper assumptions." [1]

Cultural Intelligence: Schein addresses the broad concept of "cultural intelligence" to help learn and develop understanding, empathy, and the capability for successful multi-cultural collaboration and cooperation. He identifies four required capacities for "cultural intelligence": [1]

(1) Actual knowledge of some of the essentials of the other cultures involved.

In the context of international nuclear transportation, this would involve, for example, knowing about the level of a nation's technologies, technical expertise, regulatory system, and legal/legislative basis: In other words, what is important to each nation for nuclear transportation across its national borders.

(2) Cultural sensitivity or mindfulness about culture.

This would involve, for example, awareness of a nation's broader nuclear energy needs, plans, and related policies that may involve use of nuclear fuels and radioactive sources.

(3) Motivation to learn about other cultures.

This would include, for example, the desire to collaborate and cooperate with other nations to achieve successful international commerce and trade.

(4) Behavioral skills and flexibility to learn new ways of doing things.

This would include, for example, broadening one's professional skills, knowledge, and abilities needed to cooperate during international nuclear transportation.

How can we foster cross-cultural learning?

Because culture is so deeply embedded in each of us, cross-cultural learning must confront the fundamental reality that each member of each culture begins with the assumption that what they do is the right and proper way to do things within the nature and framework of their own national nuclear culture. For example, as members of a national culture, we behave according to certain aspects of nuclear energy policy, and we behave as well according to the culture of our particular technical occupation and expertise.

We each come from a social order, or technical policy order, into which we have been socialized or taught; and therefore, we take its assumptions for granted. Intellectual understanding of other cultures may be a start in conceding that there are other ways to do things. More likely, we begin by noting how the "other processes or positions won't work or are wrong." One example of a potentially successful approach to collaboration through intellectual understanding of other ways of doing things was presented by Stephen G. Burns, former Chairman of the NRC, at the 2022 INMM Workshop on Security of Advanced Reactors [2]. He explained international collaboration on "harmonizing" national regulatory licensing practices by encouraging each new nuclear nation to view other national systems and adapt them to suit their own specific needs and culture.

As the nature of corporate nuclear business becomes more multinational, effective ways of building working relationships need to be invented, because training everyone to be more culturally intelligent and composing groups with the most expert members may not be practical. As international activities, such as nuclear transportation, become more electronically connected, mechanisms will need to be invented to enable people who have not met face-to-face to develop understanding and empathy. This need became apparent during the COVID pandemic, when some organizations and corporations significantly curtailed business and reduced in-person interactions while others opted to continue business to the extent possible through electronic virtual meetings instead of in-person meetings.

It seems that "culture cannot be understood without looking at core technologies, the occupation of organization members, and the macro-cultural context in which the organization exists." [1] Cultures

have been around for a long time and have acquired some very stable elements in the form of basic languages, concepts, and values. Sometimes it's necessary to assess the culture of an occupation or nation and to identify cultural DNA because of the need to solve specific problems or adjust to circumstances, for example, during the transportation of nuclear material.

In his first edition of "Organizational Culture and Leadership" in 1985, Edgar H. Schein identified five basic reasons why organizational culture needs to be addressed [16]:

(1) The topic of organizational culture has received increasing attention.

By 2022, the topic of nuclear culture was being addressed by the nuclear industry. Many Member States of the IAEA have begun to include the topic of nuclear culture in nuclear training courses.

(2) The topic is confusing.

In 1985, Schein explained why culture must be better understood, what the functions of culture are in organizations, and what the levels of culture are. All these considerations are relevant to nuclear transport, as they lead to a better understanding of the nuclear macro-culture of a nation. The topic of culture in the nuclear field has significantly evolved since the 1986 Chernobyl accident, after which Member States realized the need and value of an IAEA nuclear culture standard for safety. Since then, authors have introduced a range of definitions and analyses for what is meant by "nuclear culture."

(3) The analysis of culture can illuminate the study of leadership.

Schein originally asked, "Why link the concept of culture to leadership at all?" The further he explored the topic of organizational culture, the more he realized the important link to company founders, leaders, and institution builders and practices. He found that much of what is mysterious about leadership becomes clearer if we separate leadership from management and link leadership specifically to creating and changing culture. This applies to national nuclear macro-cultures as well. For example, many IAEA Member States undertaking nuclear transport have sent nuclear experts to the IAEA to contribute to development of nuclear standards, guidance, and recommendations, including nuclear safety culture and nuclear security culture.

(4) The study of organizations is maturing into more interdisciplinary modes of thinking and conducting research.

Organizations are increasingly being studied with explicit interdisciplinary models in mind. In later editions of his book, Schein reported on examining three interdisciplinary occupations, or subcultures, within a corporation: management, operations, and engineering. Similarly, nuclear authorities and technical experts are increasingly recognizing interdisciplinary activities involving the subcultures for 3S for transportation [17, 18].

(5) Schein's own perspective has shifted toward a more interdisciplinary view.

Schein refers to a time when the occupations of anthropology, sociology, social psychology, and clinical psychology made a concerted effort to enhance each other. IAEA Member States, in comparison, likewise have sought to enhance nuclear activities, for example, nuclear transportation, packaging, and storage, undertaken within national nuclear macro-cultures.

Why Must Culture Be Better Understood?

There are three basic reasons why a better understanding of culture is beneficial [1]:

(1) Organizational cultures are highly visible and "feelable." Culture has impact on all types of organizations, professions, and corporations.

(2) An organization and the members of the organization are better understood when one takes into account the culture of the organization or profession.

(3) Organizational culture as a concept can be confusing. To benefit from understanding it, a concept and framework for analyzing it is needed. Schein's 3-level concept is one approach to doing this.

Cross-Cultural Issues

Cross-cultural issues may arise when professions have significantly different political systems or different technologies. For example, cross-border nuclear transport may encounter cultural differences, circumstances, or issues. Professions, like international nuclear transportation, typically build practices, values, and basic self-image around their underlying technologies. If the technology,

circumstances, or regulations vary at the border, practices must be reconciled and redefined in ways that may involve deep cultural assumptions. An example of a cross-cultural issues is the various policies regarding the presence or use of firearms monitoring technologies.

Origin Of Subcultures

During publication of Schein's five editions, from 1985 to 2017, Schein's analyses transitioned from focusing on the culture of corporations to working with macro-cultures such as nations and worldwide occupations. He emphasizes that every organizational culture is nested in other larger cultures that influence its character. Every subculture, task force, or work group is nested in larger cultures; and culture is what a group learns. For example, a nuclear transportation subculture exists in the nuclear macro-culture of a nation. Different subcultures interact at national borders when nuclear materials or equipment is transported across the borders.

As an interconnected set of basic assumptions, culture can be a complex system. For example, the cultures for the 3S disciplines (safety, security, and safeguards) within the transportation culture are interconnected and must be aligned to achieve successful nuclear transportation.

Cultures are dynamic. Culture analysis is common for ethnic and national cultures. Groups and organizations within a nation also develop cultures that affect in a major way how members think, feel, and act. Once a group acquires a history, it also acquires a culture. A single group may subdivide into multiple subgroups or subcultures. Within a group, there may be a managerial subculture, various occupation-based subcultures, and other group subcultures based on shared experiences, education, or work history.

The word "culture" can be applied to any group size that has the opportunity to learn and stabilize its view of itself and the environment around it—in other words, its basic assumptions. At the broadest level, there are civilizations and nations with recognized cultures. Within these, Schein says there are groups such as "occupation, profession, or occupational community." If such groups can be defined as stable units with a shared history of experience, they will have developed their own subculture.

The forces creating functional subcultures derive from the technologies employed and the occupations associated with the functions, such as nuclear transportation, packaging, or storage. With organizational growth and continued success, these functional subcultures become stable and well defined. As an organization grows geographically, it becomes necessary to create subunits to effectively take into account sub-issues and needs. Examples are the growth of multiple nuclear subcultures for transportation, packaging, and storage, and subcultures for the 3S disciplines within a national nuclear macro-culture.

The Nature of Culture and Its Definition

What concepts help describe and define the content of a national macro-culture? Schein identifies, with some overlap, levels of observability useful for describing and analyzing culture: [1]

Observed behavioral regularities when people interact—language used along with regularities during interactions (examples: "Thank you," "Don't mention it.")

Climate—feelings conveyed by physical layout and member interactions (example: an artifact of a culture that is physically visible and feelable, such as a weapon used for security)

Formal rituals and celebrations—ways of celebrating key events or values of importance (examples: promotion, level of achievement, milestone)

Espoused values—articulated, publicly announced principles and values (examples: goals, objectives, services)

Formal philosophy—broad policies and ideological principles (examples: explicitly stated policies, strategies, requirements)

Group norms—implicit standards and values (examples: particular behavioral norms that evolve among members of an occupation)

Rules of the game—implicit, unwritten rules for getting along (example: the “ropes” a newcomer learns to be accepted)

Identity and images of self—how an occupation views itself (examples: “Who are we?” “What is our purpose?”)

Embedded skills—special competencies (examples: unwritten occupational skills.)

Habits of thinking, mental models, or linguistic paradigms—shared cognitive frames that guide perceptions, thoughts, and languages (example: guidance used and taught to “socialize” new members of an occupation)

Shared meanings—emergent understandings created during interactions (examples: same words in different occupations that have the same meaning)

“Root metaphors” or integrating symbols—the way an occupation evolves to characterize itself (examples: unconscious embodiment in buildings, office layout, vehicles, other material artifacts)

Based on these descriptive elements, what is a dynamic definition of an international nuclear transportation culture? Schein provides a conceptual definition based on how any culture is learned and evolves: “The culture of a group can be defined as the accumulated shared learning of that group as it solves its problems of external adaptation and internal integration; which has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, feel, and behave in relation to those problems. This accumulated learning is a pattern or system of beliefs, values, and behavioral norms that come to be taken for granted as basic assumptions and eventually drop out of awareness.” [1] This definition can be tailored to any group or occupation, such as nuclear transportation.

Culture solves a group’s basic problems of (1) survival in and adaptation to the external environment and (2) integration of its internal processes to ensure the capacity to continue to survive and adapt. The issues or problems of external adaptation basically specify the coping cycle that any system must be able to maintain in relation to its changing environment. Internal integration for the process of becoming a group is simultaneously (1) the growth and maintenance of relationships among a set of individuals who are doing something together and (2) the actual accomplishment of whatever they are doing. An example of this integration is a group of transportation experts cooperating to undertake international transport of nuclear material.

Analyzing Nuclear Transportation Occupation Culture

Schein developed a three-level concept to analyze culture. [1] These three levels, shown in Figure 1, are: (1) physically observable artifacts, (2) espoused values of the group, and (3) basic underlying taken-for-granted assumptions.

In what follows, this three-level concept is applied to the international nuclear transportation occupation culture. The term “level” means the degree to which the cultural phenomenon is visible to an observer. Occupations reflect the national culture in which they are embedded and the technologies that underlie them.

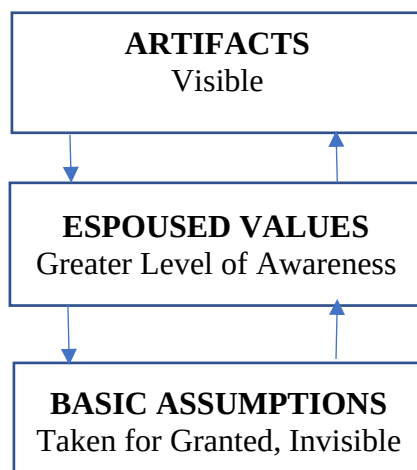


Figure 1. Levels of culture and their interactions

At the first level are artifacts, which are very tangible manifestations that one can see, hear, and feel when encountering a group with an unfamiliar culture. Artifacts of an occupation may include visible aspects such as logo, office features, architecture of the physical environment, language and terminology, nuclear technology, equipment, designs, stories, and rituals. This level is easy to observe but may be difficult to decipher. For example, the office and meetings for transportation cultures may be quite different from the office and meetings for fixed-site cultures.

The next level comprises espoused values and beliefs, including norms, rules of behavior, goals, and strategies, that an occupation depicts as the culture to themselves and to others. All group learning ultimately reflects original values and beliefs—the sense of what ought to be, as distinct from what is. For example, a nuclear transportation occupation has grown out of regular national and international meetings, many sponsored by the IAEA and PATRAM, involving values and beliefs for nuclear programs and occupations. Subsequently, the transportation occupation has evolved a transportation culture for the transport of nuclear material and equipment with published values, norms, and beliefs. With the advent of small modular reactors, one can expect the evolution of national transportation cultures that involve new types of reactors and fuels.

At the base of the three levels are the taken-for-granted underlying basic assumptions, which are the deeply embedded, unconscious basic assumptions that Schein defines as the essence of a culture, or its DNA. When a solution to a problem works repeatedly, it comes to be taken for granted. What was once a hypothesis gradually becomes treated as a reality. In this sense, basic assumptions have become so taken for granted that there is little variation within the occupational social unit. This degree of consensus results from repeated success in implementing certain beliefs and values. For example, the transportation occupation for each nation is nested within the national nuclear macro-culture. This nesting becomes especially evident when materials and equipment are transported across national borders. Each nuclear transportation culture has its own underlying basic assumptions that collectively contribute to achieving successful international transport. Because cultures may vary from nation to nation, development of international standards, guidance, and definitions is important for international nuclear transportation.

Overall, levels of awareness decrease as one moves from artifacts to basic assumptions. To summarize, easily observed artifacts—features of meetings and offices, for example—are the most visible level of culture. Espoused values are the sense of “what ought to be,” i.e., beliefs or principles based on facts, such as national nuclear policies for nuclear safety, security, and safeguards. Basic underlying assumptions are certain actions that have worked repeatedly and are likely to be taken for granted and to have dropped out of awareness: for example, the nature of human relationships and long-standing national alliances. National nuclear macro-cultures develop norms within which subcultures like nuclear transportation can operate effectively. When these norms “work” in the sense that tasks are completed and members are satisfied, these norms gradually become shared basic assumptions and basic elements of national nuclear DNA.

CONCLUSIONS AND RECOMMENDATIONS

- The concept of culture is widely accepted by organizations, corporations, and nations.
- Edgar H. Schein has long supported the concept of organizational culture as it applies to organizations, corporations, and nations.
- One particular example is the concept of organizational culture as it applies to international cross-border transport of nuclear materials and equipment, including the subcultures for safety, security, and safeguards.
- The IAEA has convened consultants’ meetings and issued definitions, international standards, recommendations, and guidance for nuclear safety culture and for nuclear security culture.
- In comparison, the IAEA has not issued international standards, definition, guidance, or recommendations for the impending growth of international nuclear transport culture.

- Development of a definition and guidance for nuclear transportation culture could be achieved through a consultants' meeting, convened by the IAEA under the Practical Arrangement signed in 2021 by the IAEA and INMM.
- This development would require collaboration and cooperation of nuclear transportation experts within the commercial and national macro-cultures.

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