IOP Conf. Series: Materials Science and Engineering **966** (2020) 012118 doi:10.1088/1757-899X/966/1/012118

Epistemic responsibility of industrial enterprise engineer

N U Ignatova

Ural Federal University named after the First President of Russia B N Yeltsin, Nizhniy Tagil Technological Institute, 59, Krasnogvardeyskaya str, Nizhniy Tagil, 622000, Russia

E-mail: nina1316@yandex.ru

Abstract. The concept of epistemic responsibility of an industrial enterprise engineer is introduced. The concept of an engineer's epistemic responsibility is inspired by a situation of epistemic distrust in which the engineer finds himself as an expert. The definition of 'epistemic' in relation to the word 'responsibility' allows asking a question, what are the characteristics of the knowledge with which the engineer substantiates decision-making. For the first time in the domestic philosophy of engineering, epistemic duties of an engineer of an industrial enterprise are formulated: the duty of due diligence and epistemic zeal. The general epistemological attitude of an engineer in an extreme situation is skepticism. The author claims that the role of anomalous evidence in establishing the truth is an epistemologically difficult problem in investigating an extreme situation. In an extreme situation, the engineer's epistemic responsibility is embodied in the following: to prevent self-deception and potentially unintentional deception of others in relation to the engineering solution; do not mislead workers who do not have the proper epistemic experience and do not allow them to be mistaken; take into account abnormal or seemingly questionable information and consider it properly.

1. Introduction

The relevance of the stated issue is conditioned upon the following circumstances: today engineering as expert knowledge from the point of view of epistemology is perceived by researchers and the general public with distrust. The basis of this approach is the idea of cognitive deficiency of human capabilities. Epistemic distrust is based on doubts about the rational nature of professional activity, since the knowledge obtained in this way cannot be impartial and objective (H Simon). Secondly, epistemic distrust is a logical consequence of the fact that the engineer acts in conditions of the probabilistic nature of knowledge, which translates into spontaneity of the engineer's conclusions and decisions. In addition, engineers advance arguments, followed by the actions of large groups of people. In the process of making practical decisions, production managers may not accept the engineer's recommendation, focusing more on nonnegative arguments. In practice, the decision-making dilemma may come across the need for epistemic thoroughness. Expert assessment is always a matter of judgment. Judgment has both an ethical and an epistemological aspect, but it also has its own scope of application irreducible to ethics or epistemology. Ethical theory gives the general reasons for selection of actions in a particular set of circumstances.

Empirical theory explains the nature of a particular set of circumstances. But one more question remains, whether the particular circumstances resemble the general model for solving such situations and to what extent. The answer to this question cannot be given simply by verifying via source data, since the situation of the application of ethical standards is a complex issue that requires judgment.

2. Methods

The concept of 'responsibility' in the title of the article opens the space of normative and involves an appeal to ethics [1, 2]. The idea of epistemology as a normative discipline [3] allows suggesting how the available theoretical tools can be used to reflect on the validity of the engineer's actions. Intuitively, such actions are described in terms of deontological ethics: 'the engineer must'. The operator 'must' refers to modal verbs and fits into the relationship of necessity and opportunity in the spirit of traditional descriptive theories, according to which the determination of the truth conditions of normative sentences is the main task of explaining their meaning. The engineer also operates with modal operators 'perhaps', 'probably', 'obviously', when verifying problems and proposing hypotheses. The modal approach connects the meaning of the word 'must' with the idea of necessity stronger than the meaning of the words 'possibly' or 'probably'. If the verb 'must' is used as a modal operator to specify ethical requirements with prescriptive consequences (M Chrisman), then in this case the epistemic responsibility is implemented [4].

The concept of 'epistemic responsibility' was previously used in political discourse regarding the activities of scientists [5], military [6] and politicians [7]. But in relation to the professional activities of engineers, the concept is used for the first time. The definition of 'epistemic' in relation to the word 'responsibility' allows you to ask a question, what the characteristics of the knowledge with which the engineer substantiates decision-making are. Consequently, the problem of the article is stipulated by posing not ethical, but epistemological question. Epistemic responsibility is based on moral responsibility and vice versa, engineers who are charged with moral responsibility for personal actions make decisions under conditions of epistemic responsibility [8]. D Cody argues that 'applied epistemology logically precedes applied ethics. People's actions depend on beliefs both normatively and causally' [9].

The search for the basis of applied knowledge is a prerequisite for the professional competence of engineers [10]. This refers to the professional duties of an engineer to obtain and use reliable knowledge as the basis of both personal actions and expert opinions regarding the actions of other participants in the production in accordance with ideas about professional conscientiousness.

3. Results

The need for an epistemological examination of an extreme situation is recognized by all researchers. The general epistemological attitude of an engineer in an extreme situation is skepticism [11]. Skepticism involves not only a reasonable doubt about the credibility and reliability of official information or eyewitness testimonies, but a clear understanding of the limitations of human cognitive capabilities, even backed up by instrument readings. Guided by experience and general conclusions about the nature of the collection of primary information, an engineer is obliged to avoid unconditional trust in official sources or eyewitness accounts. The question arises: how rational is skepticism? One needs to understand what the conditions of skepticism are, even if the engineer seeks to be independent in their critical reasoning. A simple refusal to believe in anything undermines the possibility of full participation in the profession. Engineers investigating an extreme situation should be critical and honest in handling the evidence, but their responsibility in this case only extends to the issues within the designated area of research. The engineer must be properly circumspect, to act responsibly as necessary, as the situation and his role in it require.

It should be emphasized that the extremes of skepticism should be avoided no less than the manifestations of an absolute belief in authoritative judgment. Extremes can be avoided by applying rationally justified methods of responding to abnormal knowledge in official data and authoritative evidence. There is a number of types of responses, which may be appropriate depending on the different context. So, for example, it makes sense to identify the problem of claim to knowledge originating from areas that go beyond the professional or individual competence of the engineer. The

IOP Conf. Series: Materials Science and Engineering **966** (2020) 012118 doi:10.1088/1757-899X/966/1/012118

responsibility applicable in such circumstances is to avoid speaking out on issues on which it is not customary to speak out.

An extreme situation as an absolutely unpredictable phenomenon may be accompanied by manifestations of agnosticism among engineers. Two types of agnosticism of an industrial enterprise engineer should be distinguished. Firstly, an engineer's agnosticism as a rejection of the need and obligation to know the truth indicates the lack of his professionalism. Secondly, an engineer may not be aware of some circumstances of an extreme situation due to the unreliability of evidence, which can also be interpreted as agnosticism. This interpretation prompts the formulation of the epistemic responsibilities of the engineer.

The first epistemic duty of an engineer follows from the need to avoid conclusions and evaluations based on ignorance or misinformation. For an engineer, trying to avoid a statement that goes beyond his competence does not mean just keeping silent on certain issues, but believing that silence does not essentially mean tacit acceptance of an unreasonable, contradictory and possibly false decision. Hence, the engineer is obliged to prevent self-deception and, therefore, potential unintentional deception of other employees regarding the nature of the context, regarding which the regulatory recommendation will probably be applied. At the very least, this entails caution when discussing the ethical consequences of such a decision. An assessment of some of the essential characteristics of a situation may be epistemologically unfounded.

Further, the argument we propose is that the engineer has a duty to protect others from delusion. One can meaningfully engage in assessing the epistemological basis of claims to knowledge outside their powers regarding a specific empirical examination. It is necessary not only to avoid deceiving oneself, stating that when studying the data of an extreme situation, an engineer can remain an agnostic, but also to avoid misleading or deceiving others. An engineer must ensure that people who do not have sufficient epistemic experience are not mistaken about the validity of their own actions. Moreover, under certain circumstances, the engineer is obliged to check whether other employees are misled. To do this, one does not need to bring theoretical knowledge on significant issues, but simply evaluate the statement in which claims to knowledge of the truth become public domain. The engineer is obliged to check such statements 1) for internal contradictions or methodological inconsistencies; 2) for external consistency of such statements with the corresponding theoretical knowledge. This approach cannot generate new knowledge, but it can show that some conclusions of other workers may be false. An engineer's attempts to protect subordinates or managers from false information can sometimes be seriously hindered. In some cases, correcting misinformation may not be possible, as well as a rational response to abnormal data. Hence, it becomes evident that the third epistemic duty of the engineer is not only to take into account abnormal or seemingly dubious information, but to consider it properly. An engineer's attempts to provide reliable evidence may encounter falsehood and falsification of information. In this case, their actions go beyond the scope of ordinary research or expert activity. Conventional research involves constantly checking intermediate results and correcting mistakes made. Anyone's desire to change the procedure for assessing the quality of the information provided should become the engineer's concern, as it inevitably indicates a selfish interest.

False knowledge is sometimes taken as the basis of a technological solution. In these circumstances, the engineer's epistemic obligation is not only to protect against the erroneous acceptance of a false statement, but also to correct the widespread false statement. The latter may be more challenging. First, a properly worded alternative solution may be required to correct a false statement. Despite the fact that any competent specialist is able to determine the bias, fallacy, or falsity of the prevailing statement, considerable experience and special studies may be required to develop an alternative hypothesis. Secondly, the engineer's epistemic responsibility includes readiness to be persistent, as the engineer may be faced with the desire of interested workers to actively promote false propositions.

Another duty of an engineer is not to recommend actions that cause unnecessary, unjustified and preventable harm. Assuming that an engineer will never cause harm intentionally, due diligence is to avoid spontaneous, disorganized, or unreasoned actions by others. Overly optimistic forecasts, regarding the effectiveness of the engineer-recommended action or misleading about the nature or complexity of the problem that the action should solve, should be avoided.

As a rule, engineers try not to mislead or make unreasonable assumptions. If an engineer's expert assessment involves humanitarian consequences, their findings may go beyond professional competence. It would seem that this is a sufficient reason to question the obligation of engineers to give such an assessment. Most often, engineers recognize the obligation not to go beyond their competence, to use appropriate warnings and reservations in any argument that depends on assumptions about the state of affairs, explanation or interpretation of them. Ethical considerations are discussed ceteris paribus on a hypothetical basis.

The difficulty lies in the fact that epistemic responsibility requires a view that is fuller of nuances [12], and, as A Rorty [9] suggests, is always based on ethical responsibility. At the same time, C Mitcham and R von Schomberg declare that responsibility in the framework within a professional role is not fully consistent with the reality of the numerous complex roles performed by an engineer at an industrial enterprise [13, 14]. Therefore, bringing a person to responsibility for their role is often impossible.

Sometimes, external experts and engineers are invited to investigate an emergency situation, who obviously seeks to find out the true cause of what happened. If we reflect on the nature of an ideal investigation of an extreme situation, we can conclude that it contains as many, if not more, paradoxical requirements [15]. Investigation of an extreme situation serves the public interest, but no matter how noble the goals may be, their fulfillment necessarily requires some secrecy. Internal tension arises, since in the public interest certain types of knowledge cannot be made public. Therefore, various checks and procedures are needed to prevent abuse of privacy and privileges. But although mechanisms of professional and social control are technically possible, their effectiveness may be limited in practice. The following question always arises here: whether the information obtained through deception, fraud, industrial espionage has any epistemological value, whether it can be reliable.

The idea of an 'ideal investigator' is paradoxical, since a 'perfect investigator' would be a person capable of deceiving. The problem is not that the invited experts can sometimes be double agents, but that the entire organizational infrastructure of such operations shall support convincing deception. Even if expert engineers are selected based on honesty and good faith, the problem of public deceiving of the engineering community arises. On the other hand, engineers can be truthful in confidential reports that they pass to decision makers, but who can verify that the latter are meticulous in the same way? It is obvious that the epistemic zeal of an external expert cannot guarantee full protection against those who can be set on using the opacity of the system.

An epistemologically difficult problem in investigating an extreme situation is the role of abnormal evidence in establishing the truth. Engineering practice is designed in such a way as to exclude random conclusions as unfounded, that is why common sense tells the engineer to dismiss anomalous evidence. Although the responsibility for the validity of the judgment lies with the engineer, this is not a reason to reject a priori any proposed anomalous evidence. The simple identification of an anomaly in itself is likely to be limited by the significance of the fact, since anomalies occur regularly in extreme situations. The encounter with abnormal data prompts the engineer to correct the auxiliary hypotheses without involving the main assumption. The rationality of this approach is connected with the presumption that the anomaly can be caused by some errors on its part, and not with the fundamental flaw of the verified hypothesis. It would be naive from the perspective of scientific method and rationality to assume that a simple identification of the anomaly falsifies the main hypothesis or is sufficient to refute it. Since the fact of anomalous data itself 'can never logically force a researcher to abandon a certain hypothesis, any of the beliefs from which this hypothesis follows can be wrong' [16]. This means that an engineer's reaction to anomalies in itself can be evaluated in terms of rationality.

The conceptual framework for discussing abnormal information is determined by the way in which an anomaly is answered. C Chinn and W Brewer established seven ways of response to abnormal data.

IOP Conf. Series: Materials Science and Engineering **966** (2020) 012118 doi:10.1088/1757-899X/966/1/012118

In an extreme situation, an engineer can 1) ignore such information; 2) reject it; 3) exclude anomalous data from the information that is confirmed by accepted theory; 4) keep it in mind with other things being equal; 5) rethink abnormal data in accordance with accepted theory; 6) rethink the data and make partial changes to the theory; 7) accept abnormal data and change the theory. Each option will be rational in certain situations. The rationality of a particular response in a particular situation is largely a matter of judgment.

In extreme situations, epistemically cautious utterances are rare. Knowing this, one can expect that the invited experts will strive for the necessary impartiality and methodological carefulness regarding the facts that they are ready to accept as established. In fact, non-critical perception of abnormal evidence may be present in professional discussions. There may be cases when difficult situations causing serious consequences, are evaluated without due diligence and an unreasonable, reckless conclusion is made about someone's fault. Engineers can be guided not by rational evidence, but by various kinds of addictions, personal or corporate interests. At the same time, the question of whether the generally accepted position is reliably substantiated remains open. Invited external experts provide evidence with claims to impartiality. Although their conclusions look pretty convincing to a large extent, due diligence is necessary, because the engineer, by virtue of their epistemic responsibility, should be concerned about the integrity of the sources (the problem of ‘second-hand’ evidence) and the reliability of the conclusions.

4. Conclusion

Is an engineer able to formulate plausible hypotheses under administrative pressure or a mercenary interest in falsifying evidence? This is much more difficult to do. Obviously, the engineer has the right to think about the circumstances of proposing alternative hypotheses or directly ask persons with the authority to distribute responsibility, whether such an activity can be considered as a debt, and whose debt it is. The first thing to establish is how the fulfillment of such an obligation would be practicable; then you need to find out to whom this applies and why. Obviously, an engineer can directly participate in the potentially complex research needed to form alternative hypotheses. An engineer can and should use due epistemic diligence in relation to the assumptions made. This implies adoption of appropriate proactive measures to ensure that the sources, on which it is based, are not false or falsified due to the influence of factors external to the extreme situation under study.

References

[1] Chomsky N 1967 The Responsibility of Intellectuals *NY rev. of books*

[2] Bellamy A 2015 The three pillars of the responsibility to protect *Pensa. Prop.* **41** pp 35–64

[3] Zagzebski LT 2012 *Epistemic Authority: a Theory of Trust, Authority, and Autonomy in Belief* (Oxford: Oxford Univ. Press)

[4] Chrisman M 2015 *The Meaning of 'Ought': Beyond Descriptivism and Expressivism in Metaethics* (Oxford: Oxford Univ. Press)

[5] Russell B 1960 The social responsibilities of scientists *Sci.* 131 **3398** pp 391–92

[6] Kornblith H 1983 Justified belief and epistemically responsible action *Phil. Rev.* **92** pp 33–48

[7] Hayward T 2019 Three duties of epistemic diligence *Jour. of Soc. Phil.* **50** (4) winter pp 536–61

[8] Rorty A 2010 Questioning moral theories *Phil.* **85** (1) p 29

[9] Coady D 2017 *Applied Epistemology in a Companion to Applied Philosophy* Ed K Lippert-Rasmussen et al (Hoboken, NJ: John Wiley and Sons). P. 58

[10] Davis M 2019 Engineering as Profession: Some Methodological Problems in its Study In: *Engineering Identities, Epistemologies and Values. Philosophy of Engineering and Technology* vol **21** Ed Christensen S, Didier C et al (Springer: Cham) pp 65–79

[11] Lakatos I 1970 Falsification and the Methodology of Scientific Research Programs In: *Criticism and the Growth of Knowledge* ed I Lakatos and A Musgrave (Cambridge: Cambridge Univ. Press) pp 91–196

[12] Nickles T 2015 Heuristic appraisal at the frontier of research In: *Heuristic Reasoning* Ed E Ippoliti (Berlin: Springer) pp 57–88
[13] Mitcham C, Von Schomberg R 2000 The ethics of engineers: from occupational role responsibility to public co-responsibility *Res. in phil. and technol.* **20** pp 167–89
[14] Mitcham C, Mackey R 2017 Comparing Approaches to the Philosophy of Engineering: Including the Linguistic Philosophical Approach In: *Philosophy and Engineering: Philosophy of Engineering and Technology* Ed I Poel and D Goldberg (Springer: Dordrecht) **2** pp 49–59
[15] Pigden C 2016 Are conspiracy theorists epistemically vicious? In: *A Companion to Applied Philosophy* Ed K L Rasmussen, K Brownlee et al (London: John Wiley & Son) pp 120–32
[16] Chinn C A, Brewer W F 1993 The role of anomalous data in knowledge acquisition: a theoretical framework and implications for science instruction *Rev. of ed. res.* **63** (1) 19