METAETHICAL AND MODALLOGICAL ASPECTS OF THE IMPERATIVE OF SUSTAINABILITY

METAETHISCHE UND MODALLOGISCHE ASPEKTE DES NACHHALTIGKEITSGEBOTS

Joachim Schwarte

Institute of Construction Materials, University of Stuttgart

SUMMARY

The imperative of sustainability is a socially generally accepted principle, but it is not unproblematic as a starting point for scientific investigations, both from an ethical and a logical point of view. The present essay is dedicated to some fundamental aspects of this problem. After introducing central concepts of metaethics and deontic modal logic, which are illustrated in particular by the use of relevant diagrams, the attempt is made to plausibilize concepts based on gradual deontic operators and to present their relevance for the interpretation of HANS JONAS' text *The Imperative of Responsibility*, which is fundamental for environmental ethics both from a historical and a systematic point of view.

ZUSAMMENFASSUNG

Bei dem Gebot der Nachhaltigkeit handelt es sich zwar um einen gesellschaftlich allgemein anerkannten Grundsatz, dieser ist allerdings als Ausgangspunkt für wissenschaftliche Untersuchungen sowohl in ethischer als auch in logischer Hinsicht nicht unproblematisch. Der vorliegende Aufsatz ist einigen grundlegenden Aspekten dieser Problemlage gewidmet. Nach der Einführung in zentrale Begriffe der Metaethik und deontischen Modallogik, die insbesondere durch die Verwendung einschlägiger Diagramme veranschaulicht werden, wird der Versuch unternommen Konzepte, die auf graduell abgestuften deontischen Operatoren basieren, plausibel zu machen und deren Relevanz für die Interpretation des für die Umweltethik sowohl in historischer als auch in systematischer Hinsicht grundlegenden Textes *Das Prinzip Verantwortung* von HANS JONAS darzustellen.

1. INTRODUCTION

The developers of technological innovations and the users of all existing technological possibilities are under increasing pressure to justify themselves due to certain global problems that are essentially caused by the use of technology. If it cannot be proven that relevant sustainability criteria are met, the development and use of technology is considered ethically problematic. The fundamental ethical requirements resulting from such considerations are generally recognized, at least in the industrialized nations of Western Europe. It is a declared political goal and thus also the purpose of numerous national laws and international agreements to advance the so-called sustainable development. The imperative of sustainability is thus an important argumentative starting point for some sometimes quite serious social changes and especially for their scientific justification. The scientific-theoretical status of the imperative of sustainability itself is seldom examined in this context. This is questionable from a methodological point of view, since the claim of scientificity of any theory is generally dependent on the scientific-theoretical status of all assumptions made within the framework of a respective theory and of all presupposed circumstances.

In the following, the idea of the imperative of sustainability will be examined in more detail with respect to two sub-disciplines of theoretical philosophy, namely metaethics and modal logic. In conclusion, this will also enable a critical examination of the sustainability assessment methods that have become established in the meantime.

2. BASIC CONCEPTS

Metaethics is the special philosophical discipline that examines the logical-linguistic presuppositions of ethical sentences or expressions as well as their meaning and use. In the context of metaethics, the question should be clarified in particular under which circumstances ethically motivated commandments or prohibitions have a meaning and what this meaning consists of. It depends on the answer to this question whether corresponding commandments and prohibitions can be examined or justified with scientific methods at all.

Modal logics are those extensions of elementary propositional logic or predicate logic which are established by the introduction of certain non-truth functional (modal) operators. Among the most important modal operators are those represented in normal language by the adjectives "necessary", "possible", "required", "forbidden" and "permitted". In general, modal logics are forms of two-valued logic, as are the more elementary variants of logic. This means that a sentence or a logical formula is assigned either the value "true" or the value "false". Thus, modal logic is a methodology for the systematic clarification of the truth content of modal logical propositions. In particular, the question of the general validity of statements made is central. Unlike in the case of elementary propositional logic, however, in modal logic it is not possible to fall back on the concept of the so-called truth-value assignment, but, for example, a possible-world semantics must be used, which considerably increases the theoretical effort.

The connection between the explained individual philosophical fields is established by the mutual dependence of the abstract concepts "meaning" and "truth". GOTTLOB FREGE wrote in his fundamental essay *Über Sinn und Bedeutung* [1] that "we are urged" to "recognize the truth-value of a proposition as its meaning." He takes "the truth-value of a proposition to mean the fact that it is true or that it is false."

In the *Tractatus logico-philosophicus* [2] FREGE's view is somewhat weakened by LUDWIG WITTGENSTEIN. WITTGENSTEIN writes: "To understand a proposition is to know what is the case when it is true. (So one can understand it without knowing whether it is true.) One understands it if one understands its components."

Thus, the question arises whether a sentence that expresses a commandment or a prohibition can be "true" or "false" at all and to what extent the methods of logic can be applied appropriately in this context. Linguistically, it is rather likely to ascribe the attributes "justified" or "unjustified" to commandments or prohibitions. From the perspective of engineering science, such a question is at least unusual. If engineering tasks fall into the field of descriptive empirical science, the truth of all statements made can and must be ensured by recourse to objectively repeatable experiments. Those sentences, which express elementary results of this kind, are mostly called "protocol sentences". In the field of engineering science, which can rather be understood as applied mathematics, the authorization to assign truth values to statements is secured by the appropriate use of corresponding mathematical and logical methods.

Are ethical tasks such as the sustainability requirement therefore not treatable within engineering or even science as a whole?

3. DIFFERENTIATIONS OF METAETHICS

In metaethics, a distinction must first be made between cognitivism and non-cognitivism. Cognitivists assume that no dissent exists or can exist with regard to the goal that is to be striven for by means of actions that can be distinguished as ethically correct. The "good" is regarded as principally recognizable and absolute. Under this assumption, commandments can be examined as to whether the actions they induce or prevent actually pursue the set goal or not, and thus a distinction can be made between "valid" (= "true") and "invalid" (= "false") commandments. Normative sentences, i.e. sentences expressing commandments, are said to have cognitive or descriptive function within the framework of cognitivism. Thus, the precondition for a scientific classification and use of normative sentences would indeed be given. Noncognitivists deny the cognitive function of normative sentences. From their point of view, normative sentences cannot be assigned truth values and ultimately any scientific discourse concerning these sentences becomes impossible. Accordingly, this point of view regards the "good" as relative in principle.

A finer subdivision of cognitivism can start from the question to which basic principle the good assumed to be absolute can be reduced. The most important answers to this basic question of reductionist cognitivism, which is often briefly called reductionism, are classified under the terms naturalism, nonnaturalism and supernaturalism. Naturalism assumes that the "good" is empirically discoverable in the world. The essential form of naturalism is intuitionism, which assumes that every rational being basically already has a knowledge of the good. Finally, supernaturalism amounts to a trust in external sources, which is especially demanded in the context of the religions of revelation. It is obvious that all these positions are hardly compatible with a modern scientific approach.

In the literature, viewpoints based on nonreductionist cognitivism are also occasionally examined. However, these are mostly implausible and will not be considered any further here.

The term NON-cognitivism is used to describe various viewpoints that assign different functions to normative sentences than cognitivism. Emotivism or expressionism, for example, assumes that standard sentences primarily express feelings. Finally, prescriptivism claims that norm sentences are essentially prescriptions within a pre-existing hierarchical system of power. EDGAR MORSCHER writes in his book *Normenlogik* [3] "In contemporary ethics, one or another version of prescriptivism usually forms the (often unspoken and unquestioned) background theory. In this respect, prescriptivism in its various versions is dominant in contemporary ethics." This is also assumed in the following considerations.

4. OPERATORS, AXIOMS AND DIAGRAMS OF MODAL LOGIC

Table 1 summarizes the two main operators that occur in alethic and deontic modal logic, each with its own meanings, as well as the main axioms of these variants of logic.

Table 1: Operators and axioms of modal logic

	ALETHIC MODAL LOGIC	DEONTIC LOGIC
$\Box p$	necessary p	required p
$\Diamond p$	possible p	permitted p
ESSENTIAL AXIOM	$\Box p \rightarrow p$ in all possible worlds	$\Box p \rightarrow \Diamond p$ in all acceptable (ideal) worlds

The proposition $\Box p \rightarrow \Diamond p$, which is stated in the Table 1 as an axiom of deontic logic ("If p is required, then p must also be permitted.") is also valid in the alethic variant ("If p is necessary, then p must also be possible."), but there it is not an axiom but can be derived from the stronger axiom $\Box p \rightarrow p$ ("If p is necessarily the case, then p is actually the case."). The corresponding theorem of deontic logic ("If p is commanded, then p actually takes place.") is obviously incorrect, because not every commandment is actually always obeyed. Between the elementary statements, which can be formed with the deontic operators and their negations (symbol "$\neg$") there are relations, which can be summarized in a square diagram (see Fig. 1). In Fig. 1, the dashed line symbolizes a contrary opposition, the double line symbolizes a subcontrary opposition, and the two diagonals with diamonds at their ends symbolize contradictory oppositions. Finally, the two arrow-like edges symbolize "if-then" relations; in particular, this means that the left vertical edge of the diagram just represents the deontic axiom from Table 1. Accordingly, the right vertical edge can be interpreted as "If p is forbidden ('not allowed'), then p cannot be commanded."

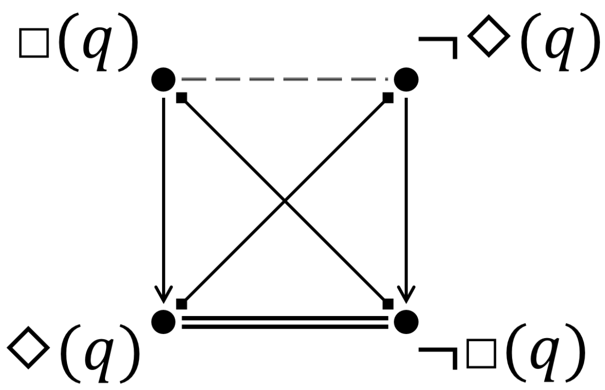


Fig. 1: The square of deontic logic

There is an isomorphism between Fig. 1 and a diagram that is essential and fundamental to predicate logic (Fig. 2).

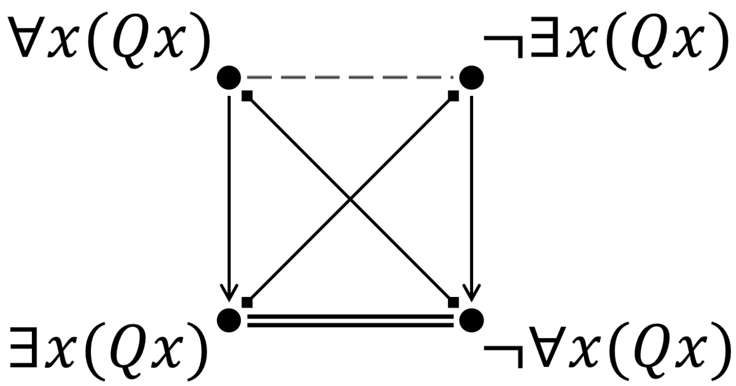


Fig. 2: The square of predicate logic

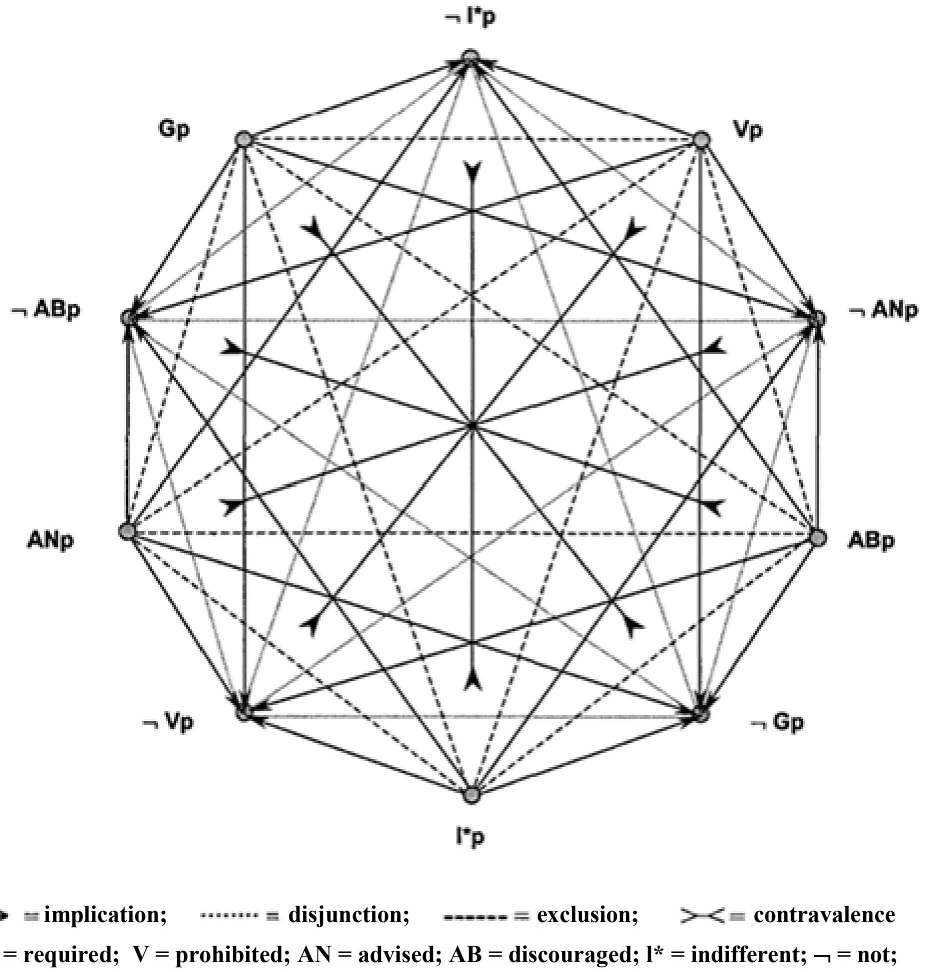
This obvious isomorphism is the key to the solution of the problem discussed above, that the meaning of norm sentences cannot initially consist in assigned truth values, so that there is no basis for a formal logical analysis of more complex sentences of this kind. Nevertheless, the rules of ordinary formal logic can also be applied in the context of deontic logic because of the structural similarity shown above.

For the sake of completeness, it should be noted that diagrams such as those in Fig. 1 and 2 have their historical roots in Aristotelian syllogistics, in which the four possible forms of judgment are traditionally given code letters. These code letters are compiled in Table 2, where they are also juxtaposed with the corresponding node labels present in the aforementioned figures.

Table 2: The code letters of the syllogistic judgments with assignment of the corresponding node labels in deontic logic and predicate logic

CODE LETTER	SYLLOGISTIC FORM OF JUDGEMENT	DEONTIC LOGIC (s. Fig. 1)	PREDICATE LOGIC (s. Fig. 2)
A	Generally affirmative	$\Box(p)$	$\forall x(Qx)$
E	Generally negating	$\neg\Diamond(p)$	$\neg\exists x(Qx)$
I	Particular affirmative	$\Diamond(p)$	$\exists x(Qx)$
O	Particular negating	$\neg\Box(p)$	$\neg\forall x(Qx)$

5. DIFFERENTIATION OF THE OPERATORS OF DEONTIC LOGIC



→ = implication; ········ = disjunction; ------ = exclusion; >< = contravalence
G = required; V = prohibited; AN = advised; AB = discouraged; I* = indifferent; ¬ = not; p = the respective action

Fig. 3: The decagon of deontic logic

Within systems of rules that are actually applied in practical contexts, it is generally necessary to differentiate between prohibitions and commandments of different strength. JAN C. JOERDEN explains in [4] this necessity on the basis of Islamic law and finally extends the square diagram shown in Fig. 1 to a decagon of deontic logic, which is reproduced in Fig. 3.

However, the decagon depicted has a defect that runs counter to the intended goal: Each of the existing nodes is either of the source or of the sink type, i.e. a sequence of nodes which would consist in an implication path leading e.g. from a strong prohibition via a weak prohibition to the situation of indifference is not contained in this diagram. For such a path to be possible, there would have to be nodes where at least one implication arrow starts and ends. In [5], therefore, a different form of differentiation is proposed, which can be visualized as an eight-cornered diagram, shown in Fig. 4.

The operators of deontic logic differentiated in this way, which appear as node labels in Fig. 4, can be interpreted using, for example, the translations proposed in Table 3.

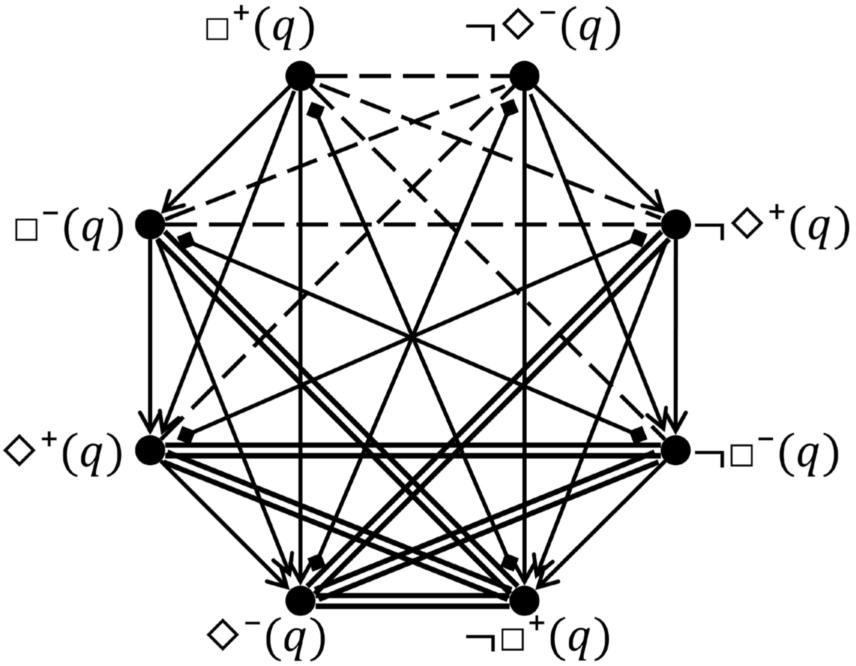


Fig. 4: An octagon of deontic logic

Table 3: Possible Interpretations of Differentiated Deontic Operators

OPERATOR	MEANING AND STRENGHT	SUGGESTED INTERPRETATION
$\Box^{+}(p)$	strong command	Commanded under penalty in case of omission
$\Box^{-}(p)$	weak command	Commanded with the promise of rewards
$\Diamond^{+}(p)$	strong permission	Permitted (No fees will be charged.)
$\Diamond^{-}(p)$	weak permission	Allowed (No penalties will be assessed.)
$\neg\Diamond^{-}(p)$	strong prohibition	Prohibited under penalty
$\neg\Diamond^{+}(p)$	weak prohibition	Prohibited (Exceptions are possible against the payment of fees.)
$\neg\Box^{-}(p)$	strong negative command	Not commanded (No rewards will be given.)
$\neg\Box^{+}(p)$	weak negative command	Not required (The omission remains unpunished.)

It is clear that further finer differentiations of the operators are possible. In particular, penalties of different severity can be imposed and both rewards and fees can be of different magnitude. In the borderline case, even continuous varying operators are conceivable (see Fig. 5).

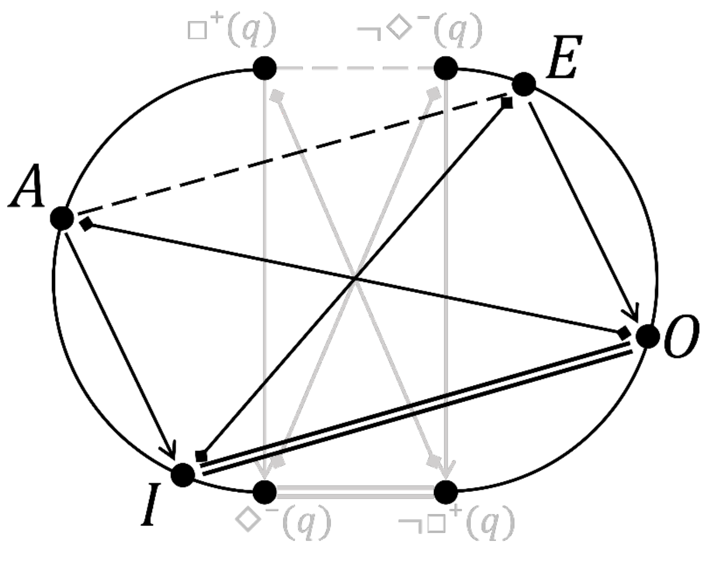


Fig. 5: Continuously variable modal operators

In Fig. 4, a total of 6 square substructures can be identified, each of which is isomorphic to the previously explained square of deontic logic. Depending on whether the future outlook guiding the rule maker is rather optimistic or pessimistic, the corresponding square is twisted more or less strongly to the left or right. Table 4 gives an overview.

Table 4: The characteristics of the square substructures in Fig. 4

A	E	I	O	COMMAND-MENTS	PROHIBI-TIONS	FUTURE VISION
$\Box^{+}(p)$	$\neg\Diamond^{-}(p)$	$\Diamond^{-}(p)$	$\neg\Box^{+}(p)$	strong	strong	neutral
$\Box^{-}(p)$	$\neg\Diamond^{+}(p)$	$\Diamond^{+}(p)$	$\neg\Box^{-}(p)$	weak	weak	neutral
$\Box^{+}(p)$	$\neg\Diamond^{+}(p)$	$\Diamond^{+}(p)$	$\neg\Box^{+}(p)$	strong	weak	hopeful
$\Box^{-}(p)$	$\neg\Diamond^{-}(p)$	$\Diamond^{-}(p)$	$\neg\Box^{-}(p)$	weak	strong	fearful
$\Box^{+}(p)$	$\neg\Box^{-}(p)$	$\Box^{-}(p)$	$\neg\Box^{+}(p)$	strong	very weak	very hopeful
$\Diamond^{+}(p)$	$\neg\Diamond^{-}(p)$	$\Diamond^{-}(p)$	$\neg\Diamond^{+}(p)$	very weak	strong	very fearful

Accordingly, in Fig. 5 in principle an infinite number of squares of the considered type can be drawn. From this manifold, the square marked in the diagram with the previously introduced code letters (see Table 2) is an exemplary choice. This example square is rotated to the left, thus representing a situation based on a rather pessimistic prognosis.

6. THE SUSTAINABILITY IMPERATIVE AND THE IMPERATIVE OF TECHNICAL PROGRESS

A still much-cited formulation of the sustainability imperative, which is often compared to IMMANUEL KANT's categorical imperative (s. [6]) under the name of ontological or ecological imperative, can be found in the book *Das Prinzip Verantwortung* (*The Imperative of Responsibility*) [7] by HANS JONAS, which is fundamental for environmental ethics as a whole. There it says "Act in such a way that the effects of your action are compatible with the permanence of genuine human life on earth", whereby the diversity of the options for action available in each case is additionally restricted by a "heuristic of fear": "It is the rule, primitively speaking, that the prophecy of doom is to be given more ear than the prophecy of salvation."

The principles cited prove to be incompatible with a fundamentally positive attitude toward technical progress per se. If technological progress is regarded as basically "good" in the ethical sense, this implies that technical progress in general must be actively promoted. Such a hopeful view of the future based on trust in the technical sciences has recently been classified as blind "faith in technology". Since, on the other hand, a solution to the world's problems seems virtually impossible without recourse to further technical development, a compromise must be worked out at this point. The theoretical considerations presented here can be a starting point for a compromise in which technical, logical and ethical aspects are taken into account in a balanced and scientifically well-founded way.

7. SUMMARY AND OUTLOOK

A proper environmental ethics must take into account the special characteristics of this field and the enormous urgency of the tasks to be solved by the related environmental politics in a way that can gain agreement in interdisciplinary discourse. To this end, the use of a novel deontic logic seems to become necessary. This logic must be able to reflect gradual differences in the strength of rules based on environmental politics. Aspects of the different visions of the future that prevail within a society and that can be dominated by fear as well as by hope should also be considered within the framework of such a deontic logic. First ideas concerning such a deontic logic have been presented in this paper.

The formal elaboration of the systems equipped with differentiated deontic operators including the indispensable adequacy proofs is reserved for later work. Also the presented novel deontic diagrams require further, deeper analysis and optimization.

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