RESPONSIBILITY AND TECHNOLOGY

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Abstract: Challenges and functions for responsible behaviour in a system-technological world are tackled from a philosophical point of view. Different kinds and levels of responsibility are distinguished in terms of action (causal), task, and universal moral responsibilities. Problems of ascribing and distributing responsibility are discussed. Professional codes of ethics and responsibility conflicts are analysed, and 15 priority rules are proposed to help deal with or solve these important problems.

Resumen: En este articulo se plantean, desde un punto de vista filosófico, retos y funciones para el comportamiento responsable en un mundo como sistema tecnológico. Se distinguen diferentes tipos y niveles de responsabilidad en términos de acciones causales, tareas y responsabilidades morales. Se discuten los problemas de atribuir y distribuir las responsabilidades morales universales. Se analizan los códigos de ética profesionales y los conflictos de responsabilidad, proponiéndose 15 reglas de prioridad para ayudar a tratar de resolver estos importantes problemas.

Moral judgements and ethical problems with respect to technology *and* economy are usually problems of bearing, attributing, and distributing responsibility. We can understand the human being as a *normative being*, that is, he or she is morally distinguished from other creatures by the capacity to bear, acknowledge, consciously identify, and accept responsibility for the outcomes of his or her actions and role-fulfilments. Humans are so to speak *moral beings*. Yet, moral responsibility is but *one* sort of responsibility, which can be located within a rather complex realm, for example, those responsibilities engendered by contracts or other mutual agreements that not necessarily be moral in the narrower sense, that is, they might not affect the life, limbs, psyche, and well-being of other people or living beings in general. These –ethically speaking– not morally relevant responsibilities might be called

ethically neutral. But they are still *normative* and prima facie to be obeyed by the respective persons who have accepted these non-moral responsibilities. In addition, these ethically neutral responsibilities can come into conflict with moral duties and ethically relevant obligations, i. e. moral duties in the narrower sense. Should a manager simply follow managerial and economic strategies of maximising [instead of optimising or 'satisficing' (Herbert A. Simon)] profits or pressing to save time in risky operations and strategies in the implementation of new technologies? Or should he refrain from taking any risks for life and limb when consenting to operational plans to implement a new technology? Is safety to be valued first - even at the price of setbacks with respect to economic development and a possible maximisation of gains or profits? Should for instance an engineer, who is employed in a dependent position, 'blow the whistle' in the case of a risky decision and issue a warning to the public about possible risks or hazards or potential negative outcomes? Should loyalty to his firm or supervisors or the consideration of his personal career override his moral (co-)responsibility for public safety? Or must moral responsibility take precedence over contractual responsibility, although keeping to contracts certainly also has a moral dimension, insofar, as we are morally obliged to abide to the law. There is also the question whether or not moral responsibilities occurring in economy and technology are identical or overlapping or perhaps contradict one another. Indeed, one could perhaps argue that ethical problems in economy are further-reaching than moral problems in technology, because there are many problems in the economic sector, such as the distribution of work, unemployment etc., which may not be directly related to technology but where technology is a contributing factor. However, there is a large overlap between these two areas, and as far as technology is involved and technological implementation is at stake within economic decision-making, the ethically relevant problems are very similar or at least closely connected in both fields (cf. Lenk/Maring 1995a, Lenk/Maring 1998).

Yet, with respect to the question of safety, managers apparently sometimes ignore this connection. This fact is dramatically illustrated by an analysis of the catastrophe of the US spacecraft *Challenger* in 1986, when 73 seconds after takeoff from Cape Canaveral the manned spaceship exploded and seven astronauts lost their lives. The direct cause was a brittle rubber sealing ring which, in accordance with the predictions and warnings of the engineers from the rocket manufacturer Morton Thiokol, cracked under low temperature conditions. One day before

takeoff the engineers, in particular Allen MacDonald, the project leader, and Roger Boisjoly, the expert on sealing rings in rocketry, had warned and protested against takeoff plans for the next day. They informed NASA about the danger that the sealing rings would break below the freezing point. They were supported by the Deputy Director of the engineering department of the rocketry firm, Robert Lund, who also informed Jerry Mason, a superordinate engineer within the same firm. Mason, however, silenced Lund and ended the discussion with the words 'Take off your engineering hat and put on your management hat'. Lund gave in and consented to takeoff, which was notified to the project leader of NASA, who authorised the takeoff without any reservations resulting in the catastrophic accident. (Later, the engineers who had launched the warnings, MacDonald and Boisjoly, were transferred to another department, which they deemed a kind of quasi-punishment.) (Cf. Lenk/Maring 1995a: 33.)

Do indeed managers decide differently than engineers? Do their decisions rest upon a different set of criteria? Regarding ethical decisions, does the management hat differ from the engineering hat? In any case, this example demonstrates how complicated the problems of responsibility, its interpretation and its distribution are: Who was the responsible person or body in this case? Everybody who had been involved? Just NASA, not a single individual? Each to a certain degree? How much, then? (cf. 3 below.) Before dealing with these questions, we will first turn to issues of defining and delineating responsibility in general.

1. Responsibility as a relational construct

'Responsibility' is not just a concept solely to be used in a descriptive sense, for example, someone is responsible, but is above all an evaluative attributional concept - somebody is *held* (to be) responsible. This introduces the normative, even ethical dimension of action in a stricter sense. The concept of responsibility itself is a diverse concept of structure or relation that is linked to assignment, attribution, and imputation, namely a scheme that needs to be analysed and interpreted with respect to the following elements:

Someone: the subject or bearer of responsibility (a person or a corporation) *is responsible for: something* (actions, consequences of ac-

tions, situations, tasks) *in view of: an addressee* ('object' of responsibility) *under the supervision or judgement of: a* judging or sanctioning *agent in relation to: a* (prescriptive, normative) *criterion of attribution of accountability within: a specific realm of responsibility and action.*

Responsibility is, first, a concept that can be expressed within a relational attributive norm (controlled expectation of action and behaviour). Responsibility means that a person must justify actions, consequences of actions, situations, tasks, and so forth in front of an addressee and before an agent in respect to which he or she has obligations or duties of rendering justification, in accordance with standards, criteria, norms. The responsible person is accountable for his or her own actions or, under specific conditions, for actions performed by others for whom he or she is vicariously responsible. (Parents, for example, are liable for certain wrongdoings of their offspring, perhaps in the sense of negligence of their supervisory duties). The concept of responsibility gives a *structure* to social reality (of norms and actions) and to social relations. One can differentiate between the typical bearers of responsibility in terms of active roles and observer roles. Specifically, one imputes or attributes a particular responsibility to oneself as an actor or to others from the perspective of participant, observer, or scientist, in relation to rules and norms that are of a general nature. The attribution (in a particular case) activates, that is instantiates, the general pattern of responsibility in a specific instance. The attribution of responsibility is an active process both in self-interpretation and in the interpretation of the actions of others. As one distinguishes between a general responsibility for the results of an action derived from a kind of role responsibility and task responsibility on the one side and legal and moral responsibility on the other side, a second aspect of interpretation emerges: The responsibility for the result of an action is initially seen only as a superordinate, schematic or 'formal' pattern; it still must be connected, through the concrete specifications of tasks or roles or through (universal) moral or legal interpretation, to the respective domain of values and norms. Only then can it be filled with meaning.

2. Different types of responsibility and levels of analysis

In the following, diagrams illustrating hierarchical models of different types of responsibility are presented; the respective levels or strata refer to different dimensions of interpretation. They should be consid-

ered analytically helpful differentiations of an «ideal typ(ic)al» prevalence similar but not identical to Max Weber's «ideal types» («Idealtypen»). These general diagrams are to be considered on different levels: For example, the first diagram of action responsibility versus the other ones which are themselves alternatives on the same level (e. g., types are paratactical and mostly disjunct, subordinate, interpretative constructs on the same level, whereas the levels are hierarchically organised). That means that the upper stratum is more abstract and must be substantiated by subordinated, more concrete interpretative constructs, e. g., kinds of responsibility). In general, the levels are analytical and perspectivistic constructs that may overlap and apply to a real case of responsibility instantiation which can be analysed either from a rather formal, abstract, and overall interactional or «causal» perspective or on a more concrete level of role, legal, or moral interpretation. That is, concrete instances of responsibility attribution can be analysed not only on a formal or abstract level (as in the first diagram), but also from a lower level, from a more concrete point of view, namely from the perspective of moral, legal, or role responsibility. Although usually one and the same analysis on a specific level is fixed to a certain interpretation, say, the legal one, this does not preclude another interpretation from a moral point of view, i. e. another general type structure. Within the rather concrete level of these schematic constructs, the different individual types are also analytic constructs which may sometimes be attributed more or less. (E. g. within the the diagram of universal moral responsibility, the higher level responsibility to keep the Fifth Commandment would also apply, for example, when a doctor must make a decision in an intensive care unit concerning the reasonableness of a measure to be taken for the welfare of a patient under consideration of practical humanity; both the direct responsibility for life and limb of the respective person and the formally higher responsibility of medical ethics as well as general ethics come into play.) Even in the lower parts of the rather concrete type diagrams in the lower level of analysis, constructs are to be understood as analytical distinctions: e. g. collective or group responsibility usually does not preclude individual or personal responsibility which might also be present, although collective responsibility cannot be analytically reduced to or derived from individual or personal responsibility alone. The same applies to institutional responsibility. Furthermore, there are conceptual connections or «analytical relations» between some juxtaposed or subordinated subtypes.

The most obvious and general level at which one can describe responsibility is referring to one's being responsible for the results and consequences of one's own actions. We may call this the level of the analysis of prototyp(ic)al (causally oriented) *action responsibility*. An agent is to be held responsible for the outcomes of his or her actions in an instance for which he or she is accountable. An engineer designing a bridge or a dam is responsible to the supervisor, employer, client and/or general public for his or her design in terms of technical correctness, safety, cost, feasibility, etc. Frequently, accountability questions are raised in negative cases, when one or more of these criteria are not fulfilled. The breaking of a dam may be the result of wrong statics calculations, careless, negligent, or even criminal work, poor craftsmanship or using cheap material. Therefore, it is important to emphasise negative action responsibility. Professionals, for example, have a responsibility to the public to ensure high standards in their work and to avoid risks of disasters as far as possible at a reasonable cost. The responsibility to avoid mistakes, failures, poor quality of work, etc. is part and parcel of action responsibility. Further subtypes of *action responsibility* are shown in the following diagram (Figure 1):

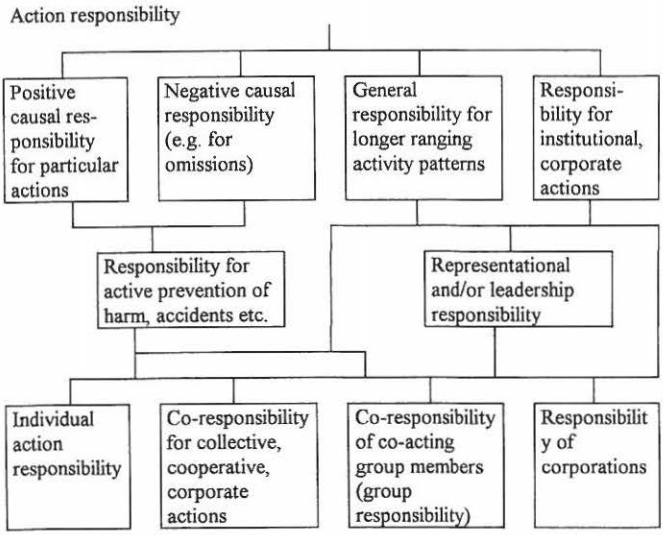

Figure 1: Action responsibility

Very often, organisations, institutions, or corporations act *collectively*. Therefore, there is a responsibility of institutional or corporate actions: it may coincide, though not be identical, with the individual responsibility of a person in a representative position (the representing person or role holder). Leadership responsibility with respect to external addressees and agents is but one example of this kind of responsibility. The most typical case of responsibility dealt with so far is *individual* action responsibility, but if a *group* is acting collectively or if individuals participate in joint group action, there is a co-responsibility of participating members. Responsibility for group actions is sometimes called collective or group responsibility. The second level is comprised of the types of *role and task responsibility, universal moral responsibility,* and *legal responsibility:*

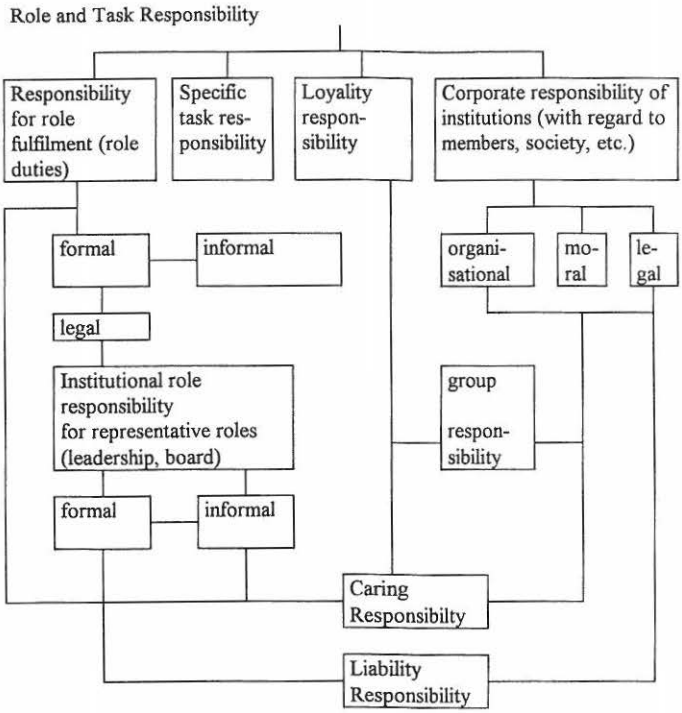

Figure 2: Role and Task Responsibility

In accepting and fulfilling a role or a task (e. g. in a job) a roleholder usually bears a responsibility for normally acceptable or optimal role fulfilment. These role duties might be assigned in a formal way or be more or less informal. They can even be legally ascribed or at least be legally relevant. If the roletaker is a representative in corporate or institutional role patterns, his or her responsibility may be connected with the associated institutional role responsibilities (as in leadership). In addition, there is the corporate responsibility of firms, corporations, or institutions, if these have a special task to perform or obligation to fulfil with respect to clients, the public, or members of the organisation or corporation. This type of responsibility can have a legal, moral or neutral organisational character. Here again, this may coincide with group responsibility (of a group in charge of the institution or corporation). The next level of responsibility consists of different types of *universal moral responsibility:*

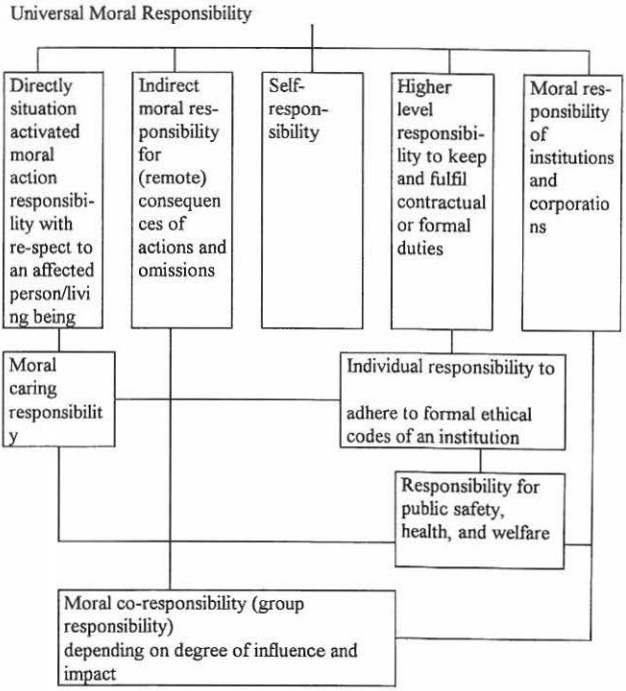

Figure 3: Universal Moral Responsibility

First, there is the *direct* moral responsibility for the agent's acts and results of his or her activities in a given situation. This responsibility is directed toward persons or living beings whose well-being is affected by the agent's activity. More remote consequences of the agent's activity - possibly combined with the impacts of other people's actions or omissions - might amount to an *indirect* moral (co-)responsibility. Neglecting a safety check or wrongly giving an approval stamp for an aircraft can result in loss of lives - as actually occurred in the 1974 crash of a Turkish DC 10 in Paris (cf. Lenk 1993: 199). In 1972, three inspectors of the DC Long Beach plant had wrongly approved modifications of the fatally dangerous cargo door locking system although no work was actually done on the cargo doors. A similar case was the erroneous approval of air brake testing of the prototype in the Goodrich case. More complex problems of indirect co-responsibilities emerge in connection with the problems of synergetic and cumulative threshold effects within interacting systems mentioned below, e. g., in pollution or depletion problems. As shown recently, beside legal responsibilities, corporations also seem to bear *moral* responsibilities (particularly if they fail to improve dangerous conditions, for example, the management of Convair in the DC 10 case (Eddy/Potter/Page 1976) or Air New Zealand in the crash on the Antarctic Mount Erebus (French 1984, Ch. XI)). This certainly is a type of moral responsibility different from an *individual's* moral accountability. *Corporate moral responsibility* frequently coincides, but need not be identical, with the moral co-responsibility of members of a decision-making board. Therefore, corporate moral responsibility is not to be confounded analytically with moral co-responsibility of group members partaking in a collective action or decision-making process (cf. below). Caring responsibility is certainly not only role-bound but also morally relevant. It is the responsibility to ensure the well-being of a dependent person or living being through specific acts within in the context of a general and permanent obligation. In engineering, ethical codes - as in many other professional codes - the responsibility for the safety, health, and welfare of the public is stressed - even considered to be of ‚paramount' importance (cf. e. g. that of the ‚Institution of Electrical and Electronic Engineers'). This responsibility, a combination of indirect moral responsibilities mentioned above and the obligation to abide by the code of ethics of the respective professional society, is - on a second sublevel - certainly a *moral* obligation, too. Therefore, besides immediate action or impact-oriented responsibilities there also is a higher moral responsibility to fulfil contractual or

role duties and promises and to live up to the ethical standards of professional organisations, etc. This obligation certainly is a universal moral one if the fulfilment of a task, contract, or role does not contradict another overriding moral norm.

In general, thus, there exists a rather differentiated interplay of the mentioned levels and types of responsibilities - the *moral* obligations being but one spectrum. Moral responsibility may be activated by a special type of action and in connection with a special role, but it is universal. It is not peculiar to a specific person or role but would apply to anybody who is in the same situation and/or role. Moral responsibility is individualised in the sense that it cannot be delegated, substituted, displaced, replaced or shoved off by the respective person (or corporation/organisation). It cannot be diminished or divided, it cannot dissolve or vanish by being borne by a number of people. It is irreplaceable and undiminishable in that sense.

In addition to the mentioned types of responsibility on the second level, one should also mention different kinds of legal responsibility (not to be elaborated here, cf. e. g. Lenk 1998: 282-3, pedagogical or educational responsibility, religious responsibility, etc.).

3. Problems of distributing responsibility

'A clergyman had rendered great services for a village of wine-growers. Therefore, the wine-growers decided to give him a barrel of wine as a present on a special occasion. So, it was agreed that each wine-grower should contribute two litres of the best wine in his cellar. Accordingly, each wine-grower poured the agreed amount of two litres into a designated barrel. On the day of the celebration following a festive address, the barrel was tapped and the first glass of wine was served to the clergyman. The glass, however, contained only pure water, and the festive atmosphere turned into one of general embarrassment' (Jöhr 1976: 127; translation by E. Hertweck).

It is not known whether the event mentioned in this example really did take place, but it is a very nice illustration of the problem of the distribution of responsibility. The example immediately shows how complicated the problems of responsibility and its distribution are: Who is responsible in this case? Everybody? Each individual? Each to a certain degree? Problems of distributing responsibility are found today in

particular in highly developed industrial societies shaped by technology and advanced economies. Individual actions seem to disappear behind collective, institutional, and group actions. Group and collective action is, on the one hand, the acting of and the acting within organisations (corporate acting) and, on the other hand, the action of *many* actors under strategic and competitive conditions; sometimes the actors are rather independent of one another. With respect to collective actions there are at least two classes of distribution problems, or rather distributability problems (which may however overlap): 1. the problem of attributing responsibility in the case of non-corporate collective actions of many actors (be they organisations or corporations or individuals) and 2. the problem of attributing and distributing responsibility *within* the organisation with respect to internal corporate division of work and role assignments (cf. Lenk/Maring 1995b). Today and in the near future these problems are becoming extremely relevant and pressing, because of the impact of new systems-technological phenomena and processes. As a rule, cases in which an individual alone must take on the entire responsibility are examined in philosophy. Yet are there not also cases of *co-operative* responsibility, collective/co-operative decisions, and collective action in general, that are becoming much more important today, in which someone carries full responsibility by *sharing* responsibility according to the degree of the individual co-operation or accountability? In other words, does the extent of the distribution of responsibility generally reduce the degree of moral responsibility?

As a provisional thesis, we come to the following conclusion in regard to this problem: Central in the model of the distribution of responsibility is the question of the distribution of normative and descriptive responsibility - according to a theory of action - and the (equivalent) reduction of the collective responsibility to individual actors, which is dependent on the form of collective actions and causes. The respective form of collective action is also decisive and should constitute a criterion for distinguishing the various ways of attributing responsibility. A further point of emphasis is the distribution in terms of the respective responsibility types. If one draws a distinction between a duty to compensate as a kind of legal responsibility and moral responsibility, then a division of compensation as a solution is more likely in the former case than in the latter. Basic problems of responsibility distribution arise not only out of the non-corporate collective action of many actors, but also out of specific strategic conditions, particularly in the division of labour processes, that is, in labour segregation in the mar-

ket external to corporations. The effects, results, and side-effects of such actions have - and always have had - an increasingly explosive nature. The difficulty can perhaps be clarified with the help of examples and models of social traps, which have to date been discussed mostly within the realm of individual rationality vs. collective irrationality (e. g., Prisoners' Dilemma, cf. Hardin 1968, Lenk/Maring 1990). Negative external synergetic and/or cumulative effects may occur if a large number of actors act along the lines of individual need calculations (each being directly responsible for their own interests and acts). Particular components, which as such are relatively, that is subliminally harmless, can lead as a whole to damage or even to the loss of highly valued 'commons' or public property. It is characteristic of such damage that property rights, i. e., individual rights to use (e. g. public) resources, are poorly or not at all defined or that they are not complied with. Externalities or external effects are characterised by an incongruity between that outcome for which one is actually responsible and that for which one is made responsible or liable. To avoid external social costs, these could, for instance, be internalised - incorporated into the 'production functions' of a business.

With regard to this problem of responsibility, one can distinguish two subproblems: first, the question of the distribution of responsibility for or in view of cumulative and synergetic damage, and second, the question of the responsibility for unforeseen or even unforeseeable consequences. With regard to moral judgement, it follows that in such a case a personal action responsibility cannot be generally attributed to an individual agent alone nor, in many circumstances, can the cause be attributed to a single domain. In the sense of task and role responsibility, and also in the moral and legal sense, the concerned individuals assume a co-responsibility corresponding to their active, potential, or formal participation (to be determined in each individual case). Considering the consequences of collective action, an extension of the operationally manageable models of the distribution of (co-)responsibility is imperative. Mere appeals to avoid social traps are not very useful. It is also necessary to introduce operationally available and efficient measures such as legal sanctions (product liability, collective responsibility, etc.), financial incentives to change production methods, the definition of property rights for public goods, and so forth. The following statement can serve as a general guideline: *as many laws, regulations, and prohibitions as necessary; as many incentives and individual initiatives and as much individual responsibility as possible.*

A second level of problems involving corporate responsibility distribution includes the external responsibility of corporations - the responsibility of corporations and some or all of its members - and the internal responsibility of organisations or corporations with different structures (hierarchies, etc.) in terms of individual responsibility and co-responsibility, the delegation of responsibility, and so forth. Thus, the respective moral responsibilitycan be differentiated in regard to (at least ideal) corporate action: organisations or corporations as such, organisational members, or the organisation or corporation and its members, among others, can be morally responsible. The attribution of individual moral responsibility must be separately justified in each case. In general, one should make a distinction between the external (moral, legal, role) responsibility *of* organisations or corporations and the (corresponding) internal distribution of responsibility.

In addition to role or task-specific, legal, and action responsibility, corporations and institutions have a moral responsibility or an accountability analogous to personal moral responsibility. This moral responsibility can also be understood as a higher, secondary responsibility; it would exist in addition to and independent of the personal responsibilities of the individual member of the organisation or corporation. Individual responsibility and corporate responsibility do not have the same meaning; they cannot simply be reduced to one and the same thing, although they must always be seen in connection with each other. One type of responsibility does not replace the other. Making organisations or corporations responsible can constitute a first step of attributing responsibility for corporate action; the internal distribution problem within the organisation can be dealt with in a second step. The latter is difficult to deal with according to kinds oder types of responsibility.

The following 10 working hypotheses are formulated to address this point.

1. It is only possible to lay down general distribution rules.
2. These rules are (ideally) to be applied to each individual case with extra provisos regarding special conditions.
3. Responsibility distribution is determined by the structures of the organization, decision-making structures (internal decision units) and principles (decision-making on an individual and collective basis, principles of unanimity or majority). (This applies to the social structure in general, too.)

4. The external responsibility in view of third parties, society and with regard to their relevant agents, is dependent on the corporate structure, on the influence and control of individuals, on the contributions of (individual) agents and in general on the internal responsibility distribution (in the sense of competency and task distribution and role-structure).

5. The internal responsibility for the fulfillment of tasks and roles with respect to colleagues is also primarily determined by the structure of the organisation. It is primarily an accountability to superiors and a special case of role and task responsibility. (The observation of these duties is generally legally required, usually in form of a contract; it can also be morally required).

6. Tasks and competencies and the responsibility connected with them can be delegated. In this case the responsibility of the delegating person does not (necessarily) end with the act of delegation. In general, however, it is not possible to delegate moral responsibility.

7. The (normative) responsibility for the consequences of actions is primarily a result of the individual contributions of action and production. The individual director or the Chief Executive Officer, as well as the performer or executive, would *act* indeed. (The execution of an order or a command does not, however, generally exculpate the performer.) The distribution of such an external or internal responsibility, which for its part is a prerequisite for other responsibility distributions, results from the respective contribution to the action or production and from the involvement of the actor or contributor.

8. Role and task responsibility results from formal as well as informal roles and tasks; the responsibility and its (external or internal) distribution depends on corporate structure, hierarchy and position.

9. Moral responsibility (in a narrower sense) as simply directly and personally attributable responsibility in view of external or internal addressees is made topical by its own action and possibilities of action. Moral responsibility is a function of power, influence and knowledge. The degree of co-responsibility depends upon the strategic position of an individual in a corporation. It increases the higher the formal authority of the bearer

and his or her position within the hierarchy or corporate decision structure is. The moral responsibility of A can be greater than, less than or the same as the responsibility of B. However, it is more appropriate to express responsibility distribution with the help of comparative statements than in percentages . As we already stated, moral responsibility is not really divisible; however, it is open to sharing. It can be borne solely (exclusively) or jointly (each person fully or partly). In the distribution model of moral responsibility both the individuality of the attribution and the intuitively justified non-disappearance of the co-responsibility must be taken into account even in the case of an increasing number of participants (which might factually tend to minimize the personal share of the responsibility).

10. The legal distribution of responsibility is dealt with separately according to legal or natural persons, to the respective civil or criminal law, to legal aspects of administration or aspects of constitutional law. In this way the legal person may, as a rule, be held liable to third parties for those who act on its behalf according to civil law. Internally speaking, the organisation or corporation may have claims against natural persons (e. g. members).

To avoid or counteract the effects of large committee irresponsibility there are several possibilities, e. g. institutional measures of audiatur et altera pars and the consultation of external experts, review boards, consultants, etc., or the official introduction of a role of advocatus diaboli for dissenting opinions within the firm, the development of a culture of fundamental debate, the establishment of an official monitoring and planning suborganisation as well as an office of internal control (cf. Lenk/Maring 1998a: 20).

A further problem of the distribution of responsibility emerges from the use of expert and information systems (cf. Lenk 1989). Can *these,* as bearers, be responsible? Can we make complex decision-making information systems and expert systems responsible? Is that not an attempt to introduce irresponsibility, with no one to be appointed guilty, the violation of a taboo, or even a category error by the analyst? It is indeed important to make computer systems more reliable, but it does not seem sensible to attribute (moral) trustworthiness or responsibility to them. Indeed, that would be absurd! Computers are not moral beings, just as information systems are not social beings. In spite of the

far-reaching social implications of technical systems, human beings must carry the full responsibility for their use or misuse. Human beings cannot morally deprive themselves of their power of decision and their accountability or hand over their moral responsibility to computers and information systems. (This thesis however, must still be elaborated).

4. Professional codes of ethics and responsibility conflicts

Professional regulations and rules of conduct, such as the codes of ethics should not and cannot merely reflect the current professional ethos (cf. Lenk 1991). It is also necessary that ethical considerations, general social values and objectives are recognised as obligatory or effective guidelines; the orientation to the common good(s) should be strengthened, various institutional control measures and possible ways to achieve and promote organisational discipline should be included; particular attention should be given to the question of the structural interrelations with the market and in the job and workplace (in businesses and corporations), to institutional corporate responsibility and to moral ideals (as virtues not enforced by law). If the codes can find stronger and increased entry into the law and gain a kind of legal status, this would increase the chances that the codes would be applied in practice: Mere appeals and the sensitisation of individuals - especially of dependent employees - appear to be insufficient, as necessary as they are indeed. Institutional support is also required. Again, it remains important to include ethical and moral basics in education and technological training, i. e. teaching, and training, e. g. off-line in trainee camps etc., and to provide for accompanying measures, such as discussion and publication of case studies, the establishment of ethics committees, the design and implementation of professional vows, e. g. a kind of Hippocratic oath, etc., and the provision of legal support for employees with particularly high ethical standards who may come under pressure, so that the ethics codes prove to be more than mere pretences or ineffective alibis that have nothing to do with real life. In particular, ethical codes must set priorities and decision criteria that will help in conflict resolution. With regard to responsibility conflicts in practice, there are no ready-made solutions or suggestions available in such cases; instead, it is necessary to develop guiding principles, general recommendations, or practical guidelines on an intermediate level. These rules should differentiate, for example, between moral ideals (virtues) and

moral (obligatory) rules (Hennessey/Gert 1985). A combination of individual and institutional measures seems necessary: The promotion of individual ethical competence is a necessary, yet by no means a sufficient step for the efficient solution of responsibility problems and conflicts. Moreover, an implementation of ethical considerations in law and politics would render this step more effective.

Most engineers and scientists work as dependent employees in industry. This means that the respective company codes, principles of management, and guidelines for specific jobs are relevant for them (cf. Lenk/Maring 1998). These norms are usually discussed under the heading of business ethics. In practical job situations, technology-related and science-oriented questions and problems are often intertwined, so that a clear-cut separation of these two fields is neither beneficial nor sensible. Responsibility for technology and science (research) is particularly concretised in corporate acting in and for businesses.

5. Priority rules

In view of the fact that there are different types of responsibility, it is necessary to have priority rules. We would like to propose the following 15 rules of priority which follow a sequential order and are valid under prima facie conditions (that is, they may at times be overruled by higher and more binding moral obligations). (The first four rules are adapted from Werhane 1985: 72-74).

1. Absolute priority or preference must be given to the individual's basic human rights, legal as well as moral. These moral rights are *non-alienable predistributive or primordial rights* overriding utility considerations. Therefore, the first imperative is to weight the moral rights of the respective individual.
2. When making compromises, the interests of all involved parties should be taken into consideration to the same extent.
3. After considering the moral rights of each party, one should vote for the solution that causes the *least damage or maximises the utility* for all involved parties.
4. Only after the application of rules 1 to 3 can utility considerations be weighted against potential harm. Thus, in general: non-

alienable (predistributive) moral rights are prior to considerations of *avoiding harm and damage* and these -in turn- have precedence over *utility* considerations.

5. In practically unsolvable conflicts, one should look for *fair compromises* (that is, compromises which involve more or less equally distributed or proportionally justified distributions of disadvantages and benefits respectively).

6. *General* (higher level) *moral responsibility* has a higher priority than restricted non-moral prima facie obligations.

7. Universal moral responsibility generally takes preference over role and task responsibility.

8. *Direct* or primary moral responsibility, is usually, but not always, to be considered as having priority over *indirect* responsibility for remote consequences. (This is sometimes true because of urgency in the case of direct, e. g., face-to-face interaction; however, in some cases this must be modified according to the overall importance, magnitude of consequences and the duration of the effects).

9. Primary and *personal moral responsibility* is more important than second level *corporate* responsibility.

10. P*ublic welfare* and the common good have precedence over all other specific and particular interests.

11. Safety comes before technical-functional and economic considerations (as stated, for example, in the German Technical Regulation DIN no. 31.000, comparable to ISO-norms).

12. Global or continental as well as regional and local «environmental compatibility» as defined by official ecological standards must be distinguished and must be taken into account: system relevant or system critical environmental acceptability and regional or continental or even global compatibility remain paramount. Sustainable development of ecosystems is particularly pressing on each of these levels.

13. Urgency of ecological acceptability, as, e. g. sustainability (especially of a system relevant or system critical character), precedes economic utility.

14. Social and human compatibility would - in the case of conflict - have precedence over compatibility with the environment and nature or species, but the attempt should be made to reach sensible compromises: Human and social acceptability are more important than functional efficiency and utility.

15. Practical or «concrete» humanity and humaneness should go in front of abstract requirements and formal universal principles (cf. Lenk 1998).

Such priority rules are conducive to tracing and solving conflicts between different types of responsibilities occurring in a particular situation. Whereas differentiating between the levels and types of responsibilities is necessary for the discovery and identification of conflicts, the rules of priority could be helpful for solving or at least for sorting out and assessing the respective conflict situations and for tracing their specific sources. Yet, much work remains to be done in this area.

6. Conclusion

The notion of individual responsibility is, even in today's era of institutional and corporate decisions and enterprises, of much import and of particular importance for technology. However, problems of collective and corporate responsibility are becoming more and more topical and the relevance of this issue will increase in the future. Engineering ethics codes should be developed, improved, and operationally implemented. The rules of priority outlined above for handling responsibility conflicts must be elaborated much further. All this, then, is necessary to fulfil the ideal prerequisites for mutual and individual responsibility for technology in society.

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