On Responsibility, Profession and the Need for a New Culture of Informatics

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Abstract. What does the notion of ”responsibility” denote? In many discussions the concept in its diversity is not clarified. In this paper we will not talk about questions of professional code of ethics, but reflect on the development and evolution of the concept of ”responsibility”, which is tightly coupled with the advance of technology. This helps to avoid a computing-centred perspective, which focuses on consequences of specific technologies.

We intend to focus on qualities and aspects of responsibility which, besides being important for descriptive, normative discussion, are especially important for the professional practice of system design. In the second part of the paper we take up several of these aspects and – like in a piece of music which started with a traditional tune – improvise, adapt and spread out central themes that are relevant to the practice of computing professionals. The reflection of the genealogy of the concept of responsibility can shed some light on ethical aspects of computing practice.

1 Motivation

What does the notion of ”responsibility” denote? In many discussions the concept in its diversity is not clarified. In this paper we will not talk about questions of professional code of ethics, but reflect on the development and evolution of the concept of ”responsibility”, which is tightly coupled with the advance of technology. This helps to avoid a computing-centred perspective, which focuses on consequences of specific technologies (cp. Lutterbeck & Stransfeld, 1992).

Our discussion has been driven by a concern about the state of our discipline and especially its professionalisation and its practice. Attempts to include reflections on the relation of computing and society (or: Computing in Context) into curricula and thus into the discipline did not have significant influence on practice. While topics of ”computing & society” remain in the margins of the discipline itself, even widely accepted quality values and methods of the academic discipline are largely ignored in computing practice. Thus a gap exists twice, once in-between academic discussion and practice and second in-between the hard-core of the discipline and its margin. Having worked in industry ourselves and talking to practitioners, we see how ethical issues are paramount, although they tend to face up in the small. For practitioners, the usual discussion on ”big” ethical issues or very particular topics is of little help - they have to decide on a minute-to-minute basis, being involved in a context full of demands and restrictions.

Reviewing the existing (mostly German) literature on computers, society, and responsibility, we found that the concept of responsibility is used very general and un-differentiated while questions of ethics and morale are diffused. Thus we attempted to start anew, using the rich structure and history of the term ”responsibility” as a resource for thinking on ”professional responsibility”.

2 Remarks on the Genealogy of Responsibility

The history of the concept of ”responsibility” can be reconstructed in three steps (following Bayertz (1995a), p. 3ff.).

(1) The classical model of responsibility develops but is not a universal, generally accepted concept;

(2) The concept succeeds on the background of profound changes in the structures of human activity (industrialisation) and lives through sustainable changes in meaning;

(3) The current phase of ”global” changes.

Bayertz (1995a:4-5) states the following theses underlying this reconstruction:

- The notion of responsibility is a specific solution which has evolved within the European society for the problem of attribution.
- Attribution is not self-evident, but a result of social ”construction”.
- Different conditions necessarily result in different constructions.

- Principle elements for the conditions of responsibility are structure and range of human action.
- The idea of human freedom and autonomy is constitutive for ”attribution as responsibility”.

2.1 The classical model of responsibility

In events where the cause is a human being or where the event can be traced back to human action responsibility gets to be a topic. Thus, the subject (or person in Kant's terminology) of the action is responsible, those ”bad” consequences which causally follow from the actions are accounted to him/her.

Often forgotten and unquestioned, but necessary prerequisites for this ”classical” model are: *causality*, *individuality* and *a sharp distinction between humankind and nature*. According to Kelsen (1941), causality had to emancipate itself from retaliation. Thus causality is not a ”natural” way of thinking. Likewise, we can not take for granted the notion of attribution to an individual subject, as blood-revenge between families shows. Distinction between humans and nature also plays an important role, as responsibility results from the specific position of human causality (in the middle ages animals which had hurt or killed humans were sentenced to death).

To take the conditions of action (that is the inner view of the ”culprit”) into consideration is a sign of moral development. The question of ”just(ified)” attribution takes into account (besides causality) the *intentions* of the actor and his/her *possibility of foresight into consequences*. In Aristotle's Nicomachean Ethics an important factor for evaluating a situation is *voluntariness* (as personal authoring of the actor). Nevertheless do ”voluntary” and ”involuntary” not mark distinct classes of actions. In any case the given discretionary powers of decision present a heavy argument for the constructional character of responsibility.

The attribution of responsibility always involves a value judgement – as the attribution itself would be only descriptive and without moral significance. Here we deal with implicit and explicit (but not always generally accepted) norms.

To understand ”responsibility”, one has to see it as a network[1] of the subject of responsibility, the object of responsibility and a system of value judgements (Bayertz).

Instead of taking an ontological view of responsibility, letting the event itself point onto the bearer of responsibility (see Picht, 1969a), one should strengthen the constructional character of responsibility. Why construction?

- Human activity is not naturally given. ”Actions” do originate primarily from post-hoc interpretation of events, viewing them as manifestation of a subject which is in principle responsible for its behaviour.
- Freedom of action (as a prerequisite) is not empirically ascertainable, it is (normatively) assumed.

[1] This network can be further refined according to Lenk & Maring (1993:229).

- The focus on specific actions (those with negative consequences) fulfils certain social means and goals: to call the culprit into account. Punishment (informal: contempt, institutional: custody, introspective: pangs of conscience) attempts to direct human behaviour into socially accepted tracks.
- It is possible to exclude certain actions from this view: acting on the marketplace while cutting out rivals is not judged as offensive.

2.2 Formation of the term responsibility

Although the essentials of responsibility according to the ”classic model” have undergone a long process of development, the term ”responsibility” was not used for a long time. Concept and term ”responsibility” do get relevant in the second half of the 18th century in ethical literature (e.g. Lévy-Bruhl, 1884; Nietzsche, 1887) and public debates (e.g. about the explosion of steam boilers).

Bayertz (1995a:24f.) holds the opinion that the rise of the concept ”responsibility” as a central ethical category must be understood as a consequence of reflection on the fundamental changes in structure and type of human activity. These changes resulted from the transition from traditional into modern society (industrialisation). Attribution of negative consequences of actions to someone is rendered difficult by two processes: a) the advance of technology, b) the intensified division of labour.

As a new phenomenon, damages with a social dimension get focus of discussions. This is visible via the (noticeable) public discussion about who is to be held responsible for the pauperisation of the working (and miserable) masses. Important resource for ”publicity” and scope of these discussions is the availability of mechanisms and possibilities of self observation (communication media, institutions) and use of them.

Discussion about the duty of government to prevent these kinds of risks started about that time (e.g. laws concerning steam boilers). The government’s responsibility interferes with private business, when security and welfare of the (entire) public is affected (see Burke, 1975:332).

It seems as if accidents in the domain of technological activity occur independently of human action and will. Technology withdraws itself from human control – in particular wherever mediating elements (tools, machines, technical systems) play a major role. Autonomisation of technological mediating elements gets more and more important during the formation of the industrial society (Bayertz, 1995a:28). But who is liable for damage resulting from *system failure*, if certain accidents can not be causally attributed?

When we resolve the originator/the-party-responsible-pays principle (this implies causal attribution) with strict liability (for risks and damages), we regain access to (a) responsible person(s) – but we can not distinguish any more between intended and unintended consequences. Liability is thus dependent on how society decides to deal with social problems resulting from technological risks.

Besides of technification we have witnessed a progressive *division of labour* since the era of industrialisation (groups, institutions, organisations, become subjects of action) not

only inside of business units but as well on the level of evolving regional, national, and international market places. Thereby partaking individuals' contribution to the results of production processes drops. These co-operations/organisations that became necessary with division of labour can fail. An attribution to any individual is not or hardly possible in these cases.

The classical question "Who is responsible for a damage?" is now supplemented with the question "Who is obliged to fulfil certain tasks?" (see Bayertz, 1995a:32).[2] The subject of action is thus not responsible for negative consequences any more, but for a positive condition guaranteeing smooth fulfilment of tasks. Not consequences get ascribed, but tasks, duties and obligations.

With such responsibility for one's competence or role a type of responsibility gains importance which is oriented prospectively and defines care and custody for a (positive) condition. But this *care responsibility* with its close connection to "duty" is reflected perceptibly less in ethical literature than "responsibility for consequences of action". In any case one can only be accountable for a certain (normatively positive valued) condition, if one "1) *possesses causal influence* on the respective issue (also in the interpretation of being able) and 2) is in a specific, normatively relevant relation to the issue (by higher mandate, by self-commitment, or the particular value of the object) and is thus obliged to fulfil the task" (translated from Bayertz, 1995a:33).

"The non-classical concept of responsibility turns out to be a manifestation of the problems of co-ordination and control that result from modern societies in general and from complex organisations with division of labour" (translated from Bayertz, 1995a:34). Tasks with high responsibility typically demand high competence and can only be adequately fulfilled having a certain discretionary power. This change in the concept of responsibility bears the risk of playing off against each other moral substantial responsibility and functionally oriented accountability.

2.3 Responsibility in times of informatisation

Science, technology and economy bear their marks on life in the (information-)technological age[3]. A deep entanglement and meshing of consequences from these scopes characterises present highly developed industrial societies. Information- and communication technologies prominently take part in this process and contribute to the noticeable sharpening of the problems of attribution, comprehensibility, irreversibility etc.

Technical means and methods – especially IT – are employed with growing success in domains, which up to now used to be beyond technical access or could only be handled with difficulties. The factual and often not reinsured or not controllable dependence on information systems thus grows. This vulnerability alone should be reason enough for computing

[2] This includes establishing a clear-cut allocation of tasks and obligations.

[3] Informatisation: see chapter 7 ("Informatisierung") of Steinmüller, Wilhelm: Informationstechnologie und Gesellschaft. Eine Einführung in die Angewandte Informatik. Darmstadt: Wissenschaftliche Buchgesellschaft, 1993.

professionals to invest time and energy in reflection and discussion of the diverse facets of responsibility.

A change in emphasis concerning value judgements can be discerned, resulting from information and communication technology affecting other areas of life as former technologies. While engineering ethics used to focus on issues of public safety and risks to life and health, IT - code of ethics refer to the public interest in general, explicitly including social aspects like privacy, quality of life, equal access, freedom of information, and participation of users (e.g. the Software Engineering Code of Ethics by ACM and IEEE (Gotterbarn, Miller & Rogerson, 1999) or the German Computing Society's ethical guidelines (GI, 1994)). Discussions about the consequences of technology include psycho-social issues, the future of democracy, education, culture.

In which way the concept of "responsibility" may respond to the new concerns raised by globalisation and virtualisation remains an open question. Both processes tend to render crucial elements of present concepts of responsibility and accountability useless, as chains of consequences get even more unpredictable (because of cultural differences and regional distance), local law can be easily by-passed, and responsible persons (or legal bodies) are out of reach, etc. We do not attempt to answer this question which clearly needs to be worked out. Some new answers may evolve, such as proceedings within the Open Source community, where self-interest and advantage for the community of users interlace based on the idea of fair procedures (see Weber, 2000).

As the following discussion will show, the concepts described up to now can help to understand (and may remedy) some of the phenomena and structures we experience within the computing profession/business (without even touching the processes of globalisation and virtualisation).

3 For Discussion

In the last chapter we became familiar with the historical changes in the concept of responsibility. We are now able to use essential notions like intention, voluntariness, autonomy, obligation, possibility of foresight, causal influence, (care) responsibility and "attribution as responsibility".

This would be helpful for the discussion of the following questions/problems of practical relevance:

- What does the notion of insight mean with regard to the process of attribution?
- Insight into consequences of actions alone does not show us which action is appropriate to take.
- How is problem awareness related to public perception?
- What means strict liability for risks in the field of system development?

3.1 Insight: In-between foresight into consequences of action and the problem of attribution

The notion wins acceptance, that ”human failure” is seldom the sole cause of catastrophes and accidents, rather being the last link of a chain. Often flaws in the design of technical artefacts are the underlying source of failure. Technological artefacts should be designed in such a way that the risk of error is minimised, its consequences are minimal and the chance of discovering errors is maximised (Norman, 1989 and 1994). Reason (1990) discerns active failure (of front-end actors, e.g. operators) and latent failure. The latter originates from preceding actions, stays out of sight for long and is caused by designers, developers, decision-makers and managers. Latent failure may be caused by bad working conditions, high work load, stress, competing demands for attention, ... Thus, accidents are usually results of a human-system-misalignment with several interacting/interlocking causes. Responsibility for failure or accidents is thus usually indirect and spread over several people and institutions. The more complex the system and the mesh of effects, the more difficulties a single actor has to foresee consequences. Analysis of accidents and near-accidents only result in subsequent improvements and do not guarantee discovery of all sources of latent failure. Because of complex systems and division of labour insight and influence of single actors is limited. Therefore the individual must be relieved from a disproportionate sole guilt. A side effect of this is, that responsibility runs the risk of being diffused.

What about the responsibility of IT-professionals and developers of software? As designers of technical artefacts they take part in responsibility for latent failures. Present law and professional practice do not meet this. IT-companies, different from engineering business (e.g. building and mechanical construction) try to enforce limited liability for product deficiencies or defects (e.g. by contractual stipulation). Users and customers are often not able to recognise program flaws as such. Usually the original code is not accessible. In addition, many IT-professionals know of situations, where program flaws were known internal, but kept secret to the customer. In some respects customers share responsibility: very often orders are given to those manufacturers promising quick and cheap delivery instead to those that make realistic calculations, including a sound methodical requirements analysis phase and extensive testing in the plan. Software bugs and bad usability get accepted like the laws of nature. These are some characteristics of the computing culture which lead to latent failure and (in part) can be read as a refusal (of IT) of taking responsibility or as an overcharge and lethargy of society to attribute accountability (to IT).

Without time resources, detailed analysis of the usage context, and subsequent testing, developers nevertheless have little chance to foresee consequences of software usage. Twisselmann (2000) describes how time pressure, non-adequate processes of software development and educational deficits lead to software with unintended impediments for work processes. Seldom it is clear to involved persons (on all sides) how far reaching the influence of the system on work processes will be. Involving several groups of people during different phases of a project (often: consultants for requirements analysis, developers coding) interrupts communication and knowledge flow. Frequently, software developers can

only inquire mediating persons about the (f)actual usage context. Thus, it is almost impossible for them to develop an adequate conception of the work context. Sometimes it is discovered only after installation, that the prescribed and specified functionality is not sufficient in practice or does not fit into existing work processes. Here we obviously deal with a systemic conditioned source of latent failure which leaves actors little chance of insight into consequences of design actions.

3.2 Action: In-between possibilities to take action and their suitableness

When insight into consequences of action is given, this does neither imply the existence of alternative paths of action nor whether theoretically given alternatives are feasible or reasonable. The individuals' freedom and autonomy are always limited.

As indicated in the preceding section, economy and competition often prevent or punish the intention of responsible action. "Time is money and thus responsibility is overridden under time pressure. (...) Working for small and middle sized companies during the past years, I could see that competition was such hard, that in case of conflict companies always dispensed with criteria like privacy or the goal to minimise strain at the workplace" (translated from Boedicker & Biskup, 2000:24). In an e-mail inquiry of the authors (about responsibility in professional practice) work load and time pressure were mentioned most often as hindrance to put good intentions (e.g. ergonomics or privacy) into practice (Hornecker & Bittner, 2000). Conflicts of interest result, considering not only responsibility with respect to acting in the best of customers and users, but also responsibility for the own personal surroundings (e.g. protection of colleagues and subordinates from further demands and more work load) or the company (e.g. keeping deadlines to prevent fines).[4]

Loyality/Allegiance to the employer (as contractual obligation) do often compel employees to conceal knowledge from the customer and to give non-optimal recommendations: "When I / my employer is contracted to sell certain products, then I am compelled to recommend it, even if there might be a better one. If the company earns from outsourcing, I cannot recommend the customer to keep his data and train his own people, instead of outsourcing." (reply to our e-mail inquiry) The only option is giving indirect hints, hoping the employer will not notice. The individual's position inside the organisation (position in hierarchy and informal networks: newcomer, established expert....) discerns which path of action is accepted by employer and colleagues and how well the risk of action can be pre-calculated.

[4]The Software Engineering Code of Ethics (Gotterbarn et al, 1999) deals with many of these issues and the mesh of responsibilities for different groups of people or issues. The public interest always comes first and can serve as argument to depart from any other obligation. Nevertheless, it should be pointed out that Codes of Ethics tend to include primarily items referring to professional behaviour (and to laws, which should be obeyed anyway) rather than to morality or ethics (see Weber, 2000). This is true for both the just mentioned and the GI ethical guidelines. Reconsidering some of the mentioned characteristics of the computing trade, true professional behaviour seems rare. The relation of professionality and responsibility needs to be clarified urgently.

The US law provides the construct of ”Whistle Blowing” for extreme cases concerning a risk to the public. Employees can publicly point to these risks, protected from dismissal (if the risk can be proved). Although judges often use their discretionary powers in favour of workers (see Däubler, 2000), this construct does not exist in German law (yet – it should be established!).

But when exactly does risk to the public begin? And what about the question of proportionality of means of intervention? An example: If during design of an information system laws concerning privacy are ignored, while this is not taken advantage of during system usage, this is a violation of law but represents no ”acute danger”. The employee should point out to his/her superiors this breach of law. What next if they do not change matters? Can we demand from the employee to intervene further and thus to endanger the relation of trust to his superiors and to jeopardise his/her job (remembering that system usage does not take advantage, thus there is no acute danger)? The individual has to reflect whether the risk to the public outweighs his/her interests and with which decision his/her conscience can live by.

It is nonetheless important to transcend the concept of ”whistle blowing” which is imbued with tragic heroism. These cases form only the tip of an iceberg plus having antecedents. Most ethical conflicts do not occur in such clear-cut, unequivocal situations. As Lynch & Kline (2000) analyse for engineering practice, it is workplace culture and routine decisions which in the long run lead to unintended results. Lynch and Kline call to attention the social context of everyday workplace and company culture, where small incremental adjustments, which appear rational at every stage of the process, accumulate and in result decide over the trajectory of events. When in retrospective this trajectory is perceived as false, these precedents of small routine decisions have been established and it is difficult to declare them false. Thus moral dilemmas have a long period of ”incubation”. At the same time engineers are active producers of mundane practice and workplace culture and thus shape available options. Therefore it is a crucial skill (and thus should be goal of engineering ethics in the classroom) to recognise implicit assumptions and everyday ethical issues in poorly structured problem fields, to develop creative solutions, and to identify available resources. Much alike us, Lynch and Kline argue for preventive ethics instead of crisis ethics.[5]

Looking back to the description of computing culture we can imagine how this too is result of small routine decisions. Thus computing professionals should be reminded of actively shaping workplace culture; Codes of Ethics might fulfil this function of reminders.

[5] In addition they explain why cases of whistle blowing are detrimental in classroom. Giving students only ”all-or-nothing” cases may make students feel that ethics ”involves nothing more than a trade-off between sacrificial heroism and amoral self-interest” (p. 209). Looking closely most whistle blowers did not achieve real change.

3.3 Attribution as social construction: In-between problem awareness and public perception

Whenever problem awareness for certain risks increases, the perceived pressure to act (in order to reduce the risk) and to accept consequences rises, too. Following the explosion of a firework factory in Enschede, The Netherlands, which set a complete neighbourhood on fire, several illegal firework depots were found in Germany due to anonymous hints. Whoever gave these hints must have known for quite a while about the depots. Whenever there is public discussion about a risk, similar cases are more easily uncovered. This is due to the enhanced awareness of the risk and to the fact that handing over the originators to police and justice is socially accepted, as the deed is not considered a peccadillo any more. In addition the originators get under pressure to change things and to change their priorities.

Sadly there is little public debate up to now in relation to information technology and its risks and the responsibility of its protagonists. Exceptions are some discussions about vulnerability and IT-security (e.g. viruses and Y2K). But even these showed a high level of inertia. Although the Y2K problem was known for a long time, media noise (and IT bustle) started not until a year before the ”dangerous date”. Any detailed analysis afterwards seemed to be rather taboo. Concerning viruses which are perceived as immediate menace, interest is stirred quickly and looses impact quickly. The question is: ”Why are risks associated with IT-technology so often hushed up?” We believe that it is necessary to stir up discussion again and again and sharpen awareness inside our trade and – even more important – in the concerned (and afflicted) public.

3.4 In-between obligation for precaution and strict liability for risks

Strict liability makes the operating authority of a system liable for risks and imposes obligation for precaution upon him. This heightens the motivation to take every thinkable precautionary measure. However, as discussed in section 1.2 this lets the distinction between intended and unintended consequences fade away and the ability to foresee consequences of action loses importance as well. Both were essential prerequisites for individual responsibility.

A further question is, to whom strict liability applies – besides the operating authority also to the developers of a system? A developer writing a database does not know exactly, what kind of data will be put into it. The administrator, who would be responsible, can be overburdened, as (s)he can not always verify, which items the users do in fact put into which fields, what this means, and how the data is used and interpreted. For developers of general technical systems it is nearly impossible to prevent misuse of products (Kern 1990). Merely possible are technical-physical means preventing uncontrolled dissemination (e.g. dongle) or contractual stipulation interdicting use of the product in certain contexts (e.g. military). But if the product itself is a tool, there is no chance to prevent indirect effects of use, as tools such as compilers can be used to build products which in return are put to use in unwanted contexts.

3.5 Finally a plead for continuing discussion

In the centre of any discussion about responsibility is the accounting a (moral) object to a subject. We can account retrospective consequences of actions or prospective a (positive) condition which has to be preserved/conserved or to be produced. Criteria for such attributions must be developed and motivated (not only) for computing. These criteria are value judgements and a question of morality and therefore must be made independent of any attribution. Thus factual responsibility requires value judgements. Because of this computing professionals should take part in public discussions about valuation measures concerning the practice of design. To strengthen awareness for potentials and options and to actively create design cultures, computing professionals should also engage in discussions about options for acting and changing workplace culture.

References

Bayertz, K. (1995*a*), Eine kurze Geschichte der Herkunft der Verantwortung, in *Verantwortung: Prinzip oder Problem?* (Bayertz 1995*b*), pp. 3–71.

Bayertz, K., ed. (1995*b*), *Verantwortung: Prinzip oder Problem?*, Wissenschaftliche Buchgesellschaft, Darmstadt.

Boedicker, D. & Biskup, H. (2000), 'Grau ist alle Theorie', *FIfF-Kommunikation* **2000**(1), 22–25.

Burke, J. (1975), Kesselexplosionen und bundesstaatliche Gewalt in den USA, *in* Hausen & Rürup (1975), pp. 314–336.

Coy, W. & al, eds (1992), *Sichtweisen der Informatik*, Vieweg, Braunschweig/Wiesbaden.

Däubler, W. (2000), 'Wann darf ein Arbeitnehmer 'Nein' sagen?', *FIfF-Kommunikation* **2000**(4), 29–31.

Gesellschaft für Informatik (GI) (1994), Ethische Leitlinien (Ethical Guidelines), technical report, Gesellschaft für Informatik, Bonn.

Gotterbarn, D., Miller, K. & Rogerson, S. (1999), 'Software Engineering Code of Ethics is Approved', *Communications of the ACM* **42**(10), 102–107.

Hausen, K. & Rürup, R., eds (1975), *Moderne Technikgeschichte*, Kiepenheuer & Witsch, Köln.

Hornecker, E. & Bittner, P. (2000), 'Vom kritischen Verhältnis zur Berufspraxis in der Informatik – Ergebnisse einer Befragung', *FIfF-Kommunikation* **2000**(1), 33–39.

Kelsen, H. (1941), *Vergeltung und Kausalität – Eine soziologische Untersuchung*, W.P. Van Stockum & Zoon, The Hague.

Kern, R. (1990), Mißbrauchsschutz für Software unter Beachtung rechtlicher, technischer und organisatorischer Aspekte, diploma thesis, FB Informatik, TH Darmstadt.

Lenk, H. & Maring, M. (1993), Verantwortung – Normatives Interpretationskonstrukt und empirische Beschreibung, *in* L. Eckensberger & U. Gähde, eds, 'Ethische Norm und empirische Hypothese', Suhrkamp, Frankfurt/Main, pp. 222–243.

Lévy-Bruhl, L. (1884), *L'Idée de Responsabilité*, Hachette, Paris.

Lutterbeck, B. & Stransfeld, R. (1992), Ethik in der Informatik – Vom Appell zum Handeln, *in* Coy & al (1992).

Lynch, W. T. & Kline, R. (2000), 'Engineering Practice and Engineering Ethics', *Science, Technology and Human Values* **25**(2), 195–225.

Nietzsche, F. (1887), *Zur Genealogie der Moral*, Verlag von C.G. Naumann, Leipzig.

Norman, D. (1988), *The psychology of everyday things*, Basic Books, New York.

Norman, D. (1994), *Things that Make Us Smart – Defending Human Attributes in the Age of the Machine*, Addison Wesley, Reading, MA.

Picht, G. (1969*a*), Der Begriff der Verantwortung, *in* Picht (1969*b*), pp. 318–342.

Picht, G., ed. (1969*b*), *Wahrheit, Vernunft, Verantwortung – Philosophische Studien*, Klett-Verlag, Stuttgart.

Reason, J. (1990), *Human Error*, Cambridge University Press, Cambridge, MA.

Twisselmann, U. (2000), 'Informatik und Arbeitsumgebungen', *FIfF-Kommunikation* **2000**(1), 28–31.

Weber, K. (2000), Grenzen von Ethikcodizes, internet publication, http://viadrina.euv-frankfurt-o.de/˜kweber/download/Grenzen _von_Ethikcodizes.pdf.