Realising social justice in the water sector: 1

M. B. Abbott and Z. Vojinovic

ABSTRACT

The present work is directed to the analysis, design and construction of web-based systems capable of catalysing processes of stakeholder participation in such ways as to realise changes that are judged by these stakeholders as positive in the water sectors of both the human and the natural economies. The thesis is advanced that the judgement that is so passed is a recognition on the part of the stakeholders of a realisation of social justice. This paper is thus given over in its first part to an analysis of the origins and the nature of social justice in this sector. It is emphasised that, although the resources of hydroinformatics in this endeavour are largely based upon quantitative assessments, the ways in which these translate through stakeholder participation into experiences of social justice are essentially qualitative. Thus, although we are currently concerned for the most part with a *hydroinformatics of the quantities*, this now has to be extended into a *hydroinformatics of the qualities*.

Key words | numerical modelling, social justice, software as a service, stakeholder participation

M. B. Abbott (corresponding author)
European Institute for Industrial Leadership (EIIL),
Château Latour de Freins,
Brussels B-1180,
Belgium
E-mail: *knowledge.engineering@skynet.be*

Z. Vojinovic
UNESCO-IHE Institute for Water Education,
Westvest 7, Postbus 3015,
Delft, DA 2601,
The Netherlands

WHAT DOES HYDROINFORMATICS CURRENTLY PROVIDE AND WHAT DOES SOCIETY WANT?

The answer to the first part of this question was provided in *Hydroinformatics: Information Technology and the Aquatic Environment* (Abbott 1991), even as, at the same time, the limitations of this response were also presented. Hydroinformatics at that time was taken up almost entirely with numbers and their calculations, making use of *computational hydraulics* and drawing upon *computational fluid dynamics* (the first an established technology and the second a putative science) to provide *numerical models*; so that it was using numbers in ways that were essentially new, as expressed in the aphorism that "the numbers are beginning to function in another way". At the same time, of course, these models were themselves being applied within a new environment, being one in which they were becoming the central elements in a much more far-ranging activity employing measuring equipment, its radio links and SCADA systems, weather radar, meteorological forecasts and early warning systems generally, remote sensing equipment and its interpretation facilities, and many other such accessories

as are introduced later here. It was then this whole complex of equipment and activities that was brought together under the one rubric of *hydroinformatics* (Abbott 1991).

Already within this founding document, however, the limitations of a world that was being reduced only to collections of numbers was criticised as something undesirable in itself and dangerous in its potentialities. It accordingly drew heavily upon the insights and analyses of the philosopher Martin Heidegger, and then very specifically upon his *Die Technik und die Kehre*, of 1963/2002, as translated into English as *The Question Concerning Technology* in 1977. However, its author could not stop with Heidegger, but was obliged to deepen his analysis by placing it within the more general environment of a rapidly spreading and specifically European nihilism, following such authors as Kierkegaard, Nietzsche and Barth. This, however, might be said to have been the book's undoing, for it was launched for the most part into a Western world which was rapidly losing its foundations in

spiritual values, and especially those that were mediated by the established churches as expressed in their church dogmatics. Correspondingly, such a world could not, for the most part, understand the onto-theological language in which the second part of the book was written, so that this fell for the greater part on deaf ears.

However, as Heidegger (1963/2002, p. 32//1977, p. 32) had predicted:

> *So birgt denn, was wir am wenigsten vermuten, das Wesende der Technik den möglichen Aufgang des Rettenden in sich* (Thus the coming to presence of technology harbours in itself what we least suspect, the possible arising of the saving power).

We are constantly reminded that our present-day world is crying out for something quite other than mere numbers: this world is crying out for *social justice*. Although this very general term is so widely used in our present-day societies, its meaning and indeed the very possibility of defining it remain very open and contentious (see, for example, Flew (1993), and for the more normative approaches that Flew criticises, Rawls (1971), and subsequently Miller (1999)). Although we recognise the possible relevance of results in social welfare studies (e.g. Kelly 1978) and in the area of policy analysis (e.g. Durning 1999; Hoppe 1999) we eschew any consideration of these aspects in this place. Before so much as starting upon the means to realise social justice within our own field of endeavour, therefore, a serious and relatively deep-going analysis is required of its nature and the ways in which it functions and is brought to presence within society as a whole and in hydroinformatics in particular. This work has proceeded concurrently with the design, writing and development of the software necessary to realise its aims and ambitions, with a special attention being given to the new kinds of user interfaces and viewing facilities that are then required. This work will be described separately by other authors involved in this initiative: see, for example, Harvey (2009) and Tumwesigye (2009).

SOCIAL JUSTICE AS AN *EXISTENTIELL*

Social justice is inseparable from human existence itself and indeed it is something that we share with so many of our fellow creatures here on earth that we may suppose that it in fact pre-dates human Being, which is to say that it is *pre-ontological*. The word "existentiell" is commonly used to translate Heidegger's *existenziell*, as referring, reflexively, to our own understanding of our own modes of existence. (In the words of Heidegger himself (1927, p. 12//1962, p. 33): "*Die Frage der Existenz ist immer nur durch das Existieren selbst ins Reine zu bringen. Das hierbei führende Verständnis seiner selbst nennen wir das* existenzielle"//"The question of existence never gets straightened-out except through existing itself. The understanding of oneself which leads *along this way* is called *existentiell*"). Thus *it can only be known* by *living through it*. Social justice refers to the one of these modes that has to do with what we perceive as "our just relations" with our fellow beings within our social context and its presence is inseparable from the emotional force with which this perception is experienced. We should observe that this characterisation speaks only of "The understanding of oneself": it does not speak of an understanding of that through which one is actually living, that one is experiencing. Social justice can certainly be known, and social injustice even more so, but *it does not follow that this very personal experience of either of them can itself be understood*. Consentaneously, simply because social justice is an existentiell, any definition of it must be immediately circular, and in this case we speak, following Dilthey (e.g. 1976), of *hermeneutic circles* of words and their meanings that can only feed upon themselves, such as were symbolised by the Greeks by a snake and by the alchemists by a crowned dragon, each eating its own tail (e.g. Jung 1944//1953, p. 103). Of course, every dictionary definition ultimately has this property—a dictionary is always "a book that only speaks about itself"—whether defining a lexeme of the word by what its sememe is or by what it does (e.g. Klinkenberg 1996; Abbott 2002). In much this same vein, we shall not enter here into the relation between social justice and "the rule of law", only observing that, in many places, and especially in the so-called "third world", "the rule of law" is as often employed to subvert social justice as it is used to promote it (Roy 1999).

Although the emotional moment of social justice must be essentially personal, it can become social though its *expression* within a social group, such as an association of

active stakeholders. In the now-classical unified theory of objects and values, as originally established by Meinong between 1880 and 1920 (see, for example, Meinong (1913), but taken much further since that time) expressions are properly so called because they are capable of expressing something about the thoughts of the expressing (and consequently expressive) agent. Each expresses something that is not itself a belief or a judgement–which are essentially private, subjective and mental–but *a state of affairs*, which is essentially public, objective and tangible. At the same time, of course, the expression has a meaning which is mental and in that way private. In the words of Simons (1996, p. 173, with italics added): "In the matter of meaning, it is the relation of *presentation* that wears the trousers, because it gets us from the private and the mental to the public and objective".

Clearly the sense of justice is then both personal and social. At the same time, although the evidence presented by the hydroinformatician–the *presentation*–may be, and in most cases should be, scientific, the act of judgement that it engenders is itself pre-scientific. All processes of stakeholder participation have this property, which is to say that they cannot be conducted entirely scientifically, and certainly not exclusively in the spirit of modern science, but they must be conducted at least in part pre-scientifically, taking due account of their pre-predicative and even pre-linguistic elements. Indeed it is a common experience that many of those who engage themselves and their fortunes in such endeavours are possessed of an engagement that often rises up to a passion: they often *care passionately* about the causes that they represent. It is this passion that largely drives the environmental movements and so often engages its proponents in body and soul, and it is to this that the hydroinformatician must respond, supporting it and protecting it whenever and wherever necessary. Hydroinformatics is no longer only about numbers, even as it continues to be based to a large extent upon the use of numbers, but it is also about emotions, including some of the deepest emotions of mankind and, if only through surrogation, of so many other creatures in the world of nature besides. This naturally implies that we must also proceed here much more cautiously and with more circumspection than has previously been considered necessary.

THE NATURE AND THE FUNCTIONS OF THE STAKEHOLDERS

Increasingly many projects in the water sector of the human economy have consequences for so many persons that some of them insist on participating directly in the making of the most vital decisions affecting the executions and the outcomes of these projects. Some of these persons then come to press the interests of specific human-social interests while others again press the claims of many creatures situated in the natural economy, so that they act as surrogates for these creatures. Such persons see themselves as *active stakeholders* in a project in which they feel that they have an interest, so that they press a claim to participate in the processes of decision-making within the project, and their interests may be so widely shared and their integrity and competence so respected that their claim to representation is upheld as legitimate within the society concerned. In this case we speak of an *active stakeholder participation* in the decision-making process that may or may not lead to social justice. At its most pragmatic level, the purpose of stakeholder participation is to induce a change in the built and managed environment that aligns with a positive change in the social environment. This change is, however, only *recognised* as positive when it corresponds to *a sense of social justice* on the part of the stakeholders, preferably as a whole or, in extremis, for the greater part. Correspondingly again, to use a term that is popular in the world of architecture, this gives this built environment *the quality of an attractor*, as a quality that will attract and filter the persons and businesses that set a store upon this environment, thus promoting such an environment even further.

Stakeholder participation is then justified on the basis of a claim that *it is a means of realising social justice*, whether this be a justice in human societies or a justice in the societies of nature within which human societies are in turn embedded. Since it is water which, with earth and air, is the most basic requirement for the sustainability of both the human societies and the societies of nature, these claims to social justice are among the most important of all claims. Thus, Abbott (2007) spoke of "an understanding that the greatest crime of all is to deprive people of the possibilities to exercise their own deep-rooted knowledge

and understanding"; and correspondingly it is often observed that the greatest of all social injustices is to drive a people off its lands and to deny this people its waters, as those environments where their knowledge and understanding most essentially belong (see again, Roy 1999). As Machiavelli long ago explained ($1516^{+/-}$/1929//1970), this is commonly experienced as a social injustice that is something even more cruel and terrible than the murder of the members of one's own family.

The present paper is directed to an analysis of how hydroinformatics, as the study of how communication and information technologies can best be applied within human and other natural societies, can contribute to the realisation of social justice in the water sector of human society and, if only by surrogation, in the water sectors of other, natural, societies. It is thus directed towards identifying the social arrangements concerned and the mutations that these undergo during the participation process, the sociotechnical tools and environments that such arrangements can best use in order to catalyse these mutations, the ways that these tools and environments can best be employed to reinforce the corresponding processes and the new demands placed upon the producers and users of such means. These requirements in turn have consequences for the more general social arrangements, as environments, best suited to the production and developments of the tools and vice versa. In the same vein, the ways in which these innovations are employed have to be brought into conjunction with the social mutations that are occurring within the societies concerned, and especially following the ways that these societies are themselves mutating from modern to post-modern conditions, that is, from societies composed primarily of knowers to societies composed primarily of consumers of knowledge. Correspondingly, the tools and environments are now for much the greater part web-based and make an ever more intensive use of the mobile internet using the increasingly ubiquitous resources of mobile telephony and working within a Software-as-a-Service (SaaS) paradigm. Beyond all this again, the nature of the person of the hydroinformatician has to change too, and the nature of this change has also to be identified so that its potentialities can be augmented. This paper follows the insight of Latour (1991//1993); (see also Abbott 1999) that a post-modern science then reverts in most cases to a

pre-modern science, such as alchemy, thereby displacing modern science in such cases.

For the purposes of this paper, a first paradigm case was provided by the construction of the road and rail link across the Sound between Denmark and Sweden, a project that was concluded in 2000 without any deleterious consequences for the environment, within budget and six months ahead of schedule (Thorkilsen & Dynesen 2001). These authors then observed that:

> In effect, this amalgamation of different technologies provided such synergies that a new confidence was generated in the capacity of this new kind of integrating technology, called hydroinformatics, to provide solutions not only to unprecedented technical problems, but also to hitherto intractable social problems concerning the integrity of the natural environment. As and by themselves, of course, these earlier developments did not suffice to justify the construction of the road and rail link between Denmark and Sweden. However, without these developments it would have been much more difficult, and perhaps impossible, to persuade the various parties involved to proceed with this project. It was at this point of *persuasion* of the various stakeholders to grant their consents, and to incorporate these into the enabling legislation and contractual agreements, that the social side of the sociotechnical equation of hydroinformatics first became satisfied …

> A common feature of all the different phases of the project was the widespread uses of ICT solutions, not only functioning in the role of technical problem solvers, but also as facilitators for communicating complex decision problems to all interested persons and parties. This was done, for example, by simulating work procedures, providing visualisations of design features and especially of information about environmental aspects related to the flow of water. The task of informing the politicians, the responsible authorities and the public as a whole in a truthful and realistic way about the consequences of the construction and, inseparably from this, the empowering of these to act as genuine stakeholders in the management of the natural

environment, was a task of hydroinformatics over and above its tasks within the physical project itself…

When concluding, these authors observed that:

This overall tendency away from an exclusively representative democracy and towards direct participatory democracy (itself now being more and more catalysed by the technologies of the Internet) made it clear that public and political support could only be regained through allowing a much wider dissemination of environmental information and, in particular, information on the potential consequences in a readily understandable form.

This process accordingly introduces new forms of what, following the teachings and writings of Michel Foucault (e.g. 1972–1977//1980) are widely called *knowledge/power relations*, such as lead to the formation of new *knowledge/power structures*. These new structures are widely seen as attractive alternatives to the longer established knowledge/power relations and structures of what is commonly called "representative democracy", such as is associated with the practice of politics. Indeed, they are often regarded as reactions to what is nowadays perceived as an ever-increasing *politicisation* of nearly all social activities, including those of the water sector. It is in fact a mark of the strength of this reaction that the word "politicisation" (replacing the earlier "politicalisation") has entered so widely into the currency of everyday discourse, and that it now appears regularly in translations into English from other languages, not the least of which is Chinese. In nearly all cases this term is used in a deprecatory, and often even in a derogatory, sense and it is commonly contrasted unfavourably with what is called "participatory democracy", often also called "participative democracy". It is claimed here that the principal reason for this distinction and preference arises from the increasingly widespread view among many stakeholders that "representative democracy" is failing to promote *social justice*, in the present sector as in so many others, and that certain forms of participatory justice can do much better in this respect. Of course the politicians are still represented in participatory democratic arrangements, but they now become only one part, and

usually even a small part, of a much more extended population of stakeholders.

For the present purposes, however, the concluding observations of this paper were among the most significant (see also Abbott 2007, p. 29):

There was complete transparency in all data and the means to interpret it by its often very disparate users. This procedure was followed with particular care throughout the project in relation to the media, with the consequence that an originally dismissive and often antagonistic tone was transformed, step by step, into a more accommodating and finally quite supportive and even congratulatory attitude.

This may then be seen as a first indication that this project was perceived by a major section of the public as a manifestation of social justice in the water sector. Given the scale of the investment in this case together with the very similar Great-Belt link that complemented it (of some 8 billion euros) this public appreciation was highly valued within the political circles of the European Union.

Since the present paper is concerned with identifying the new social arrangements that are required in the water sector in order to realise such expectations and to relate them to the technologies that can promote and stabilise these arrangements, we are scarcely concerned here at all with the devices and procedures employed for realising such developments as, for example, Integrated River Basin Management Systems or in Integrated Urban Water Management, while the ways in which expert knowledge and understanding are employed within the knowledge/power structures of participatory democracy are very different from their employment when applied within a representative democracy (e.g. Evers 2008). Many of the current tools and facilities can be taken over from the representative approach to the participative approach, but these are then used in markedly different ways and within entirely different social environments to provide results that, as will be explained, would be unrealisable within the representative approach. Thus, although it may be claimed that many, and possibly most, of the required scientific knowledges and modern technologies have already been developed within hydroinformatics, the social arrangements necessary to employ

these tools must be completely rethought and new conjunctive knowledges and tools developed accordingly. This is a very demanding and difficult task, and correspondingly it is primarily these aspects that have been emphasised and continue to be developed within the environment of the currently ongoing, St Maarten, flood management project, as a paradigm case. However, the representative-political aspects of this endeavour cannot be discussed here.

On the Island Territory of St Maarten, flooding has become a growing and serious problem creating an ongoing threat to its residents and their homes and businesses, as well as the public infrastructure. With the frequent presence of hurricanes and tropical storms, with an increased frequency of high-intensity storms due to climate change, the inability of the existing stormwater system to cope with larger rainfall events and the dynamics of the new urban development activities, the situation is likely to become disastrous if appropriate actions are not taken as soon as possible. As a response to such threats, in 2005 the government of the Island Territory of St Maarten initiated a stormwater modelling study as a first step in a substantially larger "flood management" project aimed at developing a sustainable stormwater drainage system on the island. That project is still ongoing and it deals with issues that a typical tropical island urban drainage application faces nowadays, and so especially issues of an essentially social nature (Vojinovic & van Teeffelen 2007).

There are in this case several significant infrastructural and environmental issues arising from the pressure of an increased population, ongoing development activities and the capacity of the existing drainage systems which are far from being adequate even with their present loadings. The pollution of waterways by the operation of these drainage systems is also an issue of major concern to island communities, infrastructure owners, operators, environmentalists, and other government and non-government organisations. These have all come to function as stakeholders. It has now become evident that the structural damage and environmental degradation due to inadequate systems are already further advanced than was previously supposed, with the result that the thresholds of sustainable operations will be exceeded much sooner then was formerly anticipated. Furthermore, Vojinovic & van Teeffelen (2007) observed that, for St Maarten and other tropical islands,

most urban drainage projects were and continue to be treated only as technical constructs with some minor "social aspects" appended. This is certainly due to the lack of sociotechnological expertise to weave these together into synergic interactions so as to provide a balance between the technical and the social values, or, as expressed in the current and still restricted context of hydroinformatics, as a balance between computational and communicational aspects. Therefore, the sociotechnological application in such initiatives for tropical island communities plays a critical role in addressing some of the most crucial problems of our time and these are the truly great challenges facing urban hydroinformatics today.

For the St Maarten flood management project, effective communication of information and knowledge is the first key to ensuring that each phase of flood mitigation is understood by all concerned, and remedial measures are implemented accordingly. Therefore, effective decision-making is inextricably linked with an effective communication process. In order to enable effective communication to take place between all stakeholders efforts are currently being made to translate the data and technical information into those forms of knowledge and understanding that can be assimilated by the non-technical population so that these may intervene meaningfully and responsibly in the decision-making process. The provision of the most appropriate means for enabling such effective communication processes to take place is yet another challenge facing the St Maarten flood management project. In the case of modelling studies more generally, this leads us to a knowledge production chain that has the basic form:

Outgoing site-specific knowledge = outgoing site-specific knowledge(outgoing site-specific information(incoming generic information(incoming generic knowledge)), site-specific chart and field data).

This is to say that the generation of knowledge about a particular site starts with information generated for that site (such as through a numerical model that brings together generic knowledge for the physical and other processes and particular data and information concerning the site). Since the information from the model becomes knowledge-generating only insofar as the end-user is able to interpret
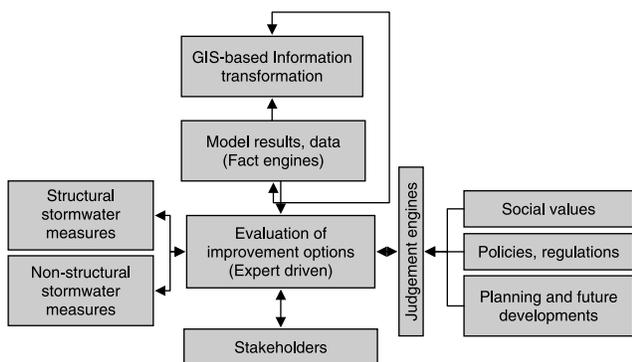
Figure 1 | A socio-technical decision-making framework (see also Vojinovic & van Teeffelen 2007).

that information, the practical implementation of the above concepts clearly necessitates a complete rethinking of current work practices and the application of advanced communication and information technologies. Therefore, for the effective management of stormwater drainage systems it is imperative to design a decision-making framework that will contain the cognitive and normative elements as presented in Figure 1.

As shown in Figure 1, the decision-making framework considered here can be regarded as representing one of the sociotechnical processes in that it is mediated by an expert facilitator—subsequently identified here as "an initiating modeller"—who is responsible for the instantiation of computer models for the evaluation of the different options, so that cognitive and normative dimensions are shared equally by all stakeholders. The functioning of such a decision-making framework can be described as follows:

1. Stormwater drainage-study outputs are determined by data collected at different spatial and temporal scales as well as by the instantiation and running of models. Such outputs are fed into so-called "fact engines" which provide the means to aggregate the measured data and the data provided by the models and to transform the aggregation into knowledge about the state of the system and its environment. The fact engines' output is then used to categorise flood hazards and, as such, this is placed into correspondence with the GIS layers of the urban infrastructure. The hazard maps, as GIS layers, then become the basis for defining flood impacts as these represent the physical flooding attributes.

2. Judgement engines are charged with the aggregation of constraints defined by various regulations, standards and individual stakeholder objectives.

For St Maarten, efforts are currently being made not only to select various structural measures to achieve sustainable drainage systems, but also to promote the development and implementation of appropriate non-structural measures. The aim of the decision-making framework presented in Figure 1 is to integrate the hydrologic, hydraulic and GIS flood data for the series of rainfall events with respect to the constraints defined by stakeholder interests. Initially, the most preferred (and feasible) set of structural improvement options is selected. This is then followed by the process of evaluation of these options and negotiation between stakeholders (supported by an expert-advice-serving system) in order to generate the preferred implementation measures for the policy and actions that can best be adopted so as to achieve the stakeholder-perceived objectives and so increase the overall stakeholder benefits. This is then coupled with appropriate hazard mitigation and prevention, improved preparedness and warning systems, well-organised pre-emptive actions and emergency response plans: see Figure 2.

In addition to the selection of structural and non-structural measures, there is also the intention to define a set of effective restoration and reconstruction activities as part of the island's disaster management plan in order to
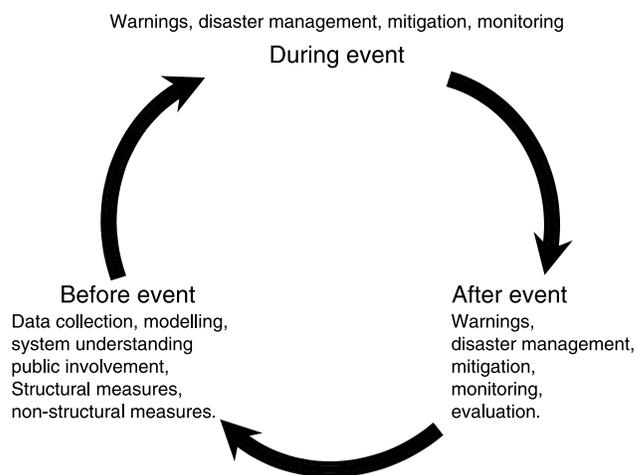

Figure 2 | The flood management cycle (Vojinovic & van Teeffelen 2007).

restore communities back to economic and social health following a disaster.

Within the decision-making framework described here, the main objective is to identify an optimal strategy (which will contain both structural and non-structural measures) to manage flooding on the island. In this instance one can speak of "optimising" system improvement measures, as a process which cannot be done in terms of numbers, even though of course we need the numbers for all the calculations of the effects of our actions in the worlds of nature and human society. In more general terms, one can only then speak of "optimising social justice", or "optimising human and natural values", or "optimising a quality of life" in a qualitative way, in that such expressions can only have any meaning at all in the minds of those who are directly concerned by and directly involved in the actions whose consequences are to be "optimised", who are those that we commonly call "the stakeholders".

Already, in Abbott (2007), it had been explained that:

> There could be no way to "manage" the stakeholders in the Øresund project and that instead it was essential to engage them all actively in the project as equal partners with a stake in its success. Although this activity thus had little or no need of formal management, it did call for a leadership by persons with influence at the highest executive level. Accordingly, a major part of top executive time on the Øresund project was taken up with this function. The empowering process started when the project was first conceived and continued until some time after it was completed. It necessitated complete honesty, transparency of decision making and the exercise of excellent communication skills, while using properly integrated technologies.

In social-organisational terms the stakeholders together functioned as what is described precisely as *an anarchistic arrangement*, whereby (Abbott 2004, drawing upon Winch 1967):

> In order to view this category more clearly, we may recall the three principle components of all anarchistic movements, namely those of mutualism between participants (the recognition of mutual interests and the provision of mutual support), of federalism (the formation of a federal structure between the groups of participants, such as may be provided by the structure of a syndicate) and of direct action (the direct involvement of this federation/syndicate in processes occurring in society and in the world of nature).

The critical importance of a shared ethic in any such movement was similarly related already at that stage to the observation that "such a development is itself a game with all of its participants functioning as players". Thus, referring to the work on gaming in hydroinformatics of Jonoski (2002), "the ethics necessary to support such a mode of development are self-generating and self-sustaining", a matter to which we shall return shortly.

THE BUILT ENVIRONMENT AS A MANIFESTATION OF SOCIAL JUSTICE

In the first paradigm case of the Denmark–Sweden connection, it was clear from the very beginning that it would be essential to engage all the stakeholders in a positive and meaningful way if the link were to be so much as legislated, let alone built. This necessitated the genuine empowerment of all interested stakeholders in the project. The key stakeholders in this case were composed of representatives of the owner–where the very form of ownership was strongly conditioned by the stakeholder participations–the contractors, Danish and Swedish parliaments and governments, their respective ministries (environment, fishing, transport, and so on) and their departments, various organs of the European Commission, representatives of governments riparian to the Baltic and certain of their ministries, the general public, represented so far as possible by their non-governmental organisations, Danish and Swedish mussel-bed farmers, Danish and Swedish eel fisheries associations and herring fishery associations, the society for the protection of the eider duck, swan and seal protection interests, and of course the media. Then (from Abbott 2007, with some italics added):

> This example illustrated that such an *infrastructural project* has two sides: it has on the one side the visible and tangible *physical infrastructure* of steel, concrete,

stone, and whatever other materials, as shaped by various machines and formed by surveying equipment, GPS systems, fixed and towed measuring devices and their radio links, SCADA systems, numerical modelling systems with their seamless interfaces to GISs, aerial photographic records and their interpreting equipment, satellite imaging devices, cartographic coordinate transformation systems and so much more again. But on the other side it has an invisible and intangible *social infrastructure* sustained by the intentions, beliefs and codes of behaviour of people, most of whom are interested in, and some of whom are actively engaged in, *this same project*. This 'inner world' of the minds of socialised people requires means to transform the data, information and knowledge provided by the physical equipment into forms that these minds can easily assimilate, each after an own individual interest and ability. The consortium charged with constructing and subsequently operating the connection accordingly set up facilities for transforming the content provided by the equipment into forms that could be assimilated by the various stakeholders, each in its own special ways. Thus the data needed by those concerned with respiring mussels was not the same as that required by those concerned with feeding swans and such differences had to be addressed correspondingly. The Internet-based system, called the *Eagle*, that carried this material out to the different stakeholders and accommodated their reactions, was a central bearing instrument in the success of the project as a whole.

Thus, such an infrastructural project has to comprehend two very different aspects that often appear as two different worlds. On the one side it has to do with *creating in the outer world* of physical forms and activities, while on the other side it has to do with the *creating in the inner world* of human minds as these come together through communication subject to specific social arrangements. Being creative processes, both are technologies, the one being a technology of the outer world and the other of the inner world. The first is constantly advancing of course, but it is the second that is advancing so much more rapidly today due to the catalytic effects of advances in the Internet and the World-Wide Web and, much more again, by the rapidly

ongoing advances in applications software and supporting services that are enabled by these facilities. Previously, what happened in the outer world was what was obvious because it was immediately visible and tangible, while what happened in the inner world was mostly hidden and usually unheard and unfelt in a wider circle. Now this situation changes as the inner world broadcasts its observations, inspirations and aspirations through the developments made possible by advances in the computation and communication technologies and the proper understanding of their appropriate applications. The most immediate consequence is that the media loses its quasi-monopoly in the technologies of persuasion, as these are increasingly appropriated by the web-sites, 'blogs' and other instruments of the environmental and other, less regular, bodies. The nature of leadership increasingly shifts correspondingly from direct and regular forms to indirect and irregular forms.

Stakeholder participation changes the way in which the individual stakeholders think and feel about the world in which they live and function. This begins already with the behaviour of persons in government agencies who are otherwise so constrained in the forms of their thinking and their very being by their subjection to political imperatives. Thus, to extrapolate from an expression of Findley (1977), one could say that during stakeholder participation and interaction there emerges "a bustling Agora [a boisterous market or bazaar] where such forms are involved in endless transactions and conversations; and even though it is by the intermediation of such forms that there is a reaching-out to their individual instances, they none the less enjoy a relative independence there, a detachment in the thought-ether, that they never enjoy elsewhere". Thus even those who must otherwise be most beholden to their political masters find here an opportunity to do what they know to be right rather than what is most currently politically expedient, or 'correct'.

Similarly, by their intercourse with those who identify with specific creatures, such as certain species of mammals, birds, plants and others in the world of nature, participants in this stakeholder endeavour come to attain to an awareness that the knowledge of modern

science is in fact exceedingly restricted and severely circumscribed as compared with the depth of knowledge and understanding exhibited by the world of nature, and this is one of the most salutary of all experiences…

Thus, through stakeholder participation and involvement, each of the individual stakeholders attains not only to a broader, but also to a higher level of collective understanding, and this leads not only to a higher state of *collective consciousness* but also to a higher state of *collective conscientiousness* that can decide issues that are in the abstract unresolvable. There thus arises a much clearer sense of responsibility and duty generally that, although it may appear to proceed ethically, *in fact transcends the ethical*. This is the essential nature and ultimate form–the *quiddity*–of stakeholder participation.

This characterisation then indicates that, to the extent that stakeholder participation can be employed to realise social justice at all, *it must have a transcendental character* and that this must necessarily have the capacity to transcend the level of the ethical, at least when the word "ethical" is taken in the malleable secular sense that is so widely accepted and employed in the West. Thus, within this last context, ethics is merely concerned with pragmatic choices based on reasoning within whatever social arrangements happen to be acceptable at the time. Thus what is most unethical and severely punishable by law at one time, such as abortion, can become ethical and state-subsidised at another time: such an ethics is temporal through and through. Such changes are of course justified in the name of *progress*. Correspondingly, social justice can be characterised in very different ways within such societies and between such societies even though it is experienced in the same kind of way at the level of the emotions. However, it suffices to observe our fellow creatures here on earth to see that social justice must in their case at least be pre-temporal, supra-temporal and post-temporal; correspondingly, this is the position concerning humanity too that is adopted in almost all religions and spiritual practices and so in most places outside the West (see Barth 1938–1950//1961, II. 1, pp. 638, 639). This is also so when we have to work within what we can perhaps best describe here as a *perennial*

ethics, such as is expressed in the analects of Confucius. Carey (2007) quotes a very relevant observation of G. K. Chesterton to this same effect:

I have never been able to understand where people got the idea that democracy was in some way opposed to tradition. It is obvious that tradition is only democracy extended through time …. Tradition means giving votes to the most obscure of all classes, our ancestors. It is the democracy of the dead. Tradition refuses to submit to the small and arrogant minority of those who merely happen to be walking about.

Clearly the hydroinformatician has to take account of these aspects even while striving to create an environment that will cause the present-day stakeholders to rise above their temporalities: he or she must ensure that the evidence is presented in as clear and unadulterated a way as possible within his or her fields of competence, and especially when this evidence is conflictual. He or she can never even so much as try to impose a personal view upon whatever is the current ethic: he or she can only try to create situations in which the living stakeholders themselves are confronted with the consequences of their own opinions and their own actions in their own time.

The greatest danger in this case is that the whole discourse will descend to a state that is commonly described by its German name, of *Gerede*, mainly because it can only be translated much too innocuously as "gossip, chatter and idle talk", while it is in point of fact much more dangerous in its consequences than these translations might suggest (see Heidegger 1927, pp. 167–170//1962, pp. 211–214). Accordingly, those participating must be provided not only with the data, the information and the knowledge relevant to the project, but also the *understanding of the reasons* why the operations in the outer world are deemed necessary to the project as a whole. In some cases, at least, this necessitates following the very thought processes, including the trains of reasoning, that underlie the engineering decisions that are being taken during the project. The process of creating *an environment of transparency* is a sociotechnical process in which technical developments in such areas as the World Wide Web and mobile telephony are woven together with the emergence of group and more

general social structures that may in some cases lead to the creation of new facilities, new institutions and new legal frameworks as already exemplified by the case of the Denmark–Sweden fixed link (see again Thorkilsen & Dynesen 2001). This process is observed to provide also the means to arrive at deeper and broader *conflations of understandings* within the stakeholder community as a whole. This exemplifies only one of the many "technologies of the inner world" that this discipline requires.

Another "technology of the inner world" expresses itself in terms of the *coherence* and the *intelligibility* of the participative discourse, and the leader of such a participative endeavour must be well versed in the exigencies of attaining to these desiderata. It should, however, also be mentioned that it is these developments which, when combined with the above conflations of understanding, lead to the exposure of any attempts by certain special-interest groups to promote their more selfish and otherwise hidden agendas, while corruption can also be more quickly identified and exposed in this way. Thus, to the extent that such states of coherence and intelligibility are induced throughout the stakeholder community, so there occurs a *positive opening-up in the inner world of the project* as it progresses in time, and then in such a way that this is congruent with the *positive opening-up that is occurring simultaneously, and indeed synchronously, in the outer world of the project*.

A STATE OF SOCIAL JUSTICE AS A TRANSCENDENTAL STATE

The theory that underlies this study has many and various precedents, primarily in the fields of philosophy and theology, but it is associated in the first place with one person whose writings themselves *transcended the bounds of both philosophy and theology*. Just to take the views of two of the most eminent philosophers of the twentieth century, he was described by Wittgenstein as "by far the most profound thinker of the last [nineteenth] century" (see Drury, in Rhees (1981) p. 102) and by Heidegger as "the only one of his kind". This person was Søren Kierkegaard. From the side of theology, we may quote from a work that was published under the imprimatur of H. H. John Paul II in

(1998) entitled *Fides et Ratio*, or *Faith and Reason* in English, where we read (on p. 111): "Saint Paul, the Fathers of the Church and, closer to our own time, philosophers such as Pascal and Kierkegaard reproached such presumption [on the part of certain philosophers]" where the presumption to which mention was made there and which was to be reproached is not only still with us, but is continuing to gain ground, whereby the combating of this presumption provides one of the principle motivations for the present study:

> Another threat to be reckoned with is *scientism*. This is the philosophical notion which refuses to admit the validity of forms of knowledge other than those of the positive sciences; and it relegates religious, theological, ethical and æsthetic knowledge to the realm of mere fantasy. In the past, the same idea emerged in positivism and neo-positivism, which considered metaphysical statements to be meaningless. Critical epistemology has discredited such a claim, but now we see it revived in the new guise of scientism, which dismisses values as mere products of the emotions and rejects the notion of being in order to clear the way for pure and simple facticity. Science would thus be poised to dominate all aspects of human life through technological progress. The undeniable triumphs of scientific research and contemporary technology have helped to propagate a scientistic outlook, which now seems boundless, given its inroads into different cultures and the radical changes it has brought.

Our starting point in the applications that are considered here is a work of Kierkegaard called *Repetition* (as translated from the nineteenth-century Danish *Gjentagelse*, translated literally as "taking-again"). Like nearly all of Kierkegaard's published works it is readily available in most major languages, such as any visit to a major international bookshop, such as the chain of *Takashimaya* bookshops in Asia, will demonstrate. It is important here, however, to draw attention to the subtitle in this work, namely *Et Forsøg i den Experimenterende Psychologi*, which Hong & Hong translated into English, after *Repetition*, as *A Venture in Experimenting Psychology*. In his incisive comparison of this work and the much more recent work of Jacques Lacan to which we shall return in conclusion here,

Yves Depelsenaire (2004) translated Kierkegaard's Danish subtitle as *Un essai d'expérience psychologique* and this seems more appropriate within our present context, since the Danish infinitive *at forsøger* most commonly translates as "to try", and thus *à essayer*: we have to do here with *a trying, an attempt*.

We need examples, and even paradigm cases, and we can then best follow Wittgenstein (Rhees 1982) initially in considering the structure of *games*, whether physical or mental. All games exhibit this property of repetition, whether they are ball games or card games or word games or whatever other kind of games. Each repetition can lead to success or failure in the short term, but in the longer term all games other than those governed by "pure chance" have the property that each failure, to the extent that the player overcomes the despondency caused by such failure, can function as an incentive to learn, and it is the repetition of this process that leads to many, and indeed in nature to most, kinds of learning processes. This is very obvious in the case of many wild animals where the young offspring play games through which they develop their hunting and other survival skills. Here we observe the repetition of failure and the overcoming of failure that leads to *a higher level of being* on the part of the creatures concerned. In such a situation the very self of the creature concerned comes to *transcend* its earlier self, and in so doing *it changes qualitatively*. We commonly call the process concerned "maturing" and its transcendent state "adulthood" although it obviously extends further to the development of "alpha" or "lead" individuals. Among pack and herd animals this is a process of both individualisation and socialisation. Since it is so widely experienced in natural as well as within human societies we must again accept that it is pre-ontological, and thus pre-predicative and pre-scientific. Within human societies, however, it acquires a further feature, in that this process of transcendence can attain to a social dimension where it acquires other kinds of attributes again. To take a particularly popular example, a football match may demonstrate skills honed over thousands upon thousands of repetitions and failures and recoveries from failures that lead to such a level of transcendence that the match can create states of euphoria among the spectators as well as among the players themselves. This process is associated with a transcendence of the individual players that is

interwoven with, and is thus inseparable from, a transcendence of the group as a whole, as a *team*, and that which is said to emerge here is called a *team spirit*. In this case, as in several others, the presence of up to a hundred million spectators for some events demonstrates the power of this process and the fact that this sense of team spirit can be transmitted way beyond the team itself. The Olympic Games, similarly, can be perceived as a celebration of transcendence within the mind–body relation, and in this case the audience is estimated at some four billion persons. Certain events can then appear to many of the spectators as nothing less than "miraculous" and it is important to bear this accolade in mind, for it corresponds again to a qualitative transformation, as one that in such a collective case corresponds to what will later be reintroduced as a *mutation*. To anticipate our later development of this phenomenon, we adopt from the open-source movement in software production the term *halo* to describe this kind of social extension. We are here clearly already in the domain of deep feelings and strong emotions.

In order to comprehend the possibilities inherent in this mutation it is necessary to recall the Kierkegaardian definition of *the self* that is employed here. Thus, following Abbott (2002):

> Hydroinformaticians are themselves proxies for their fellow humans and for the creations of nature, and in this position they must relate their own selves and their own selfhood to the selves and selfhoods of others through that substance, water, that is common to all life on Earth. Whether it is through the ways of a data mining for knowledge discovery that is directed to 'listening to nature' so as to 'understand what nature is trying to tell us', or whether it is through its ecological associations, in which hydroinformaticians participate in alleviating and restoring the lives of their fellow creatures, or whether it is in the direct sociotechnical direction, in which hydroinformaticians strive to provide the means for their fellow humans (directly) and other creatures (indirectly) to participate in the decisions that so influence their lives, questions concerning the 'self' and 'selfhood' are constantly and increasingly posed. We may conceive that these 'other selves' create objects in their minds and associate these

objects through their own content, and these processes cannot be indifferent to us. How are we then to *define* 'self' and 'selfhood' in this general context? There are obviously very many approaches to this question, and correspondingly a considerable literature has been devoted to it. Since the self cannot 'it-self' be an object, it can only be objectified for the purpose of expressing its meaning by the application of metaphor and allegory, and many such devices can be found in the literature for this purpose (e.g. Hermans 1996). However, most current approaches to expressing the meaning of 'self' and 'selfhood' follow one or the other of two encyclo-pædic models, the one corresponding to a *computer metaphor* and the other to a *narrative metaphor*. The first, being associated with agents, agenthood and agent communication languages, will probably be the most familiar to hydroinformaticians. The second, which is however closer to our present theme, is more associated with the humanities and is often traced back to the work of Henry James (1890/1902) on the psychology of the self. In particular, James' characterisation of the 'self-as-knower' with both a 'sense of personal identity' and a 'sense of sameness' remains apposite to our present theme despite its logical-empiricist origins (see also the collection of essays in James 1976). In a very different vein, however, it also relates back to the now classical definition originally suggested by Hegel (albeit with two obvious Biblical allusions) in the Phänome-nologie des Geistes (1807//1952/1977). This is in turn best known nowadays as the starting point for one of Kierkegaard's three great explorations of an already rapidly advancing nihilism as this was experienced at the level of the individuated self. Kierkegaard's (1849/1920–31/1963//1989/1985) formula becomes, in one of the better translations into English.

The self is a relation that relates itself to itself, or is the relation relating itself to itself in the relation; the self is not the relation but is the relation relating itself to itself.

Thus, in the notation of Category Theory, the definition of the self, s, as denoted by $def(s)$, is:

$$def(s) = s : s \to s.$$

so that [the source of the mapping s, denoted by] $\square\, s, = s$ and [the target of the mapping s, denoted by] $s\, \square, = s$. In popular terms, then, the self might be described as 'the ultimate *self*-referencing system' in that, so to say, 'it defines itself'. We observe here already the premonition on the part of Kierkegaard (who in fact had a sound mathematical education) of the necessity of what we nowadays call 'strong typing', in that the self is not defined exclusively in terms of its functionality, but inclusively with the sets upon which it acts and the sets that are the result of its action. The self is then that unique entity for which all three are one and the same. Formulæ similar to that of Kierkegaard have taken a prominent place in the works of several later authors (e.g. Sartre 1943//1958). Among these authors, however, it is probably Sartre who has most popularised the concept of the *other* as something that is defined by the *self* in the image of this self, and which in this process simultaneously defines another, and higher, state of the self. This self then relates the other to itself in the same manner as relates to its own self, and thereby it is said to attain to a higher state of *selfhood*. To the extent that a self creates objects within the same value system as it applies to its own self, so it transcends its view of its world in terms of objects, as items of *primary reflection*, and instead attains, if only by degrees, to states of *secondary reflection*. We then speak of the resulting self as a *subject*, being one who views the others as subjects too. This then applies not only to fellow humans, but to all other creatures. Thus, when Gabriel Marcel said (see Troisfontain 1953/1968, part 3, p. 8) that "to be a subject is not a fact or a point of departure, but a conquest and a purpose of life" he was regarding the subject in just this way.

Thus, when the other is experienced in this way, it is said also to have attained to *selfhood* in the mind of the self, and this is then, entirely symmetrically, the necessary condition for the individual experiencing the other, his-*self* or her-*self* also to attain to *selfhood*. It is only within this relation that any kind of authentic interaction can take place at all between the self and the other.

This is a long quotation but it contains the essence of what we need before introducing the resources that hydroinformatics (and in this case not only hydroinformatics!) must deploy and the new means that are becoming available to employ these resources in order to realise states of social justice. Within this context, it is essential to accept that the concept of "self" and "selfhood" proceeds way beyond humans, clearly extending over the world of nature and even extending further in many cases into the world of artefacts, covering, in effect, *all the things about which we care*. Our attitude towards all such entities must then always be one of *respect*, and indeed in the "Religions of the Book" our only purpose here on earth is to serve as the stewards, or even only as the servants of the creation, so that we are *obliged* to treat all of its creatures and other created objects with respect. We are within this perspective only *the proxies of the creation*. In this same vein, we are ourselves only the temporary custodians of our genes. As Jung constantly emphasised, the self must be clearly differentiated from the ego, and indeed "owing to the fundamentally indefinable nature of human personality, the self must remain a borderline concept, expressing a reality to which no limits can be set" (Jung 1952//1953, p. 355). Correspondingly, anyone who wants to know "what consciousness is" has only to look into the eyes of a living creature to read the answer.

Essential to the understanding of the structures and dynamics of stakeholder participation is that one is concerned with *a community of caring*, and such a community is itself held together by a mutual *concern* on the one hand and, on the other hand, by the very special kind of relationship with one another that this communality of concern induces. This kind of relation-with-one-another, this Being-with-one-another, creates states of *solicitude*, as guided by *considerateness* and *forbearance*, as the "glue" that holds the body of stakeholders together and stabilises their relation to such an extent that, as exemplified shortly, they can do what would otherwise be impossible, so that when it is done it again appears as a 'miracle'.

In situations of this kind we can speak at the most basic level of a *transcendental æsthetic*. In order to see the generality of this term we may recall its use in the first of the Kantian Critiques, where moreover we can see more clearly how it can take on a further vital attribute again. Kant did not, of course, approach his subject in the present way, proceeding instead through the notion of *experience*, as a mode of cognition that must certainly make use of the understanding, but then immediately observing that the mode of understanding that is so employed is itself given to us *a priori*: it is again in itself pre-predicative, and in the more general biological case pre-ontological. This is most memorably expressed in Kant's most famous aphorism: "*Sie begriffen, dass die Vernunft nur das einsieht, was sie selbst nach ihrem Entwurfe hervorbringt*"//"*Reason perceives only that which it produces after its own design*" in the (more mellifluous) Meiklejohn translation (Kant 1787, 1924, 1979//1855/1934/see also 1929/1987). The now-classic examples are those of space and time, both of which we know very well indeed, testing their nature from birth onwards and repeating our experiences of them through all our waking hours, but the experience of which is so much a consequence of our own nature that *we cannot understand them*, and indeed *we see no need to understand them*, such an "understanding" being experienced as superfluous (see again Abbott (2002), and, especially for the case of time, Fraser *et al.* (1978)). In this transcendent state, then, we have to do with things which, *although we may know them very well, we can scarcely ever understand them*. Put another way and even more simply for almost every such case: although we *know that* it is, we cannot *understand why* it is. It just '*is*'.

A STATE OF SOCIAL JUSTICE AS A TELEOLOGICAL SUSPENSION OF THE ETHICAL

Although the transcendental æsthetic is important within the *presentational* aspects of hydroinformatics, much more important to us again is the *transcendental ethic*, and this priority is established by the entire Abrahamic tradition that is at the foundation of the Judaic, Christian and Islamic faiths. In this case we have no choice concerning our paradigm case! Correspondingly again, Kierkegaard had no choice either (Kierkegaard 1843/1976//1983/1985).

In his case the repetition, the repeated failure and overcoming of failure that prepared this event was that of Abraham's repeated efforts to produce a child on his lawful wife. He proceeded with his faith in this endeavour, in

which repetition he persisted into an advanced age before she finally gave birth to Isaac, thus providing him with a foundation of faith from which to take the ultimate "leap of faith". We may then recall that Abraham was subjected by his God to the hardest test of faith that could be conceived in his case, namely that he should proceed with his so long-awaited and so dearly beloved son, Isaac, to an appointed place and should then kill him by way of a sacrifice. Abraham obeyed this command unquestioningly, but still kept his faith that his God would, in fact, not allow this sacrifice to happen. If Abraham had proceeded after his God's will without such a hope of redemption he would simply have resigned himself, reflecting a lack of faith, while if he had sacrificed his son only to reconcile an angry god in the Greek manner, he would have been no more than a Greek tragic hero, as exemplified by Agamemnon, who sacrificed his beloved daughter Iphigenia to this purpose. But Abraham did not resign himself and neither did he act to reconcile an angry god, but he acted in his faith in a merciful God. If he had acted for either of the first two motives it would be possible to understand him in an ethical manner, but in the face of the reality of his action it is no longer possible to understand him ethically.

Of this entire paradigm case, Kierkegaard spoke of *en teleologisk Suspension af det Ethiske//a teleological suspension of the ethical*. He explained his own feelings as follows (Kierkegaard 1843/1976, pp. 54, 59//1980, pp. 33, 37, with italics added):

Thinking about Abraham... I am shattered. I am constantly aware of the prodigious paradox that is the content of Abraham's life. I am constantly repelled, and despite all my passion, my thought cannot penetrate it, cannot get ahead by a hairsbreadth…

Abraham I cannot understand; in a certain sense I can learn nothing from him except to be amazed. If someone deludes himself into thinking he may be moved to have faith by pondering the outcome of that story, he cheats himself...

We should observe that this same property can be identified in injustice within the context of mainstream theology, or at least in that branch that is commonly called "negative theology" where objects are defined through the absence of certain attributes. Within this context, injustice is clearly a product of that which is called in English translations "nothingness" (Kierkegaard's *Intethed*; Sartre's *le néant*, Barth's and Heidegger's *das Nichtige*). Thus, with Barth (1938–1950, III, 3, p. 354, again with italics added):

Nothingness is absolutely without norm or standard. The explicable conforms to law, nothingness to none. It is simply aberration, transgression, evil. For this reason *it is inexplicable*, and can be affirmed only as that which is inherently inimical. For this reason it can be apprehended in its aspect of sin only as guilt, and in its aspect of evil and death only as retribution and misery, but never as a natural process or condition, *never as a subject of systematic formulation…* Being hostile before and against God, and also before and against His creature, *it is outside the sphere of systematisation*. Its defeat can be envisaged only as the purpose and the end of the history of God's dealings with His creature, and in no other way.

This notion of that which is transcendental, whether within the positive sense of social justice or the negative sense of social injustice, may perhaps be most familiar to hydroinformaticians from the inspiration that it gave to Cantor in his momentous investigation into the nature of *transfinite numbers*. Jourdain introduced his translation of Cantor's memoirs (1895, 1897//1915) by mentioning an earlier one of Cantor's contributions, published as *Zur Lehre vom Transfiniten* in 1890 (see Cantor 1915, pp. 73, 74):

A greater part of this little book is taken up with detailed discussions about philosophers' denials of the possibility of infinite numbers, extracts to and from philosophers and theologians, and so on.

From the theologians, however, Cantor must have come across the *credo quia absurdum*–the "I believe it because it is absurd" of such as Irenaeus, Tertullian and Augustine–and this inevitably led him to his presentation of infinite sets of numbers and the vital difference between those that were enumerable and those that were not–of which the most

familiar of this latter kind were those which were "of the order of the continuum". Thus (Cantor 1915, p. 74):

All so-called proofs of the impossibility of actually infinite numbers are, as may be shown in every particular case and also on general grounds, false in that they begin by attributing to the numbers in question all the properties of finite numbers, whereas the infinite numbers, if they are to be thinkable in any form, must constitute quite a new kind of number as opposed to the finite number, and the nature of this new kind of number is dependent on the nature of things and is an object of investigation, but not of arbitrariness or prejudice.

Thus, one finite set of elements is said to "have the same number" of elements as another finite set if a one-to-one correspondence can be established between each of the individual elements of the one set and each of the individual elements of the other set and in this case we say that "the sets are equivalent". In such a case, no set can be equivalent to a proper subset of itself. In the case of infinite sets, however, it is easy to construct, for example, a one-to-one correspondence between the natural numbers and the rational numbers, even though all our intuition tells us that the natural numbers are a proper subset of the rational numbers and indeed that there "should be infinitely more rational numbers than there are natural numbers". Such observations as these provide the foundations of the Functional Analysis that provides, in its turn, the basis for the computational hydraulics and the computational fluid dynamics that are situated at the very foundations of hydroinformatics (e.g. Kolmogorov & Fomin 1953, 1961; Abbott & Minns 1998, pp. 349–396, especially p. 352). For his part Kierkegaard used the expression "*i Kraft af det Absurde*", which, although it is usually translated as "by virtue of the absurd" can be rendered more literally as "by the power of its absurdity". Thus the entire theory of transfinite numbers rests upon this insight, while the power of this transcendence can be judged from Manin's observation (1977, p. 106) that: "In the hundred years since the introduction of transfinite induction, not a single new method of constructing sets has come into common use". Thus, to take one notable example that should be familiar to

hydroinformaticians, it is easy to prove from the continuum equations of almost-two-dimensional fluid motion with bed resistance terms, but no diffusion terms, that no eddies can be produced in a two-dimensional flow, whereas it is observed that eddies are produced in the numerical computations that satisfy these same conditions and that these are very similar to those observed and measured in the nature and in physical models. In this case, the application of some innovations in Fourier transform theory to the analysis of the nonlinear discretised governing equations concerned led to an explanation of this phenomenon, but this explanation transcended the bounds of classical consistency theory, necessarily passing way beyond the conventional Banach-space assumptions of that theory (Abbott *et al.* 1985: see also Abbott & Basco 1989, pp. 357–367; Abbott & Minns 1998, pp. 438–457). In this case it could be shown that, so long as there was a sufficient level of resolution of the higher wavenumber components and the scheme used was non-diffusive, what was demonstrably impossible in the one language, such as the second-order language of real numbers, L_2Real, became perfectly possible in a first-order language, such as the first-order language of arithmetic, L_1Ar (see Manin (1977) for this distinction). A somewhat similar situation arises in the theory of weak solutions of conservation laws (see Abbott & Minns 1998, pp. 370–378) for which Peter Lax, its originator, received the million dollar 2005 Abel Prize of the Norwegian Academy of Science and Letters *on the fiftieth anniversary of its original publication*. (Fortunately for Lax, he was still alive to collect the prize!).

It is important to what follows to observe also that in this case it is the *finite* model that provides the transcendental state, which might at first sight appear to be in conflict with the notion of *infinite* numbers as transcendentals, but once again, and indeed as always seems to be the case, Kierkegaard was ahead of us. For he observed that a *complete transcendence* consisted of two "movements", *first an infinite movement* that took the self into a relation with what he called "The Totally Other", as a first transcendence, *and then a finite movement* that brought this transcended self back into the nominally "everyday world" of the finite, *to function there through a second transcendence*, and so in a "twice-transcended" form (Kierkegaard 1844/1851/1960//1980). It is precisely this

double movement that has to be performed here, where we observe that what was impossible in one, once-transcended world, became possible in another, twice-transcended world. Thus, when we say, as we have above, that "each of the individual stakeholders attains not only to a broader, but also to a higher level of collective understanding, and this leads not only to a higher state of *collective conscious-ness* but also to a higher state of *collective conscientious-ness* that can decide issues that are in the abstract unresolvable" we are speaking of just this kind of double movement that makes possible that which was otherwise impossible.

Associating the observations made above on the quiddity of stakeholder participation, which appears to proceed at just this transcendental level, it must appear that any authentic active stakeholder participation *must* be situated at this level if it is to meet its obligations towards a social justice that is situated at this same level. Concerning the force that drives the authentic and active stakeholder just as it drives the hydroinformatician that has to bring the whole project together, we can then do no better than to return to an earlier work, probably written by H. H. John Paul II himself, where (1994, p. 104) he echoed a theme that also passed from Kierkegaard to Jaspers, and further again to the great Jewish thinker, Emmanuel Levinas (e.g. 1995/2006), namely that "Man, perhaps subconsciously, waits for such a challenge, *indeed, man feels the inner need to transcend himself*. Only by transcending himself does man become fully human (cf. Blaise Pascal, Pensées, Ed. Brunschvicg (1670/1953) p. 434, "apprenez que l'homme passe infinement l'homme [//understand that the man infinitely surpasses the man])".

Necessarily putting to one side here the related insights of Karl Jaspers, as well as of Martin Heidegger, we may conclude this section with Wahl (1959//1969, pp. 74, 75):

Jaspers' interpretation of the idea of *repetition* is different from Heidegger's and a little closer to Kierkegaardian repetition: our failures, he believes, are nothing but the affirmation of transcendence. The fact that we fail is an indication that there is some greater thing, a sphere higher than existence. We become aware of this sphere in what Jaspers calls 'boundary situations'.

Thus failure makes it possible for us to mount from existence towards transcendence, and for this reason, in so far as it conducts us to repetition, it is the supreme 'cipher', the supreme symbol of transcendence…

It is thus that the two ideas of failure and repetition are not so opposed as they seem at first, since in both Heidegger and Jaspers it is failure that brings about the possibility of repetition, it is failure that leads us to triumph and to authenticity.

The realisation of social justice is the reification of this process; but it is now necessary to see how this process has been realised and can be further developed in the water sector, as one of the most significant applications of hydroinformatics. We have to give expression to it even though we can never really understand what it is "in itself", so that social justice is that which, even as it is experienced, surpasses our understanding.

THE REPRESENTATION OF SOCIAL JUSTICE

It is of the essence of social justice that it should be *seen* to be done, and even if we cannot understand it, we still want to be able to recognise it when we see it. But how is this process of recognition to be represented, portrayed, instaurated, or "brought to life"? Clearly the language of ethics is much more one of actions than it is one of words, and it is then essential that these actions are displayed alongside the dialogue and the background of events: no amount of words alone could ever do justice to such actions and that which they symbolise. The deeper grounds for this were explained as follows by Kathleen Raine (Keeble 2004, pp. 51, 52):

Symbols speak to the soul. The psyche doesn't think in words; it is temporal man, the ego, that uses a verbal language. But a symbol which is finally grounded in nature reaches back to regions of experience that are far deeper than verbalisation can ever reach. These symbols touch us at a much deeper level; they come from a deeper level and they speak at a deeper level. They strike these resonances. A symbol must be grounded in

physical nature because that is where the form of the symbol comes from, but it also resonates in a vertical level, in the level of the soul, and possibly beyond that, at a metaphysical level. Therefore, while words are, as it were, a horizontal level of discourse, symbols are a vertical level, calling into play all the different levels of our humanity: life, spirit, the whole range of our human being. Of course, dead symbols are not doing so; they are then like any other kind of verbalisation. But when a symbol is living, it speaks to the whole being. And again, to return to Jung, whom I must defend, the soul receives its oracles in symbolic form, as for example in dreams, very seldom in verbal form, and more often visual than verbal.

We may associate this insight with the more mundane (as contrasted with the much more exalted, Platonic) formula of Locke (1690/1990, p. 208), that "words, in their primary or immediate signification, stand for nothing but the *ideas* in the mind of him that uses them", in which case we may continue with Locke to define an *idea*, albeit in a modern idiom, as "any object that has become a subject of the understanding"–and here, we repeat, we are concerned with the outer limits and indeed the transcendence of the understanding. We may indeed recall that the goddess of justice is commonly depicted as a blindfolded woman holding a weighing scale. Corresponding to this situation we need *new didactic instruments* that will transmit the nature of the qualitative changes that are occurring during the realisation of social justice, and these must accommodate all their manifestations as actions, words and even, passing above and beyond these again, *their music*. The notion has correspondingly arisen within the first author's courses at the EIIL, as in other places besides, of using videos of films and television programmes that portray the processes that are in play in situations of this kind in the most penetrating forms conceivable. For the purpose of portraying the processes that culminate in social justice it is been found convenient to use videos of a BBC production entitled *Judge John Deed*, the nature and content of which is thoroughly covered in Wikipedia and which is readily available from Amazon and other retail outlets. In other environments, a US film entitled *12 Angry Men* is frequently used to much the same effect. In the first

case a particular interest accrues to one production in which the teleological suspension of the ethical occurs in such a way as to attain to social justice and correspondingly avert what would otherwise have been an extreme case of social injustice. This same production also excels in providing the means to inculcate in the mind of the viewer a particular form of knowledge, commonly called *tacit knowledge*, by following the words, facial expressions, gesticulations and other bodily movements and human interactions generally within a jury of a court of law, and thereby observing how *an increasingly augmented state of collective consciousness comes to transmute into a transcendental state of collective conscientiousness* within that particular environment (and so again how *what starts out as impossible becomes possible*). As will be taken up later in this paper, what is in play here is indeed much less knowledge itself, but that which is a necessary adjunct to it, which is *imagination*. Following Corbin (1958//1969/1996, p. 80) we may then say that "the active imagination guides, anticipates, molds sense perception; that is why it transmutes sensory data into symbols". These are typical of the new ways of using the new kinds of references that must be employed in this kind of enterprise, and they have the added advantage that they are widely available in other languages than the original, either through sound-synchronisation or subtitling, while the invaluable role of background music, often serving as *Leitmotiv*– and in the John Deed case played by the London Symphony Orchestra no less!–is then readily accommodated. It is through these devices, correspondingly, that the means now become available to express what would otherwise be inexpressible.

If we should ask what kinds of emotions are finally being aroused in such productions we are obliged to return to the sensation of "a miracle", such as may be exemplified in the instance just cited by the portrayal of the amazed relief of the accused when declared not guilty, and this sensation must also be induced within these environments as authentically as possible with the means available. For example, for such a person faced with disaster unless social justice is done, its actual appearance may well be experienced and projected as "a miracle": see the famous (or as one of his editors called it, "notorious") tenth section of Hume's *Enquiry Concerning Human Understanding*

(Hume 1748, 1999). The last sentence of this section especially bears recording here:

> Mere reason is insufficient to convince us of its veracity. And whoever is moved by *Faith* to assent to it, is conscious of a continued miracle in his own person, which subverts all the principles of his under-standing, and gives him a determination to believe what is most contrary to custom and experience.

Such a behaviour as this thus corresponds to *an act of faith*, wherewith we must then always add, thinking reflexively with Kierkegaard, "and faith is a miracle, otherwise it is not faith".

But still this should not excite too much euphoria, for as Pascal observed (Pascal/Lafuma 1670//1962, 2003, p. 161):

> Les miracles ne servent pas à convertir mais à condamner (Miracles do not serve to convert, but to condemn).

which is to say that we must then be lacking in faith if we have to be looking for miracles (e.g. John 11:4). Correspondingly, the miracle is viewed in theology not so much as a product of *the faith* as of *the doctrine*.

We can otherwise speak of this as *a revelation*, that is, as an experience of a higher truth, or, to cross the line into theology, as *a moment of epiphany*. The dangers involved in this process should not need any emphasis here and the role of the hydroinformatician in avoiding at least some of these dangers is correspondingly taken up in the second part of this paper.

INDUCING TRANSCENDENCE WITHIN PROCESSES OF *ACTIVE STAKEHOLDER* PARTICIPATION

Thus it is the very similar processes that occur during active stakeholder participation, again taking forms of successive failures and overcomings of failures, as repetitions, that drive the process of transcendence whereby the higher levels of consciousness provided by the productions of the hydroinformatician mutate into these higher levels of conscientiousness that then occur "spontaneously", so to speak, within the active stakeholder community.

We observe that the first movement is modern and the second is pre-modern, and indeed it is in its expression alchemical. What is occurring here is a transcendence within the character of the individuals and a transcendence within the character of the group, which is thereby a social transcendence, and it is this process that "leads us to triumph and authenticity", whereby, if conducted properly–where "conducted properly" has still to be defined in our present case–justice prevails and injustice is exposed. *Social justice is correspondingly a transcendental state of social being*.

Within this context we continue to refer, as in common speech, to "the chemistry of the interaction" when the elements, the characters of the persons participating in the interaction, do not themselves change, so that only *transformations* can occur, whereas when we speak of "the alchemy of the interaction" we refer to situations in which the elements, the characters of the persons them-selves, are changing, so that we then have to do with *transmutations*: see Jung (1944//1952). We then commonly say that "if the chemistry is right" then people will "bond with one another" so as to "create a good team", but it is not then necessary that the individual persons concerned, the "elements" of the team, need themselves change very much, if at all. In the case of the alchemical transmutation the situation is totally different, in the sense that the "members of the team" come to change their attitudes, and even their "views on life", their "horizons" in the language of Husserl, as a consequence of their working together in the team: they are "not the same persons" after working together as they were before they worked together; they have changed qualitatively, attaining to another kind of *being-in-the-world* (*In-der-Welt-sein*). At the risk of passing over into hyperbole, one might even speak with the ancient Greeks of a *collective metamorphosis*. One might correspondingly go so far as to say that without this higher-level-of-conscious-ness to higher-level-of-conscientiousness transmutation, social justice would be for the most part unrealisable.

We may thus see better how the introduction of certain kinds of hydroinformatic environments in processes of stakeholder participation have the capacity to change the ways in which individual stakeholders think and feel about the world in which they live and function, even as the stakeholder group as a whole then mutates correspondingly

so as to provide one collective voice, as a voice that is experienced as one of social justice–just so long as this process is "conducted correctly", which is then the subject of the second part of this paper.

REFERENCES

Abbott, M. B. 1991 *Hydroinformatics: Information Technology and the Aquatic Environment*. Avebury Technical, Aldershot/Brookfield, VT.

Abbott, M. B. 1999 Forchheimer and Schoklitsch: a postmodern retrospection. In: *Memorial Symposium P. Forchheimer and A. Schoklitsch, Proc. 28th IAHR Congress, Graz* (ed. W. H. Graf). Also available at: http://www.knowledge-engineering.org

Abbott, M. B. 2002 On definitions. *J. Hydroinf.* **4**(2), pp. 1–27, electronic version only. Also available at: http://www.knowledge-engineering.org

Abbott, M. B. 2004 *European Industrial Leadership*. European Institute for Industrial Leadership and Knowledge Engineering, Brussels.

Abbott, M. B. 2007 Stakeholder participation in creating infrastructure. *New Civil Eng.* **160** (1), 26–32. [Awarded the Telford Gold Medal of the Institution of Civil Engineers in 2008].

Abbott, M. B. & Basco, D. R. 1989 *Computational Fluid Dynamics: An Introduction for Engineers*. Longman/Wiley, London/New York.

Abbott, M. B., Larsen, J. & Tao, J. 1985 Modelling circulation in two-dimensional flows; Part 1: the accumulation of the evidence. Part 2: a reconciliation. *J. Hydraul. Res.* **23**, pp. 309–326, pp. 397–420.

Abbott, M. B. & Minns, A. W. 1998 *Computational Hydraulics*, 2nd edition. Ashgate, Aldershot/Brookfield, VT.

Barth, K. 1938–1950 *Die Kirchliche Dogmatik*. Evangelischer, Zollikon-Zurich//1961 Church Dogmatics (transl. Bromiley, G. W. & Torrance, T. F.). Clark, Edinburgh.

Cantor, G. 1895, 1897 *Math. Annalen*. 1895, xivi, pp. 481–512; 1897, xiix, pp. 207–246//1915 *Contributions to the Founding of the Theory of Transfinite Numbers* (transl. Jourdain, P. E. B.) Dover, New York.

Carey, J. 2007 Editorial. *Temenos Acad. Rev.* **10**, 7–13.

Corbin, H. 1958 *L'Imagination créatrice dans la Soufisme d'Ibn Arabî*. Flammarion, Paris/2006 Entre Lacs, Paris//1969 *Creative Imagination in the Sufism of Ibn Arabî*. Princeton University Press, Princeton, NJ/1997, Bollinger series XCI, Princeton University Press, Princeton, NJ.

Depelsenaire, Y. 2004 *Une Analyse Avec Dieu*. La Lettre Volée, Brussels.

Dilthey, W. 1976 *Selected Writings* (ed. and transl. H. P. Rickman). Cambridge University Press, Cambridge.

Durning, D. 1999 The transition from traditional to postpositivist policy analysis: a role for Q methodology. *J. Pol. Anal. Manage.* **18** (3), 389–410.

Evers, M. 2008 *Decision Support Systems for Integrated River Basin Management: Requirements for Appropriate Tools and Structures for a Comprehensive Planning Approach*. Shaker, Aachen.

Findlay, J. N. 1977 Foreword to Hegel, G. W. F. *Phenomenology of Spirit* (transl. Miller, A. V.). Oxford University Press, Oxford.

Foucault, M. 1972–1977/1980 *Power/Knowledge: Selected Interviews and Other Writings* (ed. C. Gordon). Pantheon, New York.

Flew, A. 1993 *Social Justice Isn't Any Kind of Justice*. Libertarian Alliance, London.

Fraser, J. T., Laurence, N. & Park, D. (eds) 1978 *The Study of Time, III*. Springer, Heidelberg.

Harvey, H. 2009 The hydroinformatics platform. In: *Proc. World City Water Forum 2009, Incheon, Korea*. Forthcoming.

Heidegger, M. 1927 *Sein und Zeit*. Niemeyer, Tübingen//1962 *Being and Time* (transl. Macquarrie, J. & Robinson, E.). Blackwell, London.

Heidegger, M. 1963 *Die Technik und Die Kehre*. Niemyer, Tübingen (10th reprint: 2002 Cotta)//1977 *The Question Concerning Technology and Other Essays* (transl. Lovitt, W.). Harper, New York.

Hegel, G. W. F. 1807 *Phänomenolgie des Geistes*. Goebhardt, Bamberg and Würzburg/1970 with an afterword by Lukács, G. Ulstein, Frankfurt am Main, Berlin and Vienna//1977, *Hegel's Phenomenology of the Spirit* (transl. Miller, A. V., with a text analysis and foreword by Findlay, J. N.). Oxford University Press, Oxford.

Hermans, H. J. M. 1996 Voicing the self: from information processing to dialogical interchange. *Psychol. Bull.* **199** (1), 31–50.

Hoppe, R. 1999 Policy analysis, science and politics: from 'speaking truth to power' to 'making sense together'. *J. Sci. Public Policy* **26** (3), 201–210.

Hume, D. 1748 *An Enquiry Concerning Human Understanding*/1999 (ed. T. L. Beauchamp). Oxford University Press, Oxford.

James, H. 1890/1902 *The Principles of Psychology*. Vol. 1. Macmillan, London.

James, H. 1976 *Essays in Radical Empiricism* (collection of articles and correspondence from 1889 to 1909, edited by Bowers, F.). Harvard Univ., Cambridge, MA, and London.

John Paul, H. H., II 1994 *Crossing the Threshold of Hope*. Jonathan Cape, London.

John Paul, II, H. H. 1998 *Fides et Ratio*. Libreria Editrice Vaticana, Vatican City//*Faith and Reason*. Veritas, Dublin.

Jonoski, A. 2002 *Hydroinformatics as Sociotechnology: Promoting Individual Stakeholder Participation by Using Network-Distributed Decision Support Systems. Swets and Zeitlinger, Lisse*. Swets and Zeitlinger, Lisse; UNESCO-IHE Institute for Water Education, Delft/Balkema, Rotterdam.

Jung, C. G. 1944 *Psychologie und Alchemie*. Rascher, Zurich//1952 *Psychology and Alchemy*. Routledge, London.

Kant, I. 1787/1924/1979 *Kritik der reinen Vernunft*. Facsimile reproduction of the 1924 Kehrbachsche Ausgabe, Reclam, Leipzig//1855 *Critique of Pure Reason* (trans. Meiklejohn, J. M. D.)/1934 (ed. A. D. Lindsay), Everyman, London/see also 1929/1987, *Immanuel Kant's Critique of Pure Reason* (transl. Kemp Smith, N.), Macmillan, London.

Keeble, B. 2004 An interview with Kathleen Raine. *Temenos Acad. Rev.* **7**, 27–58.

Kelly, J. S. 1976 *Arrow Impossibility Theorems*. Academic, New York.

Kierkegaard, S. Aa. 1843/1976 *Frygt og Bæven*. Gyldendal, Copenhagen (reprinted from Danish 5th edition of the Collected Works, Gyldendal, Copenhagen//1983 *Fear and Trembling*) (ed. and transl. H. V. Hong & E. H. Hong). Princeton University Press, Princeton. NJ/but see also, as a valuable alternative translation, 1985 *Fear and Trembling* (ed. and transl. A. Hannay). Penguin, Harmondsworth.

Kierkegaard, S. Aa. 1844/1851/1960 *Begrebet Angest* (reprinted from the Danish 5th edition of the Collected Works, Introduction and Notes by Sørensen, V., Gyldendal, Copenhagen//1980, *The Concept of Anxiety* (transl. Thomte, R. & Anderson, B.). Princeton University, Princeton, NJ.

Kierkegaard, S. Aa. 1849 *Sygdommen til Døden*. Reitzel, Copenhagen/1920–31, *Samlede Værker* (ed. A. B. Drachman, J. L. Heiberg & H. O. Lange, Gyldendal, Copenhagen)/1965, *Sygdommen til Døden*, Gyldendal, Copenhagen//1989, *The Sickness unto Death* (ed. and tranl. H. V. Hong & E. H. Hong), Princeton Univ., Princeton, NJ; (see also 1985, *The Sickness unto Death*, transl. Hannay, A., Penguin, London).

Klinkenberg, J.-M. 1996 *Précis de sémiotique générale*. De Boeck et Larcier, Seuil, Paris.

Kolmogorov, A. N. & Fomin, S. V. 1953 *Elements of the Theory of Functions and Functional Analysis* Vol. 1: *Metric and Normed Spaces*; 1961 Vol. 2: *Measure, the Lebesgue Integral, Hilbert Space*. Graylock, Albany and Academic, New York.

Latour, B. 1991 *Nous n'avons jamais été modernes*. La Découverte, Paris//1993 *We Have Never Been Modern* (transl. Porter, C.). Harvard University Press, Harvard and Harvester, London.

Levinas, E. 1995/2006 *Altérité et transcendence*. Fata Morgana, Paris.

Locke, J. 1690/1961/1977/1990 *An Essay Cancerning Human Understanding* (abridgement selected and edited by Yolton, J. W). Dent, London.

Machiavelli, N. 1516$^{+/-}$/1929 *Tutte le opere storiche e letterarie di Niccolò Machievelli* (ed. G. Mazzoni & M. Casella). Barbèra, Florence//1970 *The Prince* (transl. Bull, G., Prelude by Mussolini, B.). Folio, London.

Manin, Yu. I. 1977 *A Course in Mathematical Logic* (transl. Koblitz, N.). Springer, Heidelberg.

Meinong, Av. 1913 *Abhandlungen zur Erkentnistheorie und Gegenstandstheorie*. Barth, Leipzig.

Miller, D. 1999 *Principles of Social Justice*. Harvard University Press, Cambridge, MA.

Pascal, B. 1670/1962/2003. *Les pensées* (ed. L. Lafuma). de Seuil, Paris.

Pascal, B. 1670/1953 *Les pensées* (ed. L. Brunschvicg). Vrin, Paris.

Rawls, J. 1971 *A Theory of Justice*. Harvard University Press, Harvard, MA.

Rhees, R. 1981 Wittgenstein on language and ritual. In *Wittgenstein and His Times* (ed. B. McGuinness), pp. 69–107. Blackwell, Oxford.

Roy, A. 1999 *The Cost of Living*. Flamingo/Harper Collins, London.

Sartre, J.-P. 1943 *L'Être et le néant*. Gallimard, Paris//1958 *Being and Nothingness* (transl. Barnes, H. E.). Methuen, London.

Simons, P. 1996 Meinong's theory of sense and reference. In *Meinong und die Gegenstandstheorie: Meinong and the Theory of Objects* (ed. R. Haller), pp. 171–186. Rodopi, Amsterdam.

Thorkilsen, M. & Dynesen, C. 2001 An owner's view of hydroinformatics: its role in realising the bridge and tunnel connection between Denmark and Sweden. *J. Hydroinf.* **3** (2), 105–136.

Troisfontaines, R. 1953/1968 *De l'éxistance à l'étre: La Philosophie de Gabriel Marcel*. Nauwelaerts, Louvain.

Tumwesigye, E. 2009 *The Water Webframe Modelling Framework and Business Context in the Development towards the Fifth Generation of Hydroinformatics*. Doctoral Thesis, National University of Ireland: University College, Cork.

Vojinovic, Z. & van Teeffelen, J. 2007 An integrated stormwater management approach for small islands in tropical climates. *Urban Water J.* **4** (3), 211–231.

Wahl, J. 1959 *Les philosophies de l'existence*. Armand Colin, Paris// 1969 *The Philosophies of Existence* (transl. Lory, F. M.). Routledge, London.

Winch, P. 1967 *The Encyclopaedia of Philosophy* (ed. P. Edwards), Vol. VI, pp. 44–46. Collier-Macmillan, London.