Realising social justice in the water sector: 2

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ABSTRACT

The second part of this paper is given over to the role of the hydroinformatician in creating sociotechnical environments in which the transmutations necessary to provide states of social justice can be catalysed through the creation of appropriate web-based environments. Some recent exemplifications of these processes within the second paradigm case that is used here are provided in conclusion. In particular, the ways in which the objects presented by the user interfaces to the different classes of stakeholders become transmuted into symbols in the minds of these stakeholders through the active exercise of their imaginations are exemplified and further analysed.

This work has proceeded concurrently with the design, writing and development of the software necessary to realise its aims and ambitions, with 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.

It is emphasised at various junctures that enterprises of this kind carry substantial risks and must be approached with much care and understanding; and indeed the primary reason for writing this paper is to communicate not only the risks, but also the corresponding level of understanding that is necessary to overcome these risks.

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

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THE HYDROINFORMATICIAN IN THE SERVICE OF SOCIAL JUSTICE

Even in hydroinformatics as it exists today, the work of the hydroinformatician remains centred upon the model, whether a physically based numerical model or a more empirical or instrumental data-driven model. Currently only the numerical model is used in the kind of operations considered here and all the other resources of hydroinformatics—all manner of instrumentation; SCADA systems; radio transmission links; geographical information systems; geographical positioning systems; fixed and mobile internet, increasingly with World Wide Web access; satellite-based positioning and radio and television-transmission facilities, and so on as largely already introduced earlier here—are, so to say, distributed around and connected to a central modelling activity. We call the organisation that brings all the knowledge of this kind together and combines it in such a way as to be accessible to the stakeholder group, *a knowledge provider*. The stakeholders then become *knowledge consumers*. The hydroinformatician is the one who brings the productions of the knowledge provider together, currently through the agency of the model, and processes this knowledge into forms that are recognisable to the stakeholders. The person that we call "the modeller" is then in the first place the person who possesses the ocular system and brain functions that are capable of combining the productions of all of the technical facilities through the agencies of the numerical model, and then of computing using such images as may be relevant in order to provide the metonymic structures that will appear on the screens of the user interfaces of the individual, specifically caring and concerned, stakeholders. Each of the productions of this

initiating modeller then has the capacity to convey information that is specifically relevant to the inner and the outer worlds of each one of these stakeholders. These stakeholders then become *terminal modellers* in the sense that they possess the qualities of eye and mind that enable them to transform the information contained in the metonymic structures that the initiating modeller specifically directs to them into metaphors that are meaningful within the ambit of their own specific concerns, so that they come to experience what we might now describe as *symbolic knowledge*. In the language of a Husserlian phenomenology, the initiating modeller is one who has the capacity to use all the *indicative signs* that are available to create the metonymic structures, and these have in turn the capacity to provide the different *expressive signs* that are specifically appropriate to each and every one of the individual terminal modellers (compare Husserl 1900, 1901/1913//1970, with Husserl 1945//1973). These terminal modellers then proceed, individually and in interaction with other such modellers, to transform these expressive signs into symbols, recalling again from Kathleen Raine that "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". It is then a *conditio sine qua non* of all such stakeholder participation that all the content produced in this way must be available to all the stakeholders and that the means can be mobilised to connect them with other stakeholders who can also interpret the symbolic meaning of the content, albeit often in different, and even at some stages in conflicting, ways. In the same vein, the terminal modellers may well be provided with the possibility to introduce changes in the parameters of existing models over the Web, and possibly to introduce other changes again, so as to arrive at other analyses and insights, frequently transmitting the consequences to other terminal modellers as well as to the initial modeller. It should be emphasised that we are here using the word "model" in the sense of Abbott (2002) as that which captures and encapsulates the full range of data, numerical computations, expertise, physical knowledge and all else that is accumulated in hydroinformatics and projects the results so accumulated in the forms of the metonymic structures that appear on the screens of the persons who must (and thereby can) transmute this into

meaningful metaphors within their own more specific and circumscribed fields of concern.

Thus, all the modellers, initiating and terminal, are persons who receive structured collections of indicative signs and, in the case of the terminal modellers, whose eyes and minds transform these into expressive signs and thence, either individually or, more commonly, through interaction with others, into symbols. In the kinds of environments that are being advanced within the present context, increasingly functioning with possibly serious time constraints, most of these operations proceed over the mobile internet and should be increasingly catalysed by improved satellite-based communication coverage and, in distributed applications, more advanced mobile telephone technologies. This corresponds to the requirement of as complete a transparency as is possible in the decision-making processes across the stakeholder group, where we define a state of transparency in category-theoretical terms as one in which both the implication string:

$$(\underline{\text{beliefs}}, (\text{facts}(\underline{\text{data}}))) \rightarrow \text{attitudes} \rightarrow \text{positions} \rightarrow \text{judgements} \rightarrow \text{decisions} \rightarrow \text{actions}$$

and its *dual category*, the implication string:

$$\underline{\text{actions}} \rightarrow \text{decisions} \rightarrow \text{judgements} \rightarrow \text{positions} \rightarrow \text{attitudes} \rightarrow (\underline{\text{beliefs}}, (\text{facts}(\underline{\text{data}})))$$

(where underlining is used to denote what is known) are simultaneously present in the minds of the stakeholders (see also Jonoski 2002, pp 91–94).

(As one of the leading nations in these respects, and as one where extensive public participation has become the accepted means of preparation for decision-making, China has a particular relevance to this development. Thus, in an editorial entitled "Transparency: it's the law" (Beijing Review, 06.03.08, p 3), after castigating the many examples of social injustice that so much concern the peoples and the governments at all levels of that nation, it is observed that: "Clearly, a complete change in the above-mentioned situation lies in the establishment of a strict and transparent legislative system that features the broadest public participation". This has been strengthened by new legislation on

property and water rights and responsibilities that had become increasingly urgent—and which involved the active participation of many tens of thousands of persons, even though this participation itself necessarily led to considerable legislative delays in many cases. It depends of course on the omnipresence of the mobile internet. With the rapidly ongoing sinification of Africa and so many other places, the spread of public participation, as may be specialised to active stakeholder participation using the mobile internet, can be expected to expand into those parts of the world where it is needed even more desperately: see, for example, Michel & Beuret (2008)).

Whatever the geographical context, however, and further to this kind of process again, the views of each individual stakeholder may well be influenced by what first appear as "outsiders", even though this should not in principle be allowed in a court of law, so that these are, *de facto*, other operators again. In this case we arrive in a world of *knowledge supply chains* that may be quite complex and convoluted and which may span the entire space between the initiating and the terminal modellers. In the *knowledge supply chain analyses* of hydroinformatics, although still at an early stage, there are already two distinct models, namely one which is called colloquially (because the names are so familiar also in China!) a "Walmart–Carrefour" model, which is a centralised, exostructured "collect, process and disperse" model, and the other, called a "farmers market" model, in which all relevant contributors come together of their own volition in largely unstructured, decentralised and endostructured knowledge markets, proceeding as a "knowledge Agora". The possible attempts to subvert social justice that are inherent in both of these structures must, of course, be taken into account by both the initiating modeller and the terminal modellers interactively. The first of these models is better suited to mass-customised advice-serving systems (Abbott & Jonoski 2001) and environmental learning games (Jonoski 2002). The sociotechnical arrangements necessary in the present case, which are by far the most preferable in the situations described here, and such as can be realised by providing the means to promote the spontaneous foliation of an *outer halo* through the introduction of open-source software components, can only be adumbrated using as a paradigm case the

introduction of what is commonly called *middleware*, following the use of this term by IBM.

The manner in which this middleware can be implanted from its technical side is through introducing what we have called *sites* into parts of the modelling code that are opensource and which will *attract and bind* a potential *halo* of persons and organisations. Abbott & Vojinovic (2009) explain this as follows:

The analogy and associated metaphors that are introduced have been taken from elementary quantum chemistry and molecular biology, where patterns of free hydrogen ions on a living organism are steriospecific with complementary patterns on molecules that need to be bonded for this organism to grow and prosper. Consequently, in the random, chaotic movements of molecules, the free hydrogen ions on the living megamolecule that is the living cell come to attract and bind with those of the so-far free-ranging molecules, bringing these into the life systems and temporal cycles of the living cell. In 'IBM-speak', such interfaces are called *service-orientated platforms*. These can then be configured so as to provide bonding sites for outside developers, entrepreneurs and others in the water sector of industry generally. [We then speak of processes of *steriospecific recognition*.] Obviously, just as in the molecular-biology analogy that is further described later here, the persons and organisations that are so attracted and come to bond may, and in many cases will, provide further such sites so as to enrich their own operations again. They may of course use these facilities to bond with their own legacy software and the IBM paradigm case and our own experience suggest that such applications may be of great significance in our own field too, opening up even wider perspectives.

It is in this way that the environments that we are concerned to construct in this context acquire again the properties of *attractors*, attracting and maintaining extended halos around them.

It is this process that has come to be identified with knowledge supply chain formation as a process that must be not only accommodated but also actively promoted in any post-modern organisation, understood as one that

combines and integrates knowledge-provision and knowledge-brokering functions through its *intentional creation of an extended halo around it*. Such an organisation has then to understand that it must accordingly and simultaneously *create intentionally an environment that may, and at some stage must, compete with at least some of its own productions*. This in turn corresponds to the essential nature of such an innovation, whereby it also becomes a *disruptive* (socio-) technology (Abbott *et al.* 2005).

There are clearly circumstances in which the initiating operator, functioning as a leader in the indirect but regular sense, must identify and participate in at least some of these intervening influences and may then come to serve them also, even as they in turn serve the entire stakeholder complex. Among the most influential of these participating influences are, of course, *the media*, but in this place we can better eschew the contentious issues that are raised when treating with the media. In the same vein, we abjure any consideration here of the role of what are now widely called "media studies".

FOR WHAT, THEN, IS THE MODELLER SEARCHING?

What the initiating modeller is constantly looking for is *cause and causality*: what it is that is causing the issues that are of concern to the active stakeholders to lead to a failure to agree on a mutually acceptable arrangement, or verdict. From the first part of this paper it is clear that *he or she is looking for the cause of failure*, so that for the initial modeller, just as for the psychoanalyst described by Lacan (1964/1973//1977/2004, p 22): "In short, there is cause only in something that does not work". When it can be brought "to work", through the processes of repetition, then we arrive at 'The Great Work', the *magnum opus* of the alchemist, as both an individual transcendence of the Self and as a group transcendence of the community of Selves of the active stakeholders. Clearly, no such process is realisable in the case of passive stakeholders. In the same vein, only in the case that the initiating modeller can overcome the temptations of exercising only "deficient modes of solicitude" in the now-classical Heideggerian sense (whereby the stakeholders are maintained in a passive state, such as happens when these stakeholders are only

being "consulted", "informed" and "directed", rather than being challenged-out to exercise and develop their own inherent knowledges, imaginations and judgements, and to exercise these both independently and interactively) can "The Great Work" succeed. We shall return to this concept again, but in a broader sense, in a moment.

The second immediate consequence is that the function of the modeller changes, and indeed drastically, in such situations, as corresponds to this reversion from the chemical back to the alchemical. Whereas in the pre-internet era of hydroinformatics the emphasis was on the model, in its new web-connected and mobile era the emphasis of hydroinformatics is much more on the modeller: *the emphasis changes from the operand to the operator*. In the words of Lacan (1964/1973//1977/2004, p 9):

> What is it that makes us say that, despite the dazzling character of the stories…from ages past, alchemy, when all is said and done, is not a science? Something, in my view, is decisive, namely, that the purity of the soul of the operator was, as such, and in a specific way, an essential element in the matter.

In hydroinformatics similarly, the *purity of the soul* of the operator, which we can better here describe as the *quality of the character* of the modeller, becomes inseparable from the quality of the model in the quality of the total production. Thus, in modern science, the outcome of an experiment should be independent of the nature of the experimenter, whereas in a pre-modern (and thereby, as in the present case, post-modern) science this is not the case. Correspondingly, the central question now comes to be posed of "what is the modeller's *desire*?" It is this in turn that establishes the economy of the modeller's libidinal resources. Thus the proper employment of the web-based SaaS paradigm in hydroinformatics depends vitally upon an authentic answer to this question, and thus, so far as is possible, an authentic understanding. Our question then becomes: with what kind of human activity, and correspondingly with what kind of participating Selves, are we concerned here? To put this question in the terms appropriated by Lacan for his field of psycho-analysis: "What grounds it as praxis?"

But then we must pose the question of what we now mean by *praxis*? We follow Lacan, again adding italic,

when he says that "It is the broadest term to designate a concerted human action, whatever it may be, which places man in a position *to treat the real by the symbolic*". What we then do is to take our praxis with us, as interconnected applications in our outer world, and we let our observations of the applications "direct us at once towards some fairly well-located, specifiable points of praxis". It is then necessary, continuing to follow Lacan, to avoid a profound misunderstanding, which in our case is the misunderstanding that hydroinformatics is some form of research. We can do no better than to quote Lacan (1964/1973//1977/2004, p 7) when answering from a similar position in his own field:

> Well, allow me to say quite clearly–in particular to the public authorities for whom this search has seemed, for some time now, to serve as a shibboleth for any number of things–that I am a bit suspicious of this term research. Personally, I have never regarded myself as a researcher. As Picasso once said, to the shocked surprise of those around him–*I do not seek, I find*.
>
> Indeed, there are in the field of so-called scientific research two domains that can quite easily be recognised, that in which one seeks, and that in which one finds.
>
> Curiously enough, this corresponds to a fairly well defined frontier between what may and may not qualify as a science. Furthermore, there is no doubt some affinity between the research that seeks and the religious register. In the religious register, the phrase is often used–*You would not seek me if you had not already found me*. The *already found* is already behind, but stricken by something like oblivion. Is it not then a complaisant, endless search that is then opening up?

Hydroinformatics provides a paradigm case of *something that was found* while following a closely woven web of technological innovations that were observed, during the praxis, to be brought together around one single theme even when viewed initially only technologically. The theme itself that was thereby found was not itself modern-scientific, however, or at least it could not be described adequately in the language of modern science, so that it had to be described in terms of something else again, and in this case

in terms of the onto-theological categories and their corresponding languages.

The study of an apparently alternative approach, based upon the Derridian concept of *différance* (which does not function as a word, but only as a sign), showed that this onto-theological mode of expression might possibly be avoided. However, the conceptual difficulty of Derrida's (1967//1975/1989) linguistic innovation, that appeared to exemplify another approach to language than that of the onto-theological, in turn appeared as excessively abstract and thus too difficult conceptually for most of our present purposes. However, in one application at least it might be admitted here, namely when expressing the *complexity* of the processes that are occurring in such an enterprise and the corresponding simplicity that must characterise their realisation. Even at the level of the computational systems that are in use here–in the case of the first paradigm case these were mostly MIKE 21 and MIKE 3 and in the second paradigm case this is currently MIKE Urban coupled seamlessly to MIKE 21 with standard DHI dynamic viewing facilities–there are some trillions of *different* digital operations in all possible applications of the code that might simulate the phenomena. Correspondingly, the digital user interface has at least 750,000 pixels and each of these can have a range of possible intensities and possible colours, while all of these again may change, through combinations and permutations, in an immense number of ways over time, so that we can have, at least in principle, some trillions of possible *different* graphical representations. Only one of the possible sequences of numerical operations is, in fact, performed and only one sequence of graphical representation also. This leads to the problem of choosing the computation and the dynamic graphical representation that are best suited to the aims of the enterprise, and in this case of promoting and indeed realising states of social justice.

THE ASSOCIATED TECHNOLOGIES

Geographic Information Systems (GIS) and remote sensing in the stakeholder participation context then necessarily play important roles. Remote sensing technologies, such as Airborne Laser Scanning (ALS) or Light Detection and Ranging (LIDAR), are used to provide a comprehensive

topographic coverage of entire floodplain areas in an accurate and economic manner. Digital Elevation Models (DEMs) offer the possibility to extract catchment charac- teristics automatically by creating flow direction and subcatchment-boundary maps. The generation of flow- direction maps is usually determined by calculating the steepest downhill slope for each cell. Furthermore, the sufficiently fine resolution of ALS data can provide a good spatial framework to compensate for a coarse resolution of the hydrodynamic model. Such a framework makes it possible to map water level and velocity results onto a terrain model and to visualise the quantification of flood hazards across the floodplain. The ability to map different hazard categories to cadastre automatically has recently been realised using GIS technologies and, as such, this has promoted a greater dependence of flood plain modelling results on spatial representation. Furthermore, GIS tools have been developed to geo-reference time-varying results from hydrodynamic models to a spatial framework (or to a grid which includes a model of the terrain). Thus, for any time step of either one-dimensional or two-dimensional

model results, depth, velocity and hazard can be determined for each grid element in the two-dimensional spatial framework. Such maps, which represent the extent of flood hazards, can then provide a basis for defining not only improvement measures but also the most suitable flood emergency response actions. The flood-visualisation com- ponent of GIS technology enables engineers and emergency response planners to become familiar with the potential behaviour of flooding, its rates of deepening, its evolving flood extents and the areas of high flood hazard, all of this with lead times allowing appropriate actions to be taken prior to the area concerned being inundated. With the use of GIS technology, model results can be linked to the cadastre and property databases and, as such, used very efficiently in the overall urban planning process. Figures 1–3 show examples of how the model results (such as depth, velocities and hazard) can be superimposed with cadastre (or aerial image) within a GIS framework. A good example of an effective GIS-based framework for urban flood modelling and disaster management is illustrated in Figure 1 and Figure 2. It illustrates how the use of GIS
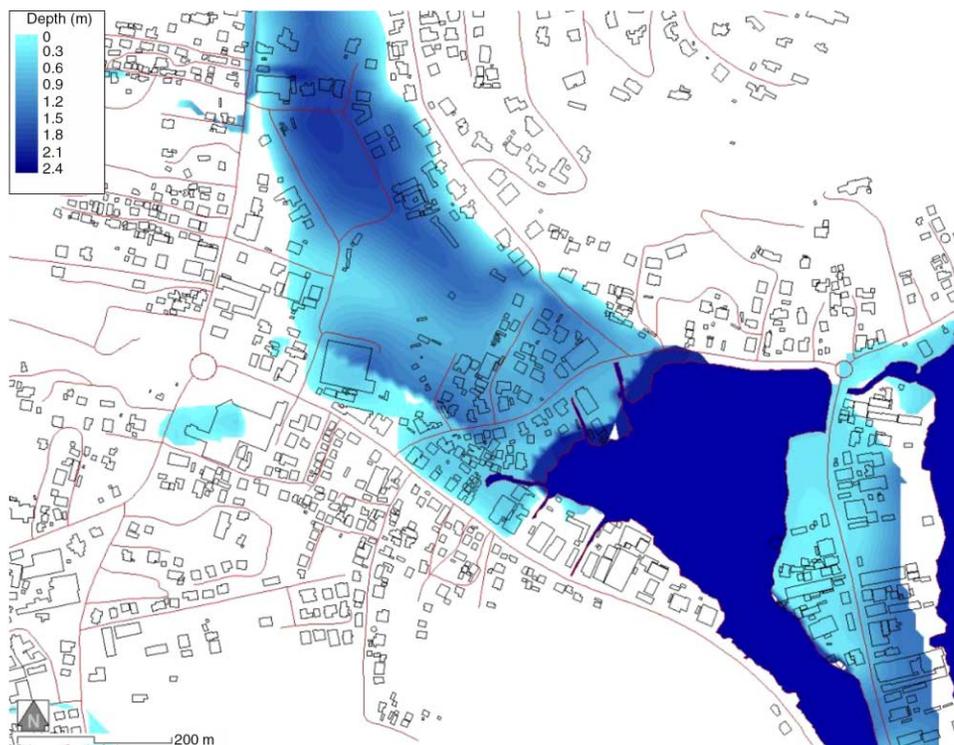

Figure 1 | A GIS representation of computed water depths.

technologies can be of a vital importance in the overall flood management and disaster coordination activities.

Providing sufficient computational power is available, the GIS tools can be used to process either on-line (i.e. real time) or off-line flood-related information to anyone concerned. In a thesis of Fikri (2006) a web-based GIS application for flood warning has been developed and described. In this thesis, it was demonstrated how the GIS layers containing valuable flood information can be displayed graphically on a designated website by using the appropriate technologies. Further examples of how such material can be presented so as to satisfy the requirements given earlier here are given on the following web-site: http://www.hydroinformatics-community.org/j/10.2166/ hydro.2009.065.

This study shows that web-based geo-information systems are already valuable and powerful tools for the collection, management and analysis of flood-relevant information. Mobile information technology (mobile phone, PDA, SMS/MMS) is a natural solution to conveniently disseminate information to those concerned.

Therefore, by combining the knowledge and technology of both mobile and geo-information systems to build a mobile internet, GIS-based application for flood warning and information systems will provide new means to manage urban floods, saving much damage, injury and loss of life.

THE TRANSMISSION OF CONTENT WITHIN PARTNERSHIPS

Once again, however, this work indicates already that this problem of transmitting content cannot be properly posed, let alone answered, in written form, but must be demonstrated and emulated by references to other ways of realising processes of semiosis, thereby introducing new didactic instruments again. In this case our preferred reference is one of the most widely printed and distributed of all strip cartoons, namely those of George Rémy, with the pseudonym Hergé, built around his fictional young detective-reporter named Tintin. This choice is made on the basis of a record of some hundreds of millions of books sold in,
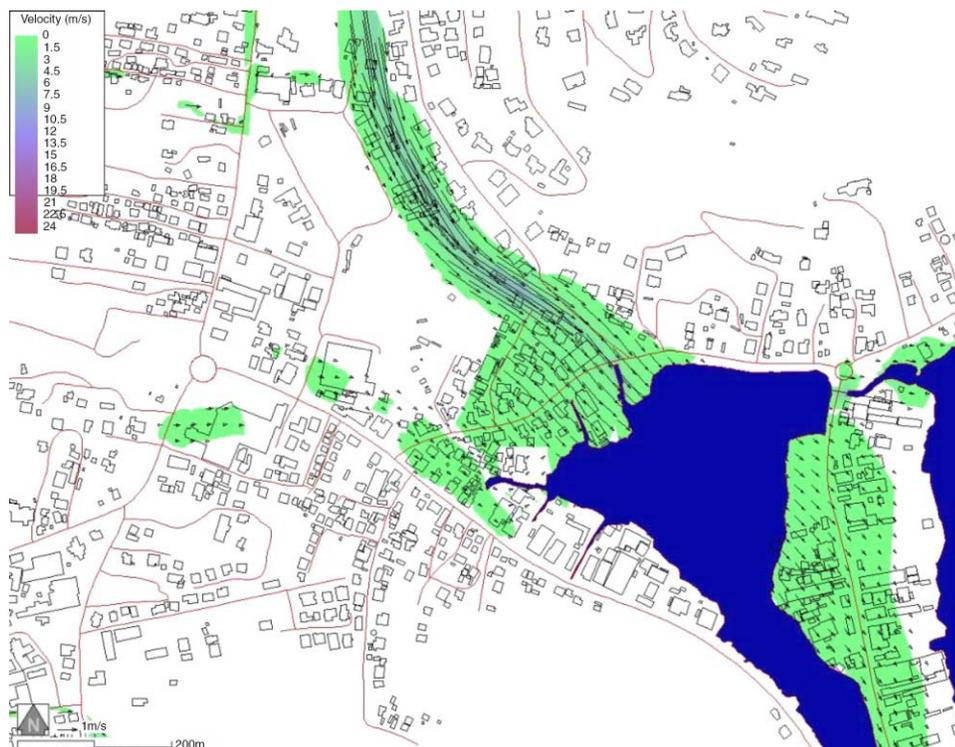

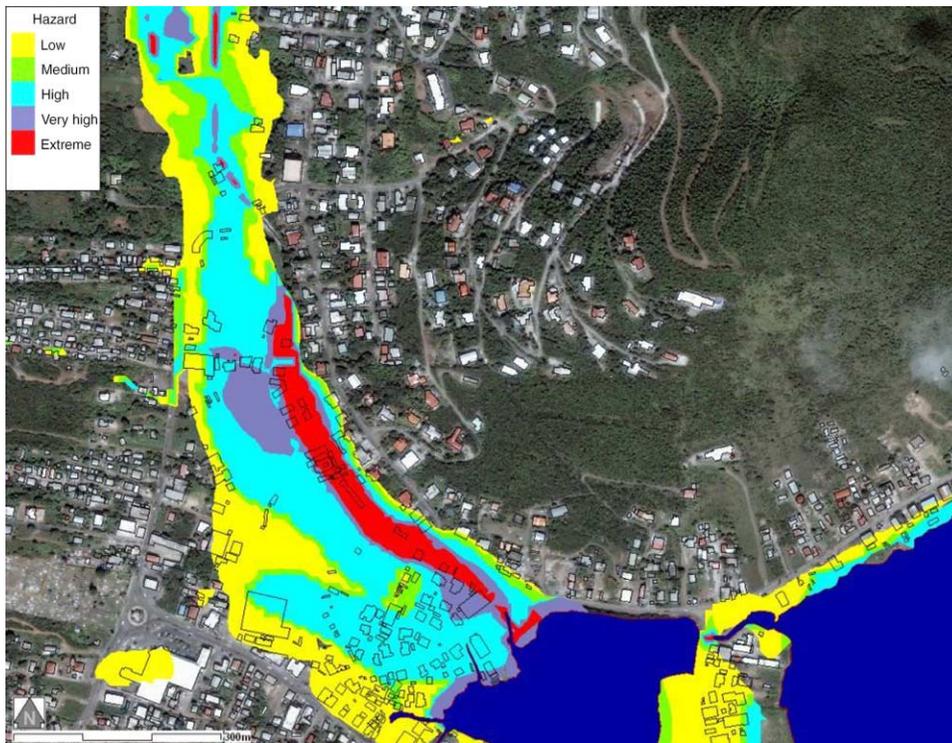**Figure 2** │ A GIS representation of computed velocities.

Figure 3 | A GIS mapping of flood hazards. Different hazard categories have been mapped by the use of advanced GIS techniques to include both of the flood-related variables, namely depths and velocities.

at the last count, 48 languages and major dialects world-wide, besides many corresponding film and television productions. What is essential here is the relation between ends and means, of resources and objectives translated into the relation between representation and tacit understanding as the imagination is developed, as can be so conveniently followed within these environments. Thus, not only is Tintin instantly recognisable by only some four or five strokes of the pen or brush, but a happy Tintin, an angry Tintin, a puzzled Tintin, or whatever other state of his being, is depicted in only seven or eight such strokes. This is then a study in *the economy of the graphical representation*, exemplifying the pre-processing of the image in such a way as to emphasise its symbolic qualities and so functioning as a new kind of paradigm case. For those who find this trivial or superficial, it should be mentioned that artists of the calibre of Leonardo da Vinci and Rafael drew and coloured cartoons, albeit within an entirely other artistic context. In such cases we are again dealing with transcendental states, albeit at the æsthetic level but now far

removed from those identified by Kant, and indeed in Kant such phenomena as these would come more under the aegis of *the sublime*. Within this environment we are indeed closer to the artistic than we are to the scientific, but then in the understanding that:

> *Art is a game that mankind plays with itself in order to learn a new way of experiencing the world*

This leads us to a consideration–which is really more suited to another study–of the agent or agency that can bind the kind of initiative considered here and its future halo partners together in a multiply connected structure of shared endeavours. What then is the "glue" that can hold the structure together under the stresses and strains of collective business initiatives and operations? What, in effect, is the relevance of *partnerships* in this field? As soon as we even so much as pose this question, however, we are back with another work of Lacan that considers this problem within the general context of praxis, albeit with

psychoanalysis as its paradigm case. Of course, this question has a simple and even trite response, to the effect that this "glue" must consist of "a shared ethic" as well as a common interest, but as Lacan explained, this "ethic" must satisfy certain very demanding conditions if it is to consist of anything other than empty platitudes. Clearly, the essence of the ethic in any person or organisation must reside and be sought in the corresponding thoughts and the thought-related reactions as well as actions, rather than in the words. Lacan explained that in his case, of psychoanalysis, this called for a new way, and then not just of thinking but also of Being, and this call comes to correspond to our accepting, again not only a new way of thinking, but also a new way of Being in our own field. Thus, at the very outset of Lacan (1959–1960/1986//1992/2008):

New in relation to what? New in relation to something that is both very general and very specific. Very general to the extent that the experience of psychoanalysis is highly significant for a certain moment in the history of man, namely, the one we are living in, although this does not imply that we are able–far from it–to specify what the collective work we are engaged in means. Very specific, on the other hand, like our daily work, namely, in the way in which we have to respond in experience to what I have taught you to regard as a demand, a patient's demand, to which our response gives an exact meaning. And in our response itself we must maintain the strictest discipline, so as not to let its deeply unconscious meaning be adulterated by that demand.

Lacan pointed to the necessity of such a position as opposed to what he called, following an expression of one of his contemporaries, *the morbid universe of transgression* (using *"transgression"* as the translation of Lacan's *"la faute"*). Lacan then observed that (with italics added): "In fact, what we are dealing with is nothing less than *the attraction of transgression*". It was Lacan's observation of the almost universal presence of this "natural/unnatural" attraction, that is so familiar from theological studies of nothingness and the philosophy of nihilism, that led him also to observe that "not everything in ethics is simply related to the sense of obligation". Put very bluntly, what we are seeking here is a Self, as a Being-in-the-world, that

proceeds actively against this "universe" of transgression and exposes the essential nature of the "transgressions" themselves and the premises upon which these are based.

What Lacan emphasises, however, is that the libidinal resources that drive this censoring activities are themselves nurtured by the desire that we have introduced earlier as the desire of the modeller in the modelling process. This will be just as familiar to those whose desire is satisfied by physical models as it is by numerical models, as the kind of desire that proceeds in any praxis. Thus, returning at once to Lacan (and again with italics added):

It nevertheless remains true that analysis is the experience which has restored to favour in the strongest possible way the productive function of desire as such. This is so evidently the case that one can, in short, say that *the genesis of a moral dimension in Freud's theoretical elaboration is located nowhere else than in desire itself*. It is from the energy of desire that this agency is detached which at the end of its development will take the form of the censor.
Thus something is enclosed in a circle that was imposed on us, deduced from what is most characteristic in our experience.

We are here confronted with a resemblance to a Hegelian dialectic, whereby desire breeds transgression and through this passes ever to a delimitation of transgression. There is, however, a more authentic resemblance to the twin "movements" described by Kierkegaard and as introduced earlier here, which however proceed at a totally other level, at the level of the religious: first the *infinite movement* that raises up the spirit to a transcendental level of consciousness and then, secondly, the *finite movement* that takes this consciousness back into the everyday world, which in our case is the world of praxis.

Thus what we are looking for in our partners and what they are looking for in us is *this more mature desire*. We are not looking only towards knowledge but also towards an irreducible understanding in this deeper sense. This then is the essential nature of the bonding and binding agency that must operate between the knowledge provider and its partners, and this has yet another economy again.

THE DISTINCTIVE NATURE OF SAAS IN THE PRESENT CASE

It should be clear already that this movement within the SaaS paradigm *is not only different, but totally different* from those of almost all current business applications, such as are exemplified by the various functionalities of Google and more generally pass under the name of *Application Service Providers* (*ASPs*). This difference resides at the most basic level of all, at *the level of intention*, giving rise to a totally other *structure of intentionality* in the sense resurrected from the Scholastics by Brentano (1930) (see the selection with commentaries of Oskar Kraus, of 1930). This difference has been already mentioned above, following Abbott (2007) and Abbott & Vojinovic (2009), while drawing upon what Heidegger had introduced as the difference between *deficient and sufficient modes of solicitude*. This essential difference can now be defined succinctly as follows (Heidegger 1927, pp 122, 123//1962, pp 158, 159):

> [Even] with regard to its positive modes, solicitude has two extreme possibilities. It can, as it were, take away 'care' from the Other and put itself in his position in concern: it can *leap in* for him. This kind of solicitude takes over for the Other that with which he is to concern himself. The Other is thus thrown out of his own position: he steps back so that afterwards, when the matter has been attended to, he can either take it over as something finished and at his disposal, or disburden himself of it completely. In such solicitude the Other can become one who is dominated and dependent, even if this domination is a tacit one and remains hidden from him…
>
> In contrast to this, there is also the kind of solicitude which does not so much leap in for the Other as *leap ahead* of him,…not in order to take away his 'care' but rather to give it back again to him authentically as such for the first time. This kind of solicitude pertains essentially to authentic care…; it helps the Other to become transparent to himself *in* his care and to be *free for* it.

This is, of course, in no way meant to disparage the social value of the many ASP businesses and SaaS tools and their functionalities that we ourselves often find so useful nowadays, but only to emphasise *the difference in intentions* between the ASP services that are offered with SaaS tools and the services that are being considered here. The intention of the one is in the first place "to create dependence" through offering these services; while the primary intention of the other is "to empower"; and of course these are situated in two different worlds. This has recently been demonstrated on the scale of between two and three million stakeholders as active participants in the Obama election campaign, where SaaS played a much publicised pivotal role, and this same difference permeates everything that we are doing in the present connection.

THE ENVIRONMENTS PRESENTED THROUGH THE GRAPHICAL USER INTERFACES

The subjects of the graphical interfaces with which we are occupied here are not just environments of rivers and wetlands, fields and forests, or houses, gardens and streets, but *they are essentially environments of care and of caring*. If they are not this then they are not relevant within the present context. The user, the stakeholder, has to be able to associate the block on the screen with his or her house, his or her home; and the space around it with his or her garden, his or her "holy place", his or her Temenos; and he or she must connect the space that runs from home to home with his or her street and thereby with the persons of his or her neighbours. The walls and roofs depicted in perspective on the user interface as *objects* have to be transformed in the mind of their viewer, through what Category Theory calls *functors*, into things of both intrinsic and social value, so that they must be experienced both individually and in their social unity specifically as *symbols*. As a symbol, *qua* symbol, this unity must *displace* the original object as it comes to be symbolised in the mind of the user (Abbott 2002). In the same vein, the water flows and inundations must be represented dynamically, with the velocity of the flows marked by moving "particles" and their elevations marked by their relations to familiar objects, such as walls of houses, churches and other such structures. This is again the exercise of what has been introduced earlier here, following Corbin [1958/2006//1969/1998, p 80] whereby

"the *active imagination guides, anticipates, moulds sense perception; that is why it transmutes sensory data into symbols*". Returning once more to Kathleen Rayne as we now must, we see again, but now more clearly, how:

Symbols speak to the soul... 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... 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 … very seldom in verbal form, and more often visual than verbal.

This is, of course, the whole *raison d'être* of the graphical user interface within this kind of environment. In such a case we sometimes speak rhetorically of a *visual onomatopoeia*. But then we must again return to Kierkegaard who, whenever confronted with the mass, the crowd, the mob (*Mængden*), always tried to break it down into individuals, and who correspondingly dedicated all his books to *hiin Enkelte*, the one, the individual, who he had the honour to call "my reader". It is correspondingly again essential to avoid any inclination to euphoria about numbers such as would entail a loss of the individual critical faculty. This is essential because it is only at the level of the one, the individual, that it is possible to transmute the object into the symbol in this authentic sense: it is then not so much the value of the object in the outer world of social or extrinsic values, but the value of the symbol in the inner world of personal or intrinsic values, that counts within this environment. The discourse that is conducted within the stakeholder group is correspondingly conducted in what is essentially a language of symbols, that

is, a symbolic language, and it is only at this level that it can lead to transcendence. It is this that then provides *a commitment to the common cause* of social justice across the stakeholder group.

The specific danger that appears at this point is that the environments that are presented are indeed not experienced as symbols at all, but only as allegories; that the focus of attention remains upon the objects and does not make the jump to the symbolic, so that "the spirit of the place" is not experienced. In much the same vein, the flooding and consequent destruction is in such a case experienced only as a phenomenon, an event, a state of affairs, and not as the mayhem of destruction, injury and death that it is in the real, outer world that is so represented. The hydroinformatician has here to take a position concerning what in a post-modernistic parlance is often called "the experience economy". Rejecting even some dictionary definitions, Corbin (1958/2006//1969/1997, p 14) explained the risk that is inherent at this juncture as follows (with italics added again):

At this point we must recapitulate the distinction, fundamental for us, between allegory and symbol; allegory is a rational operation, implying no transition either to a new plane of being or a new depth of consciousness; it is a figuration, at an identical level of consciousness, of what might very well be known in another way. The symbol announces a plane of consciousness distinct from that of rational evidence; it is the 'cipher' of a mystery, the only way of saying something that cannot be apprehended in any other way; a symbol is never 'explained' once and for all, but must be deciphered *over and over again*, just as a musical score is never deciphered once and for all, but *calls for ever new execution*.

It follows correspondingly that static images, such as are necessary in a book or journal, are inadequate for the purposes of illustrating the processes that are in play here and correspondingly a site is being established together with this paper, as will be announced in the *Journal of Hydroinformatics*, that will provide some dynamic simulations of situations that have arisen and will arise in the St Maarten paradigm case. This site will be upgraded in time, as something active, creative, or, in a single word,

poietic, thereby transcending the limitations of the printed text and again making possible that which would otherwise be impossible.

CONCLUSIONS

The realisation of social justice in the water sector of the human economy, and then by surrogation also in the natural economy, necessitates a new kind of hydro-informatics that is introduced here as *the hydroinformatics of the qualities*. Its corresponding mathematics is then a mathematics of the qualities rather than of the quantities, for which *Category Theory*, with its extension, so far unexplored within the present perspective, to *Allegory Theory*, provides a paradigm case (e.g. Freyd & Scedrov 1990). Although its mathematical formulation has been avoided in this paper for reasons of space (referring only to Abbott (2000) on the gender issue in hydroinformatics and Abbott (2002) on the definitions of words used in hydroinformatics) it is particularly well suited here also to the representation of the processes involved, providing (like the geometries before it) *the required mathematics of the qualities*. However, unlike these preceptors, it also has its own transcendental, as expressed by its introduction of the concept and operation of a *natural transformation*. We can only recall here, from Abbott (2000, 2002) that any category, such as a speech act, can be given a structure defined by two unary operations, a binary partial operation and five axioms. One category can then be mapped into another category through an isomorphic transformation, such as from a speech act into the intrinsic or personal value of the speech act, or from this same speech act into its extrinsic or social value. Each of these transformations constitutes a *functor*, as exemplified earlier here. It is then the mapping that takes one such functor into another such functor that is called by the name of "a natural transformation".

An analysis of this mathematics of the qualities was provided and further investigated in a remarkable essay *Sur l'idée de concept mathématique 'naturel' // On the idea of the mathematical concept of 'natural'*, in which the French mathematician Gilles-Gaston Granger (1994, pp 157, 158) explained this significance of the word "natural" that is used here, as follows:

Mathematicians, who do not usually show much repugnance about using metaphors, have not made much use of the word 'natural'. In more recent times, in French, one could at most make a case for the expression 'fundamental transformation' in Category Theory. The word seems then to refer to a univocal determination of a correspondence that is transposed from one universe of mathematical objects to another; but in this sense it is generally the adjective 'canonical' that is utilised… It is however a more ancient, traditional usage of this adjective 'natural' that serves as the starting point for our commentary; [such as is used when] one speaks of 'natural numbers'…

The first characteristic that appears to justify at least provisionally the introduction of the concepts of 'natural' is that these are immediately *present* before any mathematical elaboration, at one and the same time as tools and objects of thought at the centre of our spontaneous activity…

And this that we call their 'presence' signifies the fact that they have to be shown and employed in an *experience*, which we shall try to show does not demand anything of the senses but must be recognised as an *intellectual intuition* [as an intellectual *experience*].

The remarkable thing for us is that these mathematical theories, or ways of thinking mathematically, need not necessarily be associated with conventional mathematical objects, but can be applied to objects, such as the special aptitudes of women and the conventions of words, that are not "mathematical objects" in any normative sense. Thus, the word "natural" refers to "what was given at the creation" in the religious view of the world, and this is a precedence that it shares only with the natural numbers, which again cannot be defined, being intellectual intuitions or experiences "given at the creation", and so "natural" (see Manin 1977, p 17). We are of course using these terms in the sense of foundation-mythical components of a religious discourse, and there can be no suggestion here of any kind of popular "creationism" or other such current debasements of religious experience: we may indeed here recall Jaspers' celebrated "Nicht Vernichtung, sondern Wiederherstellung der mythischen Sprache ist der Sinn"//"Not the destruction, but the restoration of the mythical language is the

objective" (see Jaspers & Bultmann 1954, p 22). We are similarly using the word "myth" in a standard anthropological sense, as an easily translatable grand narrative with exceptional longevity, commonly measured in centuries and often in millennia (e.g. Lévi-Strauss 1958, p 232). As usual, Pascal had expressed much the same thing some 300 years earlier (Pascal/Lafuma 1670/1962/2003, p 469):

Il n'y a rien qu'on ne rende naturel. Il n'y a naturel qu'on ne fasse perdre.
(There is nothing that we can render natural.
That which is natural is that which we cannot lose)

As observed earlier, the study of processes of the kind described here are not suited to "the languages of average intelligibility" that are almost all that now remains for the purposes of discourse in the West. However, in most of the rest of the world there are languages that are far better suited to this task and within these languages it is possible to provide much simpler and more direct representations, as adumbrated by the references to Corbin in the text and the concept of "natural" above. These are the languages of *a third economy* and these must be mentioned in conclusion, referring to Abbott (2008*a*) for more details and examples. For a thorough analysis of what is reducible to logical thinking in humans and what is irreducible, as initially set out following the publication of the *Logique de Port Royal* of Arnauld and Nichole in 1662, see Marin (1997, especially pp 161–195): we are then already leaving the more familiar Cartesian universe and entering into a much less familiar Pascalian one. For a study of the more general intellectual "tectonic shift" that occurred in Western thinking around the same time as the *Logique*, see Michel Foucault's Les mots et les choses (1966//1970), literally meaning *The Words and the Things* (but most unfortunately translated into English under the title of *The Order of Things* for copyright reasons).

We have earlier observed that, to the extent that we can descry any structure at all in something as diverse and inhomogeneous as the human economy, so we might characterise it as a *subset of the natural economy*. For the greater part of humanity, however, this all-embracing natural economy is founded upon *another economy again*, which created and continues to support the natural economy and with this the human economy, but then in such a way that it makes its presence known to those humans within the first economy who are charged by this "other economy" with sustaining and supporting the "second economy". This "other economy", this *Third Economy*, this third support that has served to preserve the stability of the other two economies for as long as human existence can be traced, and continues to sustain some semblance of stability even in the West today, is commonly subsumed within the general category of *the religious* to the extent that it is concerned with "the divine governance of the world", to use the *Shorter Oxford Dictionary*'s definition of 'economy' in this sense. In the *Greater Webster's Dictionary* it is defined as an economy in this same sense in a more Christological manner as "God's plan or system for the governance of the world…; a special divine dispensation suited to the needs of a nation or period". From our human, all too human, perspective, "the religious" is then that which constantly transcends its own self, so that it is inherently paradoxical (e.g. Jaspers & Bultmann 1954; compare pp 45 and 68). The term "economy" itself refers back to the Greek word for the governance of the household, as *husbandry*, implying as it does an attribution of values, so that it corresponds to the positions of *steward, servant* or *proxy* used earlier in this paper.

It is within this perspective that we are obliged to mention the totally other view of social justice that then appears when the existence of this Third Economy is accepted, and so in most societies other than those of the West. It is then usual to speak of *The City* that is at the centre of any such *Economy*, so that we must then relativise, and even compromise, everything that we have written above by giving a moment of expression to this other view, even while understanding that it will find little resonance in the West. We shall follow here Rowan Williams, the current Archbishop of Canterbury, when he writes (Williams 1978/1990/2002):

The city of man, the *civitas terrena*, is built in self love, out of the human desire to make order and intelligibility and rest upon their achievements. And so two kinds of love have constructed the two cities: the earthly city, built by love of self leading to contempt of God, the

heavenly city by love of God leading to contempt of self… The earthly city is built by those who are confident of their control, not only over their own biographies but over the whole human world. And this attitude Augustine rejects as fiercely in the social as in the individual sphere. Social good *is* good, peace and justice *are* to be sought with passion; but with …the recognition that they are not to be considered as signs of human glory, human authority, human capacity to tame the world…If sought and 'enjoyed', loved for their own sake rather than …directed to a greater end …, their precariousness is at once obvious, and destructive misery follows for those who put their trust in them… Those who look for a home of their own making secure only their own deepest alienation and homelessness.

It is such considerations as these that indicate that, insofar as a hydroinformatics of the qualities develops, there must occur a division, even if initially only at the *socio*-technical level, between a hydroinformatics that "begins as a European possibility" (Abbott 1991, p 76) and, in the first place, an Asian hydroinformatics. This is because in Asia, in particular, the social–spiritual environment is so different from that of the present-day European peoples(and this difference, contrary to so much Western wishful thinking, is becoming ever greater by the day (see Abbott 2008*b*, 2009).

ACKNOWLEDGEMENTS

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