

## Towards a hydroinformatics for China

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### ABSTRACT

The relation of hydroinformatics to modern science is considered in relation to the origins and nature of modern science itself and to the technology that has assured the predominance of the European peoples over the peoples of most of the rest of the world for some 250 years. The current increasingly rapid reversal of this predominance is introduced with special reference to Asia in general and China in particular. This reversal is seen as a consequence of a transmutation in societies generally from modern conditions to postmodern conditions. The relation between knowledge providers and knowledge consumers is then introduced and related to the advent of the Internet and further to the World Wide Web, and further again to mobile devices. It is explained that the numerical predominance of China in access to the Web and to mobile telephony has proceeded alongside Chinese government initiatives that have supported this social development. The present contribution follows upon one with the same main title that was directed specifically to the Islamic world and another directed more generally to North-East Asia. Since this paper is directed almost exclusively towards China, it traces some developments currently occurring in China that exemplify its theses.

**Key words** | internet, knowledge societies, Software-as-a-Service

### INTRODUCTION

The subject of hydroinformatics was launched in 1991 in a book entitled *'Hydroinformatics: Information Technology and the Aquatic Environment'* (Abbott 1991). There already it was emphasised that this subject could not be described completely within the limits of 'modern science'; and even less could it be reduced to a study of what was orderable, numerable, countable and computable, but must encompass other dimensions of human and other-natural existences that could never be described in this way. Correspondingly, even though 'modern science' appeared as a product of the European peoples, having its first definitive formulation in the *Condemnation* of the 7th of March 1277 by the Western Christian Church at the University of Paris (e.g. Gilson 1950, 1980, 1982; Böhner & Gilson 1954; Copleston 1962, 1963; Duhem & Brenner 1997) it in fact drew heavily on Islamic and Judaic sources, which in turn derived from the profound Asian insights, understandings and values. This became, however, a science that increasingly strived to be 'totally

objective', aiming to possess no subjective elements; it correspondingly excluded all subjectivity. The predominance of this 'modern science', as it spread across the world, emanated however much more from its marriage with a technology that developed also in Europe. Indeed technology itself came to be identified in the West with 'applied modern science', thereby raising this science to the level of an ideology – and even for some people to an idolatry – that was geographically unconstrained, and indeed was regarded as 'universal'. As Heidegger (1963/2002/1977) observed, such a technology becomes itself mathematical in the quantitative sense even before it is cast into mathematical form. It was this restricted view and its quantitative objectivity that was castigated and rejected already in the *Hydroinformatics* of 1991, where the ideological foundations of this view were already exposed following earlier denunciations by other authors. These denunciations have now become increasingly strident (e.g. Newcomen Society 2009).

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The foundation, such as it was, for this notion of the supremacy of one particular essentially European view of the world of man and all his artefacts, and of nature as a whole, was its success in subjugating and to a large extent governing the rest of the world directly, so that at its apogee the Atlantic nations among the European peoples had dominated almost the whole world, with only parts of Asia left, but even there with much reduced economic, intellectual and spiritual independence. In social terms, this led to the illusions of the European peoples described by Nietzsche and paraphrased by Heidegger (1967) and as quoted in the *Hydroinformatics* of 1991 (p. 61) (Abbott 1991) as follows:

‘All the values that we [the European peoples] have so far introduced in order to make the world so estimable, and then finished up by devaluing them when they showed themselves to be untenable – all these values are, when worked out psychologically, really only results of our taking definitive perspectives on the usefulness of raising up and magnifying an image of our own domination, and these values are only falsely *projected* as being of the essential nature of things. It still belongs to the *extravagant naivety* of man that he puts himself up as the purpose and the measure of everything.’

In European philosophy, this behaviour has been associated since the end of the eighteenth century with what is called *nihilism*, while in Christian theology it is associated with what is called in English *nothingness* (in French *le néant* and in German *das Nichtige*) as something that is inimical to goodness and antagonistic to the world of humanity and its fellow creatures here on Earth, that is, to ‘the creation’ (e.g. Barth 1938–1950//1961; Heidegger 1967). The economic consequences as nihilism and nothingness spread within the European peoples were of course disastrous for the world outside of these peoples, and ultimately, through economic catastrophes and world wars that originated primarily from the actions of the European peoples, they were disastrous to these peoples themselves.

In order to introduce the historical framework, let us begin by following how the geographical distribution of some measures of production of materials that are essential

to manufacturing in the human economy changed over time during the period of the supremacy of the European peoples. We shall take as the best known precursor of such measures the set of estimates of world manufacturing output made by Bairoch & Lévy-Leboyer (1981) and as extended and commented upon by Paul Kennedy (Kennedy 1989) (see Abbott 2008b). Bairoch showed how, even as Europe’s share of world manufacturing output increased from 23 to 62% between 1,750 and 1,900, what we now call for the most part the developing world decreased from 73 to 11%, with China falling from 32.8 to 6.2% and India/Pakistan from 24.5 to 1.7%. Although these falls were clearly equated with an interaction between a rapidly ongoing industrialisation in the West and the colonisation of almost everywhere else, leading into the era of imperialism with the associated subversion and destruction of the industries of what then became the Third World by the European imperialist powers, it was indicative that Japan’s share also fell from 3.8 to 2.4% even though it was not so directly occupied or otherwise so completely dominated by military and naval force. Similarly, taking per-capita levels of industrialisation with the UK’s level providing a reference value of 100 in 1,900, whereas the UK itself passed from 10 in 1,750 to this reference 100 in 1,900 and Europe as a whole from 8 to 35 and the USA from 4 to 69, China fell from 8 to 3, India from 7 to 1 and that of the Third World as a whole from 7 to 2. Thus, with Kennedy (1989, pp. 147, 148):

‘Hence Bairoch’s remarkable – and horrifying – suggestion that whereas the per-capita levels of industrialisation in Europe and the Third World may have been not too far apart from each other in 1,750, the latter’s was only one-eighteenth of the former’s (2 : 35%) by 1,900, and only one fiftieth of the United Kingdom’s (2 : 100%).’

It is in now, however, abundantly clear that a major change is occurring in the human economy at the global scale. This change is associated in the first place with changes that are occurring with an extraordinary rapidity in the balance of economic power between continents and, correspondingly, with rapid changes in the distribution of performative knowledges across these continents. Of course, almost everyone is aware of something called ‘Asian competition’,

but the politicians and the media of the European peoples do everything possible to misrepresent and obfuscate the nature of this competition, explaining it away by references to ‘cheap labour’, to ‘undervalued currencies’ and other such chimeræ, explanations that are risible for anyone who is at all acquainted with the nature of competitive advantage in post-modern conditions of society and are acquainted with more recent and concurrently ongoing Chinese, Indian, Korean, Brazilian and Vietnamese practices in particular.

From the point of view of industry generally within Europe, it has become necessary to explain the essential nature of the new kind of competitive advantage enjoyed by these Asian societies, explaining its sociotechnical foundations and so basing itself upon a proper understanding of the new relations that are arising between people and equipment within societies that are moving into what are now widely called ‘post-modern’ social, and essentially sociotechnical, conditions. In these more general terms, it has then become necessary to trace the *transformations*, which correspondingly become *transmutations*, of present-day societies that are based upon promoting ever larger numbers of ‘knowers’ (as so-called ‘knowledge societies’) into those that are promoting ever larger numbers of ‘consumers of knowledge’, as experts in the acquisition, employment and disposal of wide ranges of knowledges (as ‘understanding societies’) (Abbott *et al.* 2006). It is within the context of this development that at least some of us need to emphasise the urgency of attaining to a proper evaluation of the dynamics of the rise, in particular, of the so-called BRIC (Brazil, Russia, India, China) nations, and then that we cannot be so much concerned with the speed with which this is proceeding, but with *its acceleration* and the way that it is extending its influence to ever higher levels of scientific, technical and more general social endeavour. In fact we can identify and characterise a specific combination and interaction of processes that are driving this acceleration and these need to be understood both in themselves and in their interactions. It is nothing like enough simply to compound growth rates, but it is necessary to understand the various, essentially qualitative, factors that have come into synergy as they drive this transformation in the so-called ‘balance of economic power’.

## THE CONSEQUENCES FOR HYDROINFORMATICS

It was a consequence of the earlier and at that time still continuing domination of the European peoples that in the *Hydroinformatics* (Abbott 1991), it was observed that:

‘Now of course the manifestations of an ever-increasing nihilism are by no means features that are peculiar to the European peoples. By no means are they this! Nihilism is however centred upon Europe; it has a focus, in the same way as does a physical sickness, and this focus is situated in the collective psyche of the European peoples. Then, in so far as hydroinformatics constitutes in its essence one part of the total field of contest with nihilism, so it follows that *hydroinformatics begins as a European possibility.*’

At the present time, now more than 20 years on, hydroinformatics has taken much of the high ground in studies of ‘water resources’ among the European peoples, as evinced by its publications and its ever more successful conferences and other such events. At the same time it has developed a commercial component employing some thousands of people, the great majority of whom have university degrees and a large proportion of these again possessing doctorates. However, hydroinformatics in the West has reached a certain limit in the sense that it remains almost completely bound within the world of the quantitative and, correspondingly, it remains moribund in face of the new and immense challenges with which the rest of the world, in particular, is confronted, being apparently unable to grasp the possibilities which the equally immense developments in the communications technologies, in particular, have opened-up for it. This hiatus in its development is not one that is caused by the shortcomings of modern science and its employment in technology, but arises from deeper social constraints that are increasingly imposing themselves upon its thinking. It is left marooned within the world of the quantitative, unable to move on into the world of the qualitative. It is unable in practice to meet the needs of the world’s populations for healthy diets and sound medical care; it is unable to confront the need to maintain the world of nature in any kind of sustainable, let alone pristine state; it cannot confront the problems of realising social justice in

the availability and use of water; and so we can go on ... and on. Consentaneously, hydroinformatics has now indeed to move on from its European beginnings and to come to maturity within quite other kinds of social environments, which comprise, in the first place an Asian social environment, but then, in a close second place, a variety of Asian social environments. The most obvious distinction in this second place is that between an Islamic world, which is really quite socially inhomogeneous in itself, and that which we can only describe, even more indiscriminately again, as a 'non-Islamic world'. The first has been considered elsewhere (Abbott 2008a) and it now becomes necessary to touch upon the second, while still necessarily specialising further in this place to East Asia, and even, specialising yet further again, to China. In its socio-technical applications, hydroinformatics becomes socio-geographically dependent, changing from region to region and even from country to country as the societies in which it operates change in space, and at different rates in time too. In this way it has the capacity to provide one of the means to restore these regions and countries to their traditional predominant positions. A historical view of this within the discipline of mathematics is given in Chemla and Shuchun (2004).

The most striking feature that currently differentiates all developments within Asia from those of Europe in our field is that they have no truly indigenous industrial component. Of course there is a DHI China, with more than a hundred technical and scientific staff in Shanghai, but that is still primarily based upon a European model of research and development that continues to think and work almost entirely within the world of the quantitative. However, hydroinformatics is increasingly working within the world of human societies and, if only by surrogation, in natural societies again. It then has to take a full account of human feelings and emotions; it has, for example, to create web-based environments that will catalyse those individual and collective social processes, primarily those of active stakeholder participation, whereby higher states of consciousness mutate into higher states of conscientiousness, so that what appeared in the abstract as technically impossible now becomes sociotechnically possible (Abbott 2007; Abbott & Vojinovic 2010; Vojinovic & Abbott 2012). Whoever speaks of society nowadays speaks of communication and this is

becoming ever more evident by the day. And this is all about qualities no matter how much it makes use of quantitative measures and computations in creating, for example, its increasingly multi-user and so mass-customised graphical interfaces. Just as the hydroinformatics of the quantities was associated primarily with computers, so the hydroinformatics of the qualities of today is associated with the ever more extended World Wide Web, the graphical user interfaces of its tools and, increasingly, with location-aware mobile-telephonic devices with photographic capacities. This whole process is commonly regarded as falling under the one heading of a Software-as-a-Service (SaaS) paradigm. The position that is taken here is that this direction is the one that Asia as a whole, and North-East Asia in particular, can best take in order to develop indigenous industrial sectors in this field. The development of these sectors within the respective countries is seen as concomitant with the healthy and harmonious development of socially relevant academic teaching and research. This is manifest in a Chinese-proposed translation of the second edition of *Computational Hydraulics*, the Chinese translation of the first edition having long been employed in Chinese universities.

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## THE SAAS PARADIGM AS A BUSINESS PROPOSITION

In order that an organisation may live by being a knowledge provider, it must have a higher level of knowledge than its business environment of knowledge consumers. The notion of 'a higher level of knowledge' implies that the knowledge provided must be relevant to the consumer and that it should in most cases be actionable, that is, it should enable the consumer to take responsible actions that he or she would not otherwise be able to take. Since such knowledge must then be relevant to the consumer, there must be a relevance relation between the provider and the consumer. If the relevance relation is a close one, the 'distance' between the knowledge of the provider and that of the consumer is small, while conversely, if the relevance is a distant one, this 'distance' between the provider and the consumer will be correspondingly greater. The difference between the knowledge level of the provider and the knowledge level of the consumer divided by this 'distance' between

them, as expressed in terms of the relevance relation between them, is called the knowledge gradient. In general then, analogously to the flow of water under gravity, the greater this knowledge gradient, the more that knowledge will tend to flow from the provider to the consumer. To the same extent that this knowledge is actionable, so the greater is the value of the flow of knowledge from the provider to the consumer.

This flow, however, can then be augmented by increasing the number of consumers and the rate at which they consume knowledge. Correspondingly, the value of the provider increases with increasing numbers of consumers and with the frequency with which they consume the proffered knowledge. Since these numbers increase the more the same knowledge is used and reused, time and time again, so the value increases further with the rate of circulation of knowledge through the provider. This is simply to repeat the economic principle of the mass production of material goods, as encapsulations of knowledge, but now exponentiated several times to apply to knowledge itself.

Thus, if the knowledge gradient is small, the knowledge must circulate with great rapidity in order for the organisation to be commercially viable, as in the case of producing and selling hamburgers, and if the knowledge gradient is large the rate of circulation may be substantially lower even while the organisation still remains viable, as in the case of software-package producers and most consulting engineering companies. A coefficient of proportionality may then in this case be introduced to provide a notional cash flow generated by the knowledge concerned.

Correspondingly again, the value of its knowledge to a knowledge-providing organisation is proportional to the sum over all consumers of the products of their knowledge gradients and their rates of circulation of knowledge. The coefficients of proportionality that relate this to the money income are measures of the social values of knowledge provided to the consumers. In practice, to date, the benefits accruing from the one hundred times increase in circulation of knowledge when moving from one generation to the next has been split between the consumer and the provider. As introduced in Abbott & Vojinovic (2010) for the case of numerical modelling, on the side of the consumers the costs have been reduced by roughly one order of magnitude, while on the side of the provider the returns on investment

have increased by roughly an order of magnitude also, thus enabling the provider to upgrade its products and services and so in turn increase the relevance of its offerings to the consumer and thus their value. The improvement in the value proposition that is thereby realised at each paradigm shift – which is again an essentially qualitative assessment – makes the productions of the knowledge provider increasingly irresistible. The social changes that are now occurring in China, as introduced here later, should make possible a massive increase in the use of the web-based systems that we call fifth generation systems, as introduced in Abbott and Vojinovic (2010). These developments, however, will almost surely lead to a wide range of halo-situated applications, passing from agricultural and medical advice-serving systems (e.g. Abbott & Jonoski 2001) through mobile-insect, bird and animal migration simulations (e.g. Abbott & Warren 1974) to simulations of human population movements following flood-driven nuclear disasters of the kind experienced in Japan in 2011 (e.g. Abbott *et al.* 1977).

A corollary to this, however, is that in any change of paradigm in which new knowledges tend to displace existing knowledges, so that the rate of circulation of these knowledges that are being displaced can be expected to decrease, the new paradigm will be vigorously opposed by many people who feel threatened by the consequent changes in economic and employment opportunities. It appears that this fear, which sees the SaaS paradigm as a disruptive technology, is braking the corresponding development of these new-generation systems in Europe. However, a very recent collaboration-cum-joint-venture between Amazon and DHI, which has, at long last, introduced the SaaS paradigm into hydroinformatics, is indicative of the appropriateness of this paradigm (<https://saas.dhigroup.com/>). Its use of cloud computing, however, carries its own risks to code security, whereby many companies in other fields have refused to use SaaS applications in cases of highly sensitive software, preferring to hold their confidential material, such as their codes, in their own internal pens (see, for example, Dempsey 2012). The seven full-page terms and conditions set forth in the *DHI Customer Agreement* are indicative of an awareness of this situation. At the same time, however, no use seems to have been made of one of the most attractive aspects of the SaaS paradigm, namely that it provides unlimited pricing flexibility, and in the Chinese market this should be crucial

for its long-term success among the new SMEs in the Chinese infrastructural sector.

### SOME EXAMPLES FROM NUMERICAL MODELLING

Let us exemplify these developments by referring to the third, fourth and now fifth generations of numerical modelling in hydraulics, hydrology and water resources generally. We may recall that the first generation was concerned with numerical solutions to algebraic equations, the second with project-customised modelling, the third with the introduction of modelling systems for constructing individual models faster and more easily, the fourth with the packaging of these modelling systems into products for sale, and the fifth, currently ongoing, proceeding within the SaaS paradigm. In the case of the third generation, the modelling-knowledge gradient was almost invariant over all the users, in the fourth this gradient varied substantially so that active support functions had to be introduced (e.g. local agents in many countries, regional short courses and conferences, computer-aided telephonic advice serving, etc.) and in the fifth generation the modelling-knowledge gradients could vary even more again, even as a whole new strata of web-based supporting functions and activities that will be only mentioned here later has to be incorporated. On the side of knowledge circulating through the providing organisations, this knowledge circulation was observed to increase from only a few projects a year in second generation modelling to a few hundreds of projects a year in the third generation, then to many tens of thousands a year in the fourth generation and it is expected that this will pass to many millions of applications a year in the fifth generation paradigm if this is marketed correctly (e.g. Abbott & Jonoski (2001), Jonoski (2002), Abbott (2007), Abbott & Vojinovic (2010), and as will be introduced only very briefly here again). We should observe in passing that the largest scale application within the SaaS paradigm more generally – and certainly the most widely publicised in the media – was the website that organised the Obama election campaign in 2008, which attracted and organised between two and three million active stakeholders in rallying and registering the votes of the general population and raising the necessary financial resources. From the side of

hydroinformatics, the number of people employed in its industries may be expected to increase from a few thousands to some tens of thousands, at least, and the annual turnover from a few hundred millions of Euros to some billions of Euros – or much more again. In the case of China, this mode of stakeholder participation is supported by having over 500 million websites already in 2011 and exceeding a billion mobile telephones in 2012, for a population of 1.34 billion.

It should also be observed that, just as the nature of the knowledges that were brought into play changed rapidly when passing from applications of third- to fourth-generation modelling, these must change again, and even more rapidly, in applications of fifth-generation modelling, once again supposing that these are properly marketed.

In the transformation from third- to fourth-generation modelling, that is from institutionally-centralised modelling-as-a-service to the provision of ‘packaged’ software to realise a paradigm of modelling-services-as-products, the level of computational-hydraulic knowledge required of the user was reduced dramatically, but this was often more than compensated in practice by the integration that was thereby realised with the other-scientific, tacit and domain knowledges that the clients for the ‘packages’ brought into play during the modelling applications. The knowledges that come together within such a context are bonded together by what are called *conjunctive knowledges* and these are indispensable adjuncts to the transformation that is our main concern here. In the fifth generation of modelling, this tendency increases greatly again: as just one example, albeit probably the most important one, we may consider the organisation and provision of services for supporting active stakeholder participation.

As introduced in earlier contributions, as referenced above, the general purpose of active stakeholder participation is to induce a change in the built environment that aligns with a positive change in the social environment. When this positive social change is not realised, the process of attempting to transform the built environment suffers accordingly.

The purpose of stakeholder participation within the social environment itself is then to transform this environment from a reactive one (in which each stakeholder reacts individually during the course of a purely technical

transformation solely on the basis of the most immediate social consequences for that individual stakeholder) into an interactive one (in which each stakeholder interacts with the other stakeholders within a community, whereby the different stakeholders come to cooperate and thereby themselves change qualitatively in the forming and shaping of the transformation as a whole, making of it an essentially sociotechnical *transmutation*: see Vojinovic & Abbott (2012)).

It can only be mentioned in passing that the development of open-source systems must also have a profound effect on the value proposition because a web-based modeling system can then be provided with open interfaces that will attract and bond the productions of many – and in principle very many – other knowledge providers again (Abbott & Vojinovic 2009) to form what has been introduced earlier here as a halo around the sociotechnical application. Similarly, we must turn to that paper and earlier papers on the present subject (e.g. Abbott 2000, 2002, 2008a) for descriptions and examples of a mathematics of the qualities, called category theory (see, for example, Freyd & Scedrov 1999; Abbott 2000, 2002; Vojinovic & Abbott 2012), with which we can conveniently notate the processes that are involved in the present cases.

## STAKEHOLDER PARTICIPATION IN CHINA

It might appear as improper for someone who is not Chinese to take up such a study as this: how can people from Europe possibly express any kind of opinion on modes of development that might be the most beneficial for China? All manner of westerners are forever lecturing the Chinese peoples on all sorts of subjects and there is no wish here to add to the cacophony that they produce. The only excuse that can be made for this present intervention is that it is an offering-up of some experience and some understanding that might be useful to the Chinese people themselves in a mode of development that will not only change our own, common, specialty, of hydroinformatics, but will, above and beyond our own specialty, change China as a whole.

This part of the paper opens with a glance at the development within China of applications of the Internet, drawing upon public statements, formulations and initiatives as described in English and French editions of

Chinese and other publications. It then proceeds further to provide some European experiences of the use of the Internet to promote and support active stakeholder participation in infrastructural development. It also introduces the long-overdue applications of the mobile Internet, working within the SaaS paradigm, in establishing, developing and sustaining knowledge-intensive organic agricultures, aquacultures and related medical and veterinary services such as are now becoming increasingly relevant in China.

Alongside these exoteric aspects are those of a more esoteric nature that provide the foundations of any and every in-depth analysis of the transmutations that are currently occurring around us and in which we, as hydroinformaticians working in sociotechnical projects, are ourselves obliged to participate. These esotericisms are associated here with the symbols and the myths that provide the origins of the understandings of our present and future tasks and our corresponding actions, and these have also been provisionally introduced and defined (Vojinovic & Abbott 2012).

A glimpse of the transmutation in China that is occurring and which underlies all our own ambitions, both in China and elsewhere, can be observed by the revolution in the performing arts that is now proceeding, partly at least, by drawing upon and reinterpreting western cultural patterns. As hydroinformaticians working in the sociotechnological dimension, we must also study and learn from these exemplars and their paradigms.

## TRANSPARENCY: IT'S THE LAW

This was the title of a leading article published in the English language edition of the *Beijing Review* on 5th March 2008 and authored by its editor, Yao Bin. This raised the issue of public participation in forming regulations concerning economic and social development and observed:

‘A direct result of insufficient consultation during the shaping of regulations means that they fail to take into account concerns of different interest groups and are therefore ineffective in dealing with some unexpected circumstances. Worst still, loopholes in these statutes were abused to legalise the infringements on the legal rights and interests of citizens and corporations in some cases.

Clearly, a complete change of the above-mentioned situation lies in the establishment of a strict and transparent legislative system that features the broadest public participation.'

It is useful at this point to consider the way that 'transparency' is used in hydroinformatics (see Jonoski 2002; Abbott & Vojinovic 2010), where a state of transparency is defined in category-theoretical terms as one in which both the implication string, regarded as a category (Freyd & Scedrov 1999):

(beliefs, (facts(data))) → attitudes → positions  
→ judgements → decisions → actions

and its dual category, the implication string obtained by reversing the direction of the implicating signs, the arrows:

actions → decisions → judgements → positions → attitudes  
→ (beliefs, (facts(data)))

(where underlining is used to denote what is initially present to the mind even before this ratiocination process begins) become simultaneously present in the minds of the participating public (see also Dilthey 1976).

In our work to date (Abbott 2007; Abbott & Vojinovic 2010; Vojinovic & Abbott 2012) we have described the participating public more specifically as 'stakeholders' on the understanding that they have a stake in the outcome of their participation in making the most vital decisions affecting the executions and the outcomes of projects. Some of these people 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 people as these 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. 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 people and businesses that set a store upon this environment, thus promoting such an environment even further.

The questions concerning social justice in society generally and the contribution of hydroinformatics in realising social justice have been taken up in a two-part paper by Abbott & Vojinovic (2010) and the book of Vojinovic & Abbott (2012), where the central role of the World Wide Web has been emphasised and the necessity for working within the SaaS paradigm is explained. There the means provided by hydroinformatics to promote the interests of active stakeholder participation by creating web-based hydroinformatics environments capable of catalysing transmutations from higher levels of consciousness to higher levels of conscientiousness have been introduced and demonstrated. It is there shown that this transformation could only be realised when the graphical user interfaces provided by the hydroinformatician were provided with metonymic structures that were capable of inducing symbols in the minds of the active stakeholders through mobilising the forces of the active imagination in these minds. Following Corbin (1958/2002//1969/1997, p. 80) we may then say that 'the active imagination guides, anticipates, moulds sense perception; that is why it transmutes sensory data into symbols'.

Within the Chinese context that is at the centre of our interest here, this process is seen already to have been initiated, albeit not so far with a direct use of symbolic means. Thus, from *La Chine au Présent* of April 2009, we already read in the editorial that:

'After the President, Hu Jintao, the Prime Minister [Wen Jiabao] is the second Chinese leader to engage in an online dialogue with citizens. This is [now] on track to becoming an important tribune permitting the Chinese people to express their own points of view. According to an opinion poll made by the *Zhongguo Qingnian Bao* (*Journal of Chinese Youth*) 71.9 percent of persons

considered that the Internet will be the new means to construct democracy in China. Regarding the Internet as the reflection of reality, the Internet users profit by discussing their problems over the Web and thereby trying to resolve these problems.'

At the regional level this approach appears to be moving faster again (loc.cit. p. 9):

'Having an open attitude towards the Internet, Mr. Wang Yang, secretary of the Provincial Party Committee in Guangdong, is considered by Internet users as 'the pioneer of Chinese democracy using the Internet'. He conducts a dialogue with Web-users so as to hear their suggestions, observing that 'the greatest fear of a leader is to be unable to know what is really happening. The Internet is the new way to realise democracy'. The exchange of views between those responsible for government and the public through the use of the Internet is a new phenomenon on the scene of Chinese politics.'

A particular importance seems to accrue in China to the manner in which the Web can be used to identify and isolate corrupt practices, and indeed direct discussions in China have indicated that senior people in education and government see this as one of the most important immediate roles of the users of the Internet. Thus (loc.cit. p.10):

'Ms Liu Suhua, Associate Professor of the Central Party School of the CPC, expressed the view that 'Internet has encouraged a profound change in the function of government. The surveillance exercised by Web users has become a vast power in front of which those leaders demonstrating faulty behaviour can no longer find anywhere to hide'.

Closer to our immediate interests is a 2008 Chinese Academy of Social Sciences report which analysed public opinion as expressed over the Web. In this report the users of web services were introduced as 'the new arrivals' to the formation of public opinion. This public opinion has increasingly influenced not only government legislation but also the decisions that flow from it. The influence of the Internet has thus passed, through this new layer of

public opinion, 'from a virtual space to the real world', to use the expression of *China Today* (April 2009, p. 12). One example, taken from this same source, may serve as a paradigm case within our present context. This concerns the placing of a major chemical complex involving an investment of 10 billion yuan near the capital of Xiamen, representing a large part of the Bruto National Product (PIB) of the state of Xiamen in which it was to be situated. Although approved by the State Council of Affairs in 2004 and a year later passing a control by the Ministry for the Protection of the Environment, Professor Zhao Yufen of the Department of Chemistry of Xiamen University objected to the situation of this complex at a distance of only 7 km from the centre of the provincial capital on the basis that '*p*-Xylene is highly toxic and carcinogenic'. Professor Zhao was, however, also a member of the CPPCC (Chinese People's Political Consultative Conference) and soon raised the support of 104 other members of the CPPCC, even as his objections were widely diffused over the Web. The Xiamen municipal government consequently held a ballot on the positioning of the project and 90% of the votes went against its situation so close to such a heavily populated area. The complex was consequently moved to a relatively isolated area a hundred kilometres from Xiamen.

A similar event occurred in Dalian in 2011 after the breaking of a dyke around a similar plant, leading in this case to some spilling of *p*-xylene. Some tens of thousands of the local people demonstrated peacefully in the streets – there were at the time some excellent BBC photographs on Wikipedia – and the central government intervened to move the plant to a scarcely populated area at a safe distance from the city.

The largest of such examples of active stakeholder participation occurred in relation to an extension of the existing magnetic-levitation train service between Shanghai and its airport by 235 km beyond Shanghai, to a terminus in Hangzhou. Protests were based upon the possible deleterious influences on the health of those close to the track, and this was successful in preventing any such extension unless preventive measures, such as placing a part of the track underground, could be put in place. A reviewer of this paper has observed that this annulment of the construction might well have been avoided if the stakeholder participation had been extended into a stakeholder reassessment of the realities of the project and we are in complete

agreement with this: active stakeholder participation should be positively engaged and not only negatively, especially since there are a recorded 100,000 such protests a year in China, mostly without any organised active stakeholder participation devoted to resolving problems. The transmutation from protest to participation is greatly to be desired, but is relatively little reported to date.

Much the same can be said of the future of democracy in China, where there has been scarcely any tradition in at least 3,000 years of a sustainable 'Western-style' representative democracy, even as the most recent developments appear to presage a participative democracy based upon the Web and mobile telephony with photographic capabilities. The current craze for iPods and iPads in China reinforces this view. The means made available by using such instruments have already been widely employed to expose many cases of misuse of authority, extended to the highest levels, as demonstrated in the removal of some of the highest-ranking government and police officers in Chungking, as well as the uncovering of many other cases of corruption, illegal land seizures, the creation of Ponzi-schemes and other misdemeanours and frauds, using evidence collected from mobile voice telephony together with visual capabilities. The deep and still ongoing restructuring of the legal system is greatly strengthening this development.

It is indicative that in a survey of the World's 11 most significant economies by *Edelman*, a communications consultancy, as reproduced in the *Financial Times* by [Andrew Edgecliffe-Johnson \(2012\)](#), China had the highest percentage of public trust of all significant governments, with 74% – albeit falling from 2011's 88% – but with the UK, for example, falling to 38% and Brazil to 32%.

Similarly, the success of active stakeholder movements in overturning totally corrupt and brutally oppressive governments in Tunisia, Egypt and Libya also provide inspirations and lessons for the much smaller movements in which we are currently engaged.

The lesser of these examples indicate the kind of forums within which hydroinformaticians should participate if they are to concern themselves with environmental matters, and it indicates that they also must learn how to mobilise active stakeholder participation using the Web in such endeavours. Correspondingly, it would seem, at least from the outside, that hydroinformatics needs to be well represented in both

the Chinese Academy of Social Science and in the CPPCC if it is to develop in this direction.

## THE QUESTION CONCERNING AGRICULTURE IN CHINA

It is an experience that is repeated again and again throughout history that those who understand do not have the means and those with the means do not understand. [His Royal Highness, The Prince of Wales \(2002\)](#), has long established and exposed this state of market delinquency in his excellent work on the neglect of organic and sustainable medical and agricultural practices. For example:

'I remember, for instance, when three Government research bodies were carrying out a three year research project into the organic farming system at Highgrove, that there was a complete refusal of my request to include the homeopathic treatment of our livestock in the research programme. Despite approaching other relevant organisations to carry out the research instead, not one of them would agree to do so.'

This situation has also been evident in Chinese agriculture for many years now, even though both President Hu Jintao and Prime Minister Wen Jiabao have repeatedly drawn attention to the lack of substantial development in the countryside for lack of investment. It is really only in the last few years, dating from 2008, that new means have been made available in the Chinese countryside to provide a proper employment of the indigenous knowledges and understandings of traditional farmers. For the relevance of this initiative, the following may be indicative enough (as taken from the *FT China Confidential* website, 23.09.09):

'New guidelines announced by the State Council (cabinet) are set to boost the access of private capital into grassroots financial institutions, reinforcing our call (CC Sept 3rd Financial China) that the penetration and effectiveness of rural financial services will grow significantly by the end of 2011.'

'The encouragement for private capital to participate in the establishment and expansion of township banks,

lending companies and micro credit companies is contained in a 29-point State Council directive aimed at bolstering the development of Small and Medium Enterprises (SMEs). We think the directive's comprehensive nature, plus its high-level provenance signals the government's seriousness.'

'Private capital has already been permitted in a few grassroots financial institutions but only on an experimental basis in areas such as Wenzhou, where the informal or underground banking system is large. The latest directive formalises this as policy and is set to accelerate the expansion of rural financial institutions.'

'We reaffirm our forecast (CC Sept 3rd Financial China) that the number of township banks will grow from around 100 in mid-2009 to 1,127 by end 2011, lending firms will expand from seven currently to 113 by end 2011 and rural mutual co-operatives will increase from 11 currently to 172 at end 2011.'

'The expanded penetration of such financial institutions will add support to one of the economy's biggest transformational themes: the rise of rural China. The main features of this theme are: the increased scale, mechanisation and specialisation of farms, the establishment of many more SME agriculture-related businesses, the accelerating transfer of land usage rights, the monetisation of land and rural assets such as housing and the gradual increase in spending among some 721 million rural residents.'

This development has naturally raised the question of conducting this development in the spirit of an organic farming practice that would be sustainable without requiring large inputs and subsequent disposals of extraneous chemicals and fuel. This could be realised through the practice of *ecologically friendly but knowledge-intensive agricultures*, an approach that can be realised through the use of the mobile internet with the more advanced, graphics-enabled mobile telephone as the primary delivery vehicle (Abbott & Jonoski 2001). The jury is still out on this however, although some initiatives within China may lead to a reconsideration of this position, as has indeed already been realised at the

micro-scale of methane production from wastes for cooking and heating in many parts of the Chinese countryside, despite some recent setbacks there too.

## THE EUROPEAN EXPERIENCE

The problem-resolution processes associated with active stakeholder participation can be seen as the precursors of the much more complex sociotechnical, and currently mostly coloured, dynamic and graphics-based environments that are now being developed in hydroinformatics for catalysing processes whereby problems that were so complex and difficult that they previously appeared to be unsolvable could now in fact be solved. In effect, what was previously considered impossible has now become possible (Abbott & Vojinovic 2012a,b). Already in the ground-breaking paper of Thorkilsen & Dynesen (2001) on the motorway and high-speed train connections joining the Scandinavian peninsula (Sweden, Norway and Finland) directly to the rest of Europe, it was observed that:

'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 bodies 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. Foucault 1972–1977//1980), are widely called *knowledge/power relations*, such as lead to the formation of new *knowledge/power structures*. As introduced earlier here, these new structures are increasingly 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 most 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 that the principal reason for this distinction and preference arises from the increasingly widespread view among many stakeholders, at least in the West, that 'representative democracy' is all too often 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 (Abbott 2007):

'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 the functioning of 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 in present day terms), this public appreciation was highly valued within the political circles of the European Union.

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#### THE RELEVANCE OF THE EUROPEAN EXPERIENCE TO THE CHINESE ENDEAVOUR

Experience in Europe, at least, has shown that although the potential of the Web in processes of active stakeholder participation in decision making in the water sector is obvious enough, the difficulties in realising and releasing this potential are so great that they at first appear to overwhelm the capacities of the current hydroinformatician. Of course the instrumental and the computational aspects in Europe remain little changed for the moment, even as the movement into a web-based, SaaS environment necessary for providing the kinds of services that society needs may appear to some as presenting overwhelming difficulties. Correspondingly again, although these instrumental and computational developments may be taken over to a large extent from the European environment to the Chinese environment with relatively little difficulty, the social side of the sociotechnical change – that is in turn so closely tied to the internet and its extension to mobile telephony – must demonstrate major differences. These social differences are of course inseparable from cultural differences and these cultural differences are almost immutable. When discussing a 'Hydroinformatics for China', therefore, the emphasis must be on these sometimes irreconcilable cultural differences, and these differences must also be researched and identified if the questions concerning a 'Hydroinformatics for China' can even be so much as properly posed. This is still work in progress.

Now, it has been repeatedly observed that the transmutation from a modern condition of society, dominated by a

society of 'knowers', to a postmodern condition of society, dominated by a society of 'consumers of knowledge', cannot be properly analysed within the constraints of Modern Science, as established across Europe in the *Condemnation of March 1277* but which has since been adopted almost everywhere else across the globe. However, since the publication of Latour's (1991/1993) *Nous n'avons jamais été modernes//We Have Never Been Modern*, we have understood that whenever a discourse passes beyond the limits of the modern scientific it must revert to pre-modern modes of expression, and in the first place to alchemy and, as is often associated with this, mythology (see Jung 1944/1952). In the sociotechnological development of Hydroinformatics we quickly pass beyond the limits of modern science and are obliged to resort to the means of expression provided by these other modes of thinking and forms of discourse. As a European example, and even as a paradigm case, we may take the praxis of psychoanalysis as developed by Lacan (1959–60/1986/1992/2008). Another way of seeing this is that, with the 'socio' of sociotechnology, we must pass from a *Hydroinformatics of the quantities into a Hydroinformatics of the qualities*, and for this purpose we need to augment our mathematics of the quantities with a mathematics of the qualities, such as is provided by (a distinctly nonstandard version of) Category Theory (Abbott 2000, 2002; Abbott & Vojinovic 2010; Vojinovic & Abbott 2012).

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## REFERENCES

- Abbott, M. B. 1991 *Hydroinformatics: Information Technology and the Aquatic Environment*. Avebury, Aldershot, UK, and Brookfield, USA, p. 61.
- Abbott, M. B. 2000 The gender issue in hydroinformatics, or Orpheus in the Underworld. *J. Hydroinform.* **2**, 87–104; also available in a slightly extended form on <http://www.knowledge-engineering.org>.
- Abbott, M. B. 2002 On definitions. *J. Hydroinform.* **4**, electronic version only. Also available online at <http://www.knowledge-engineering.org>.
- Abbott, M. B. 2007 Stakeholder participation in creating infrastructure. *New Civil Eng.* **160**, 26–32. Institute of Civil Engineers, London. (Awarded the 2008 Telford Gold Medal of the Institution of Civil Engineers.)
- Abbott, M. B. 2008a Towards a hydroinformatics for Asia. Proc. First International Conference on Human Resources and the Country's Structure, Islamic Azad Univ., Esfahan. Available online at <http://www.knowledge-engineering.org>.
- Abbott, M. B. 2008b Knowledge transfer and sharing at UNESCO-IHE: the next 25 years. In: *Water for a Changing World: Enhancing Local Knowledge and Capacity* (N. Dickinson & G. Alaerts, eds). UNESCO-IHE Institute for Water Education, Delft.
- Abbott, M. B. 2009 Towards a hydroinformatics for Asia (II). Proc. World City Water Forum 2009, Incheon, Korea. Available online at [www.knowledge-engineering.org](http://www.knowledge-engineering.org).
- Abbott, M. B. & Warren, I. R. 1974 A dynamic population model. *J. Environ. Manage.* **2**, 281–290.
- Abbott, M. B. & Jonoski, A. 2001 The democratisation of decision-making processes in the water sector, I and II. *J. Hydroinform.* **3**, 22–48.
- Abbott, M. B. & Vojinovic, Z. 2009 *Applications of numerical models in hydroinformatics*. *Journal Hydroinform.* **11** (3–4), 308–319.
- Abbott, M. B. & Vojinovic, Z. 2010 Realising social justice in the water sector. Parts 1 and 2. *J. Hydroinform.* **12**, 110–130, 223–239.
- Abbott, M. B. & Vojinovic, Z. 2012a The meaning of colour in web-based hydroinformatics environments. Proc. 10th International Hydroinformatics Conference, Hamburg.
- Abbott, M. B., Hodgins, D. O., Dinsmore, A. F. & Donovan, M. A. 1977 A transit model for the city of Miami. *J. Environ. Manage.* **5**, 229–242.
- Abbott, M. B., Chambers, J. & Cheung, C. H. 2005/2006 *From a Knowledge Society to an Understanding Society*. Knowledge-Engineering, Brussels, and European Institute for Industrial Leadership, Brussels.
- Abbott, M. B. & Vojinovic, Z. 2012b The hydroinformatics of the three economies. Proc. 10th International Hydroinformatics Conference, Hamburg.
- Bairoch, P. & Lévy-Leboyer, M. (eds) 1981 *Disparities in Economic Development since the Industrial Revolution*. St Martin's Press/Palgrave-Macmillan, New York.
- Barth, K. 1938–1950 *Die Kirchliche Dogmatik*, Evangelischer, Zollikon-Zurich.//1961, *Church Dogmatics* (transl. Bromiley G. W. & Torrance T. F.). Clark, Edinburgh, Vol. 3, Bk. 3, pp. 289–531.
- Böhmer, P. & Gilson, E. 1954 *Christliche Philosophie, von ihren Anfang bis Nikolaus von Cues*. Schöningh, Paderborn.

- Chemla, K. & Shuchun, G. 2004 (translators, presenters and annotators) *Les Neuf Chapitres: Le Classique mathématique de la Chine ancienne et ses commentaires*. Dunod, Paris.
- Copleston, F. 1962, 1963 *A History of Philosophy. Vol. 3, Ockham to Suarez*. Doubleday, New York.
- Corbin, H. 1958/2002//1969/1997 *Alone with the Alone, Creative Imagination in the Sufism of Ibn 'Arabi* (transl. Manheim R. preface by Bloom H.). Princeton University Press, Princeton, NJ, 80.
- Dempsey, M. 2012 The cloud comes into its own on rainy days. *The Financial Times Supplement 'The Connected Business'*, 21st March, 3. Pearson, London.
- Dilthey, W. 1976 *Selected Writings*. (Ed. and transl. H. P. Rickman). Cambridge University Press, Cambridge.
- Duhem, P. & Brenner, A. (Editors) 1997 *L'Aube du Savoir: épitomé du système du monde; histoire des doctrines cosmologiques du Platon à Copernic*. Hermann, Paris.
- Edgecliffe-Johnson, A. 2012 *The Financial Times* 23rd January, p. 2. Pearson, London.
- Foucault, M. 1972–1977//1980 *Power/Knowledge: Selected Interviews and Other Writings* (C. Gordon, ed.). Pantheon, New York.
- Freyd, P. J. & Scedrov, A. 1999 *Categories, Allegories*. North-Holland, Amsterdam, The Netherlands.
- Gilson, E. 1955/1980/1982 *History of Christian Philosophy in the Middle Ages*. Sheed and Ward, London.
- Heidegger, M. 1963 *Die Technik und Die Kehre*, Niemyer, Tübingen (Tenth reprint: Cotta 2002) // 1977 *The Question Concerning Technology and Other Essays* (transl. Lovitt W.). Harper, New York.
- Heidegger, M. 1967 *Der europäische Nihilismus*. Neske, Pfullingen.
- HRH The Prince of Wales 2002 A time to heal. *Temenos Acad. Rev.* 5, 11–14.
- Jonoski, A. 2002 *Hydroinformatics as Sociotechnology: Promoting Individual Stakeholder Participation by Using Network-Distributed Decision Support Systems*. Swets and Zeitlinger, Lisse; UNESCO-IHE Institute for Water Education, Delft, pp. 91–94.
- Jung, C. G. 1944/1952 *Psychologie und Alchemie*, Rascher, Zurich // *'Psychology and Alchemy'*. Routledge, London.
- Kennedy, P. 1989/1989 *The Rise and Fall of the Great Powers: Economic Change and Military Conflict From 1500 to 2000*. Random House, New York.
- Lacan, J. 1959–60/1986/1992/2008 *Le Séminaire, Livre VII, de Seuil, Paris* // *'The Ethics of Psychoanalysis: the Seminar of Jacques Lacan: Book VII'*, Norton, New York (1992) and Routledge, London (2008).
- Latour, B. 1991//1993 *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.
- Newcomen Society for the Study of the History of Engineering and Technology. 2009 Journals under Threat: a joint response from history of science, technology and medicine editors. *Int. J. Hist. Eng. Technol.* 78, 1–3.
- 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. Hydroinform.* 3, 105–136.
- Vojinovic, Z. & Abbott, M. B. 2012 *Risk Assessment and Social Justice*. IWA Publishing, London.

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