

Ergaianomics: the moral obligation and global application of our science

Peter Hancock

Peter Hancock works at the Department of Psychology, and The Institute for Simulation and Training, University of Central Florida. Email phancock@mail.ucf.edu.

The growing holistic focus of HF/E leads inevitably to a consideration of the 'system of all systems', the Earth. Our part in the incipient destruction of its civilization-carrying capacity is antithetical to the stated goals and aspirations of our science. Thus, *Ergaianomics* needs to be at the forefront of global change in the way our species collectively acts and the way we conceive of and interact with the technology that supports such social infrastructure.

An idea whose time has come

One of the most profoundly satisfying facets of our science is the way that it stands astride so many critical dimensions of the human experience. HF/E occupies common ground between the subjective and the objective. In featuring within, and prospectively leading the process of design, HF/E necessarily brings together art and science. As one of the mediators between human and machine, it naturally emphasises both the physical and the cognitive, where the underlying mind-body problem has represented the battleground between the material and the immanent now for millennia. But this is not all, HF/E explores the compromise between the aspiration for optimality as compared to the acceptance of the merely satisfied; and now, it also seeks a marriage of efforts to merge pragmatic efficiency with the more recent search for affective, hedonomic user gratification. Last but not least, there has been a growing concern for the integration of the moral with the operational imperatives for action.

All this means that HF/E is a fertile, fecund, and fervid mix of interests set within the context of an evolving world of ever greater levels of technical sophistication. Little wonder that our profession experiences an on-going tension between the ubiquity of our potential and actual contributions, and the larger world's lack of recognition of the presence of, and products of, our formal scientific enterprise. Yet, it is none of these

expressions of duality that I look to emphasise and explore here. Indeed, I would claim that the central concern of this work both logically and tragically supersedes all of the above issues both in immediacy and importance. I speak of the looming crisis of climatic change on a global level and our role in it.

A confluential flow: bottom-up and top-down

Our science was founded during an era when reductionism dominated both as a mode of scientific thinking and as the methodological theme of exploration. The central tenet of such an approach is that the world can be parsed into distinct components such that each of these elementary quanta can potentially be understood individually and then, presumably at some later juncture, re-assembled back into a now comprehensible, coherent whole. Unfortunately, the implicit assumptions embedded within this form of investigational strategy contain two serious problems.

First, in 'parsing' any particular problem at hand (some would say it was more like ripping and tearing it out from the fabric of reality), the process of extracting the phenomenon to be studied is never as clean and pristine a division as the simple phrase 'parsing' would have us believe. Indeed, in truth, this evaluative process has to sever many of the interconnections between the chosen issue and the rest of the world in order to place the poor isolated topic of interest into the sterile, acontextual desert of the experimental laboratory. While it is true that indeed you can then comprehend many of the internal mechanistic elements of the particular issue, topic or entity to hand, the full glory of its behaviour in its true context almost inevitably eludes you.

This has been a major frustration and source of challenge to HF/E in more recent decades, where the necessary, indeed requisite complexity that accompanies the activity of any highly sophisticated technological system

The cover photo is the first image taken by humans of the entire Earth. Photographed by the crew of Apollo 8. Placed in the public domain by NASA.



defies this overly-simplistic 'divide and divine' strategy. Many in HF/E have emphasised this shortfall in their various contributions and it is now forming a central theme of our collective enterprise. More generally, this reactive trend has been expressed as movement toward holistic, ethnographic, narrative, and macroergonomic approaches which feature more top-down perspectives and systems-wide apperceptions of each inherent problem space. Indeed, systems-thinking is now considered an intrinsic theme in most of HF/E. However, such is the diversity of thought between those who remain adherents of a strict, componential reductionism with the latter holistically-oriented researchers that some diverse groups within our own collective community are barely able to communicate with each other, even within the common arena of expressly polemic debate. Like many of the other dualities that I began this work with, this divide provides tension, a degree of explorative excitement, but also represents a dissonance which threatens the potential dissolution to our collective discipline and our profession.

Like many an eclectic vagabond, I am personally happy to seek knowledge wherever I can find it. I do recognise value in each approach but recently I have begun to empathise more and more with the 'top-downers' who lament the tragic scream of reality as 'Occam's Razor' savages into its unsullied flesh. But sadly, florid prose must be kept for another occasion since the incipient demands of our failing planet now require all of our available attention. Suffice it to say here that our science has begun more to feature systems thinking and even burgeoning references to 'systems of systems.' Surely, then this evolving macro perspective must lead us ever higher up the systems ladder to consider the 'system of all systems'. I take the latter to be the Earth, which itself apparently acts as a regulatory feedback system. And now a progressively more important element in that Earth-environment control equation is the effect of human beings as channeled by their use, abuse and misuse of technology. Since I take humans and their interaction with technology to be the domain of HF/E, my central question here becomes this: what is the role of HF/E in such global scale activity and how do our goal statements and the implicitly and explicitly expressed aspirations for improved quality of life accord with what is actually now occurring on our planet?

Ergaionomics

We can begin to answer this question through reference to an existing theory of terrestrial-level regulation represented by the 'Gaia' hypothesis. The Gaian theory, when first mooted, encountered a very ambivalent reception from the academic community. The notion that there is a degree of global cybernetic control involved in the sustenance of living systems seems to induce as much an emotive as a rationale critique. The corollary of Gaian theory is immediate and twofold. The first is that the notion of "control" seems to imply a degree of teleological purpose on behalf of the Earth. It was perhaps this dimension of purported intentionality which caused the greatest consternation and dissonance. After all, a planet expressing purpose, however diffusely defined, smacks more of theology than biology. However, of more immediate concern, the integrity of this current capacity for cybernetic regulation appears to be under threat and failure therein is liable to create potentially catastrophic change – at least for our own species. I do not personally believe this will mark the end of all human existence, since humans have proved to be very adaptable. However, what it may well mark is the radical reduction of the human population and especially the destruction of the infrastructure that supports human civilisation. It is one of those piquant quirks that in this, human civilisation appears to be the major architect of its own demise – or as I term the process - civicide.

The empirical question for HF/E is whether we can generate efforts toward global-level user-centered design such that these destructive trends are palliated at worst, or reversed at best. The sad answer would, at the present, seem to be no. Altering the prospect of coming failure is problematic because there is almost no nation-based constituency to support globally-oriented goals above those of its own national interests. For, if elected representatives place global over national interests, they court imminent political suicide. Sadly, down this branch of apparently self-interested development lies the species-wide destruction, of civilisation at least. Thus, we have created a social order in which the effort toward local optimisation within each social sub-component (e.g. nation states, but now more and more multi-national corporations), leads almost inevitably to 'global' system-wide sub-optimisation and thus approaching global disaster.

It seems, again tragically, that we are unlikely to change from this vector of evolution in which widespread disaster seems destined. What can science (and especially HF/E) do about this? In the past, human ingenuity, expressed via innovative technologies has acted to 'move the goalposts' of impending disaster. This has occurred to such an extent that prior prognostications as to the timing of predicted collapse have been very publicly falsified. Sadly, some commentators have taken these prior failures of prediction as evidence that there will be no future system-wide demise of functionality. However, this denial is simply flawed logic. Technical finesses cannot continue indefinitely to ward off disaster in the face of finite and diminishing system capacity.

On a more positive note, surely, our contribution can lie in our growing understanding of the interactive complexities of sociotechnical systems, in which human behaviour and human goals and aspirations represent the seminal origination of action. To improve our comprehension and elevate our level of positive contribution we, in HF/E, need to embrace complexity and accept that ethnographic narrative is a crucial dimension of our enterprise. We further need to acknowledge that the tools, techniques, and analytic methods that served us well in our predominant reductionistic phase now need to be augmented (and some would argue even superseded) by some advanced representations in simulation and modeling where vast clouds of data need to be presented visually and dynamically.

We need to examine, explicate and incorporate a much greater understanding of system-level emergent properties. Such properties emerge at numerous differing levels of analysis and often, but not always, generate unexpected phenomena in respect of our understanding of the constituents of the lower order system elements. Indeed, the controversy surrounding Gaia may itself be an example of the dissonance produced by the surprising nature of emergence. On this issue concerning emergent features in regulated systems, Lovelock states:

"Whenever an engineer ... 'closes the loop' linking the parts of his regulator (with the rest of the system), there is no linear way to explain its working. The logic becomes circular; more importantly, the whole thing has become more than the sum of its parts. From the collection of elements now in operation a new property,

self-regulation, emerges – a property shared by all living things, mechanisms like thermostats, automatic pilots, and the Earth itself." (p.48)

Surely then regulation and feedback systems with emergent properties are exactly the domain where our expertise is more and more expressing itself and as a result it is itself emerging as one of our discipline's core features.

Recently, some have argued that HF/E is design driven. Since this would make HF/E a derivative science - I disagree. Rather, I think HF/E should itself drive design. This latter proposition means that HF/E is a determinative science. By initiating the present step toward *Ergaionomics*, I'm therefore advocating for nothing less. Our science and especially our global-scale HF/E efforts should not be directed merely at the palliation of poor design or offering derivative 'device advice' to those continuing in ignorance of the fact that technology was and is created for the fulfillment of ultimate human purpose. Surely our fundamental *raison d'être* in HF/E is not to 'optimise' whatever ad hoc technology is fabricated in the transient pursuit of passing profit. Rather, our understanding of humans and systems should be used in a prescriptive and proactive manner to purify design and reconcile purpose to process. If we aspire to any other goal we, as HF/E scientists, remain simply a part of the larger problem and not a catalyst in the urgently needed solution.

It becomes ever clearer, that we are destroying the very world upon which our survival depends. In the name of patriotism, progress, profit, or what you will, we are thrusting ourselves toward the precipice of species-wide and potentially life-extinguishing disaster. HF/E protests that it looks to improve the quality of human life. And yet, through many of its seemingly laudable actions, HF/E is almost certainly fomenting exactly the opposite effect. As we have progressed from the study of individual operators to team research; from simple machine mechanisms to complex computers; from elements to systems; from micro to macro-ergonomics, can we now take the next step onto the global stage and use our scientific knowledge at the level of the ultimate system to actively design such a terra-centric enterprise? Of course, the corollary of this proposition is simple; that is, can we morally and pragmatically afford not to pursue this higher-level objective. I protest not. ❖

Further reading

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