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Review: *The Upside of Down*

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The Dow Jones Industrial Average (the DOW) did quite a dance today, with its peak to trough extending nearly 300 points before closing, pretty much at random, more or less where it started. I bring this up not to turn this column into an economic report about Wall Street (definitely out of bounds here, except perhaps in the discussion of Atom-based XML feeds retrieving DJ stats) but to discuss a bit about systems theory and to review a book that I think should be pretty much de required reading for XML architects.

I suspect that I've always been something of a systems theorist, and I've noticed that systems theory tends to attract architects like moths to a bright light (no comment about getting burned). You can tell the systems theorists out there - they are the ones that clandestinely like to play Sim City at work, who can readily tell you what the Austrian school of economics is despite not being an economist, who were getting nervous about calving ice shelves and CO2 concentrations long before Al Gore started doing his stage show. Some of us are scientists, some are programmers, some are environmentalists or economists, but the common thread that binds us together is that we're the ones who never stopped asking "WHY?" as kids.

Russia announced today that it had reached an agreement with Syria to base ships and submarines there, after having planted a very symbolic Russian flag several thousand feet below the surface of the Arctic Sea. The Japanese Carry trade is beginning to wilt at its edges as serious price deflation seems to be taking hold of the Japanese economy. One of the presidents of Bear Stearnes announced his resignation after it was revealed that two of their largest funds were essentially now worthless due to the sub-prime mortgage meltdown, causing the DOW to drop more than a thousand points in the last two weeks. The Iraqi parliament went into recess after pointedly refusing to sign an oil sovereignty agreement that was very favorable to the United States. The IPCC announces a policy-maker's draft of its research into global warming, with the consensus view being not only that global warming can be linked directly to man-made causes, but that it is increasing at a rate that is faster than even the most pessimistic models assumed.

These appear to be unconnected factoids. By the arguments of Thomas Homer-Dixon, the author of the recently released *The Upside of Down*, they are in fact quite related in that they are all symptomatic of systems that are being stressed beyond their ability to adapt. I've taken to reading quite a number of books about how civilizations evolve, grow, adapt, and collapse, and while many of them also tend to point out that we are nearing the collapsing point, in general the arguments that they raise tend to be more polemic than solid analysis. While there is a fair amount of polemic in *The Upside of Down*, Homer-Dixon (who also authored *The Ingenuity Gap*) manages to strike a chord in my inner system analyst.

By his analysis, systems are, for the most part, the expressions of networks of semi-autonomous actors, each of which both consumes and produces energy, which he extends to include information, as the encoding, transmission, decoding and processing of such information all require energy. He looks at the decline of Rome from the standpoint of energy usage and the degree to which energy return on investment (EROI) plays on the life-cycles of e culture; in general, when EROI is high, the cost of producing energy is small compared to the

return of that energy, and cultures or related systems that utilize that energy tend to start growing and developing interconnections. For instance, consider Rome of about 150 BC, when it was a somewhat largish town on the banks of the Tiber river, selling salt and related resources to its neighbors.

However, as a system grows, its boundaries also grow, and the stresses that act upon those boundaries increase as well. In order to manage those stresses, the interconnectivity within the system increases, and the components within the sytem become more efficient and specialized. Rome grows wealthy on the salt mining, but in order to feed the slaves in the salt mines it needed to expand to take in the Latiums and Etruscans, who had generally better farmland (vast solar collectors of energy), while at the same time building better roads and infrastructure to support this expansion.

Yet this costs additional energy to maintain these specialized components and connections against entropy, which in turn means that the system has to grow larger, developing into a positive feedback cycle. The bureaucracy in Rome began to grow in response to the need to manage the burgeoning army, and wealth flowing back to Rome enriched that bureaucracy disproportionately, meaning that even though the empire of Rome was growing, the costs in supporting that empire were diminishing the EROI.

Eventually, as the Roman empire extended through much of the Mediterranean, the addition of each conquered territory eventually reached a point where the EROI was essentially negative; at this point, the “tectonic” stressors acting on Rome - population stress due to differing growth rates between rich and poor, environmental stress due to poor agricultural methods and overbuilding, energy stress due to the inability to transport the energy through the empire efficiently, climatic stress due to a general drying of the Mediterranean basin during that period and economic stress due to increasingly corrupt government, currency debasement, and a widening gulf between rich and poor - all conspired against it, seemingly at once. From a systems standpoint, the cost of specialization and tightly coupled integration made the system brittle, and tended to cause shocks due to individual localized events to reverberate through the entire empire.

This didn’t happen immediately, of course, but it did cause the city of Rome to fall from more than one million people (the first megacity) in 100 CE to 100,000 people five hundred years later, and down to a low of 15,000 people by 1000 CE, due to a continuous barrage of systemic shocks. The boundaries of the empire shrunk as a consequence as well, such that by 400 CE the empire had basically collapsed back to the Italian peninsula. From a systems standpoint, this collapse is again part of an adaptive system - a rapid decline of the system to a simpler state, releasing energy (in this case, expressed as tillable land), breaking down the interconnectivity, and seeing bureaucrats (the control mechanism of the system) increasingly become autonomous feudal lords.

The parallels in *The Upside of Down* to contemporary economic and social systems are fairly obvious, and I won’t belabor them here. However, I think there’s some interesting additional points that Homer-Dixon raises that I would like to expand upon. One of the first comes from the fact that modern capitalism has as a fundamental driver the absolute necessity of a growth based economy. Capitalism works by providing financial incentives to make the process of the creation of goods and services increasingly efficient and interconnected, in the process selling goods to satisfy demand.

The problem is that such efficiencies by their very nature tend to reduce the demand for people to build those products or fulfill those services, so the only way to keep the population employed (and as a consequence having the money to purchase the goods in the first place) is for the economy to grow, in essence having people enter into the workforce in newly created positions (or replacing those who migrate to those positions). Unfortunately, the downside to this is that each new job also creates greater demands for energy and complexity in the system.

The kicker to all of this is that the availability of cheap energy (in this case oil derived) is now dropping due to a conflation of factors - increasing demand from China and India as well as worldwide, the increasing cost of oil extraction amidst aging wells globally, increasingly hostile environments for oil exploration both in the Gulf of Mexico and the Arctic and fewer remaining unmapped oil repositories (in general, the world is very well mapped in terms of oil deposits). This means that the EROI for oil (and by similar arguments natural gas) is climbing, and most other alternatives have considerably smaller EROI.

These factors, coupled with the likelihood of increasingly problematic global climatic conditions, are creating similar type of stressors to the ones that the Romans faced fairly late in their growth cycle, specifically increasing complexity and brittleness of the system at just precisely those times when everything seems to be going wrong at once. He does not argue that we're looking at a global collapse, though that is certainly one scenario, but he does argue that there is a need to make the nodes within the various systems more localized and autonomous (more resilient), or the danger exists that when a breakdown of the system does occur, it will cause a cascade that could wreak far more damage than would happen otherwise.

This resiliency, at the level of programming, would be to look at building a sustainable-oriented socio-economic system, rather than a growth-oriented one. One expression of this, as he mentions in the book, is open source … programming that basically works using a community-based approach. Open source oriented societies and sustainance rather than growth oriented societies do exist at the community and even business level (the example I gave in my last blog of FreeGeek, a PC recycling cooperative, is one very good example) but such approaches are frequently disparaged by those promoting purely capitalist solutions precisely because they tear at the fundamental concept of liberal capitalism - growth must be the primary imperative in the economy.

I've long advocated the notion that local resiliency or flexibility must be a key aspect of any development effort, because such resiliency, while costing more in the short run, makes systems considerably more resistant to shock in the long run. I see this as one of the cornerstones of REST-based programming, and I see the same application relevant at higher levels as well. Thomas Homer-Dixon lays out an elegant case for the application of such a philosophy at the social and economic level as well - if not exclusively replacing, then at a minimum creating a cross-grain layer to the highly efficient but rigid structures that we're building to eke out that last dime of profit. As an architect, a systems theorist, and someone who is very much concerned about what we're doing to the world, I would heartily recommend *The Upside of Down*.