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inside:

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will the real "sysadmin of the future" please stand up?

by Strata R. Chalup

President, VirtualNet. Starting as a Unisys 68K admin in 1983, Strata Chalup is now an IT project manager but allegedly has retained human qualities. Her mixed home network (Linux, Solaris, Windows) provides endless opportunties to stay current with hands-on tech.

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Why do I think that system administration is a growth industry, in spite of the economic climate of the last 12 to 18 months? Why do I also think that system administration will grow increasingly unrecognizable to current system administrators? Is the professionalization and specialization of the field going to become the latest planet-killer to my cohort of generalist dinosaurs?

As context for some of these questions, let's briefly recap a few points from my previous article, "Vive la Révolution: Now Get Over It."

> "Let me explain. (deep breath) No, there is too much. Let me sum up."
> Inigo Montoya, *The Princess Bride*

Our technological revolution was both eclipsed by and conflated with the economic boom cycle of the past decade. The false lesson that the business world learned from the dot-com bubble burst was "OK, we were right all along; time to go back to sleep." The general public promptly lost faith in the real power of technology for social change once their 401Ks started plummeting. To most laypersons, the Internet is now snake oil.

The dot-com bubble was information technology's Watergate. In the long term, more and more people will realize that the worst damage of the burst was done to our cultural perception of technology. Over the next decade, that will vastly eclipse the drop in fiscal valuations. My best friend and I were born only five years apart, but he can still remember when everybody trusted the government. I, who grew up with Watergate in grade school, can't even remotely imagine that. Some of you industry veterans reading this can't imagine that anyone ever believed in "the New Economy." Others, who came to this field within the past decade, may still be cursing with frustration. I know many people who believe that if the Suits and VCs hadn't panicked we'd all still be employed – and, possibly, our society as a whole would be headed in a healthier direction. To you in particular, the past six or seven years look normal and the last 18 months look like an insane overreaction.

At the same time, technology has become a startlingly transparent conduit for content delivery. Business data, transactions, and entertainment are traveling through a wide variety of networks, devices, and media and being accessed in a less specialized context by a wider variety of users. Most people give no thought to the vast array of infrastructure that provides 120 volts AC and telephone dial tone in their house. Network and content are already being treated similarly. They are relied upon without being understood. They are taken completely for granted with no perception of the operational difficulties and logistics involved in keeping these services available.

Before Enlightenment, Carry Water, Chop Wood

This change in long-term mind-set has largely bypassed the sysadmin community. Ever pragmatic, we realize that fewer dot-com Web farms doesn't mean the end of sys-

Dead ends are viewed from the forward-moving perspective of success and rarely recognized while one is traveling down them!

tem administration. The usual tangles still need unsnarling, whether you are sitting in Aerons at a VC-provided incubator office or parked on lab benches somewhere in a bunker. We also got to see a lot of stupid business decisions from the trenches, and by and large didn't give up our faith in technological advances just because we were almost constantly ordered to misapply technology by people who didn't understand it. And, of course, "looking under the hood" is what we do for a living. The better the packaging, the more suspicious we get that there's nothing worthwhile inside the package.

An ugly side effect of the transparent technology conduit is that Joe and Jane Public's reactions to technology are now *almost entirely* based on the packaging. Does it look shiny, smooth, rounded, high-resolution color, like TV, cable, cell phones, pagers, iBooks, and graphic-heavy Web pages? If so, it's a common everyday object and should "just work." Does it look angular, knobby, industrial, option-heavy, bristling with cables and interfaces? Then it's "high-tech" and probably a boondoggle – get rid of it!

Unfortunately, many infrastructure technologies and service building blocks fall into this category. Even worse, Joe and Jane Public, in their capacity as middle managers, department heads, and CFOs, are making technology infrastructure decisions informed largely by consumer-technology-marketplace conditioning, filtered through their reaction to the dot-com bubble. Ouch.

The increasing transparency of content helps to feed the growing perception that sysadmins are not necessary for everyday business and home computing services. Even the non-techie early adopters, traditionally allies of the IT department, have picked up the consumer-appliance view of sophisticated technical devices. Their smart MMS phones, home media centers that double as computers, and voice-driven GPS navigation aids seem quite routine. Their experience of the ease of use misinforms their view of the ease of deployment and leads them to devalue the role of systems architecture.

The evolutionary pressures on technology are increasing. Many people define evolution as "progress," but those of us with some sciences background may recall evolution's definition of progress: something that works until it doesn't anymore. The dinosaurs were the pinnacle of evolution until that darn comet came along. Mammals were merely experimental window systems implemented in old LISP dialects. Dead ends are viewed from the forward-moving perspective of success and rarely recognized while one is traveling down them! Circumstances and changes determine what will prove to be a bad path. The consumer marketplace is performing technology selection based on what is selling right now and what will take the least time to get to market. Meanwhile, we're heading down a rat hole where technology is supposed to manage itself (it isn't) and communicate in a plug-and-play fashion (it doesn't) to meet our larger cultural and societal needs (as defined by whom?). The role of system administrators as knowledge workers rather than janitors is questionable in the market space that is evolving.

The good news is that it's not yet too late to change this. The bad news is that the situation is not going to solve itself if we sit and do nothing. Our opportunity to add actual value to the technology process, instead of babysitting Web farms, is unparalleled at this time. The catch is that we are going to need to work hard to educate the people who need us most, the consumer technology industry. These are the folks whose output to the GNP dwarfs that of the dot-coms and the whole computer industry even at the stratospheric height of the bubble. They are also the folks who make, in

addition to our home espresso machines and 12-volt automobile mini-fridges, many things we think of as cool toys. Hey! This doesn't sound terrible yet.

A number of folks may counter that it's hard to stay optimistic when you're looking at unemployment benefits running out. I agree wholeheartedly. The recent plummet in the job market for system administrators is reflective of more than the current economy. It's also where the rubber meets the road for "sysadmin awareness." Many businesses out there might have made different choices about who to lay off if they had a better understanding of what their systems staff was doing for them. A business may decide to let things slide in a time of recession, but they rarely choose to let the infrastructure go completely to heck in a handbasket. Some firms will soon find that is exactly what they've chosen. Others are discovering it right now.

> "The future is fun. The future is fair. You may have already won. You may already be there." – Firesign Theatre, *I Think We're All Bozos on This Bus*

Let's take an example of new consumer technology: a vacuuming robot for household use. There's a small company making one of these, but at some point it will be eaten by a larger company or subdivision of a multinational. Those are the people who will be hiring you or me if we don't like to work for small edgy companies. Those are the people who have the money to fund product development. The great thing about product development is that it is a revenue expense, not an overhead expense. It is the most neglected place for sysadmins on the *friendly* side of the balance sheet.[1] Changing this will not be easy, but it is very possible and will be very worthwhile.

Our vacuuming robot is real, and it is called "Roomba." At one time these were vastly expensive research toys. Enter the $200 version, available now from various high-end "tech-toy" stores. Roomba can navigate within individual rooms of a standard household environment and is designed to require minimal intervention. Among its bag of tricks are several types of space-traversing algorithms and a receiver for an "Invisible Fence" broadcaster, which tells it where it isn't welcome (or could fall down stairs). Finally, something for all of us who have watched a swimming-pool cleaning robot at work and wished we had one that would do the floors at home.

As with any newly deployed technology, the Roomba is far from perfect. A review praised its abilities and addressed a few minor shortcomings: "Roomba shuts itself down when an object gets wrapped around its main roller, but it leaves it to you to guess what happened. I would like a better battery indicator. And in a few years time, I would like a machine that can automatically wake up when I am out of the house, clean the floors, and then plug itself in for a recharge." These are fundamentally consumer issues, but let's look at how we might address them from a system administration perspective.

The Invisible Fence signal could be modulated to carry data, saying "keep out of this area" or "follow me to your charger." A tiny wireless transmitter can send standard notifications such as "main roller stuck" or "ready for next room." Let's plan for multiple Roombas from the very beginning. Multiple Roombas are more likely than an affordable "ÜberRoomba" capable of mapping the whole house and handling obstacles like stairs. Thus each unit should come with its own RFID serial number and/or MAC address, so that it may communicate uniquely with the house controller.

House controller? Indeed – small house or apartment local area networks are becoming a standard feature in high-end "smart houses." It's easy to build small repeater-style

1. Those of you reporting to engineering groups know what I mean by "the friendly side of the balance sheet." So do those of you supporting production systems, unless you have a particularly clueless manager. Being perceived as adding to revenue is the single best defense anyone has against layoff or marginalization. Start reading Tom Limoncelli's soft skills LISA papers right now if you don't grok this. The job you save may be your own – or your next one, if you are looking right now.

2. Interestingly enough, the executive team that acquired Palm for US Robotics planned to make its major revenue off the cradle, not the device. A recent article quoted one of the team as saying that "although there might be one or two handhelds in the home, consumers would have as many as a dozen or more cradles."

monitoring stations, plugging into a handy AC outlet. These stations could listen for alerts and roll them forward into a central loghost. Alerts would be acted on according to the owners' configuration, triggering outcall paging or emailing, or changes to a wiki or Web log. For that matter, each room of the house could have an inexpensive aggregator that handled traffic for that room. The "big red button" for a room could be configured to have various meanings – "route my calls here," "turn all my appliances on," or even "call a Roomba, I just spilled my corn chips!" A true two-way network would be scarcely more expensive to deploy, especially if the first kludge, excuse me, implementation was merely to do two-way to room nodes only. The big red button by your exit doors could signal Roomba, and all your other house appliances, that you were heading out for a while, so now would be a good time to vacuum, run the dishwasher, and so on. Security mavens will quickly realize that it's also critical to encrypt or broadcast limit so that one doesn't also signal another monitor station that someone may have stuck under your porch rail.

If implemented poorly, RFID or wireless beacons on advanced consumer tech-toys could be misused in scenarios ranging from wireless peeking into wrapped birthday or holiday presents to easy drive-by house casing for neighborhood burglars. What are the chances that the lessons of decades of IT deployment and computer security will be forgotten in the rush to market? A typical example is the inept deployment of wireless cash registers at certain consumer electronics retail stores – customer credit card data was wirelessly sniffable from the parking lot. Help! Where's a systems architect when you need one?!

After Enlightenment, Chop Water, Carry Wood

> "The purpose of IT is to seamlessly and transparently provide the other nine-tenths of the iceberg for people who need to work with chunks of floating ice."
> – Strata R. Chalup

> Weinberg's Second Law: "If builders built buildings the way programmers wrote programs, the first woodpecker to come along would destroy civilization."
> – Gerald Weinberg

Technologies like clockless computing may soon revolutionize miniaturization and price points of ever more powerful systems. Clip-on GPS transponders for your child's backpack, or your girlfriend's cell phone, are becoming available. GPS technology has become cheap and entertaining enough that art/sociology projects like Amsterdam Realtime (a map of Amsterdam constructed entirely by the actual movements of people equipped with tracer units) are becoming easy to implement. The personal robotic vacuum cleaner is here. And yet – have we really invented anything new? Think about what we spend most of our time doing as system administrators, namely systems integration. Where are the systems which are designed from the ground up to be integrated?

As I look at the entire history of computing, PDAs are the only things I see that are *really* new. The Palm Pilot, and the rest of the PDA market which it created, is new and unique because PDAs are the first computing devices designed from the ground up to be used *by* an individual *for* the purpose of synchronizing and integrating into an environment. Expand the term "PC" and you get *personal* computer. A computer of my very own, which I don't have to share with the mainframe users. I'll process my own little batch jobs by myself in my own little world. In mainframe land, systems like virtual images created the illusion of a computer of one's own. This was seen as a nec-

essary interface to the shared computer. Inherent in both the mainframe and PC world is the idea that computing zones are little fiefdoms, separate and inviolate. They're simply not designed to be part of a greater whole. That little PDA with your calendar, address book, and online newspapers represents a true paradigm shift.[2]

We may be on the verge of losing this insight. PDAs running Windows CE and Linux may be cool and fun, but they're essentially portable PCs. Their quality of integration, of being a view into a larger shared data set, becomes merely another function. A PC in a PDA package is still a PC, as indicated by the increasing use of the term "handheld," for *handheld personal* computer. It's not meant to be integrated, and that's a built-in limitation. That limitation is being inherited as an unexamined assumption by new devices, such as the Roomba in our earlier example. The list of hypothetical improvements to the Roomba are all about functionality within an integrated house-wide system.

This prefigures the "smart house" as its own little neighborhood of smart devices. These devices are inherently isolated from one another, speaking only to "the controller." In our example, we held to that convention so as not to introduce too many things at once. Think of how much more functionality we could have by making each of the smart devices as quasi-autonomous entities which are preconfigured to know how to "behave" in the context of a greater whole. For that matter, none of the smart houses that I have seen documented, even Microsoft's widely touted vision, make the next step into a "smart neighborhood." People are hungry for the benefits of compatible systems and shared data, as evinced by the recent peer-to-peer software explosion. Yet few of the first P2P systems provided ways to limit the amount of data one shared, or defaults other than "my whole hard disk."

It doesn't take a great leap to map many of our security, data privacy, and systems maintainability problems onto our assumption of "personal" computing. Many of these problems can arise directly from a mental model of traditional boundaries. This mental model fails to recognize that characterizing data as a physical object, "hidden" files as actually hidden, and so on, does not reflect the real transparency and permeability of information. The necessity of shaping memes of privacy, security, and maintainability ought to be revolutionizing the field of system administration. Instead, we spend all our energy on reactive strategies that by definition will never solve the problem. Of course, bigger and bigger problems are on their way – wireless networks and broadband will not create new problems so much as provide a rich agar to nourish the swift spread of existing problems.

Here is one of the many opportunities for active, not reactive, system administration. Again, a vast market is poised and waiting to leverage what you build. You can't be the CEO of a killer company and retire at 35 on the profits. It's not that kind of market space. What you can be is an incredibly respected and valued employee or consultant, having a blast making reality out of things that were always glossed over in science fiction. You can also, if you wish, help build the "moral high ground" in data privacy and accountability. New tools and standards, which you can help create, change the way that people think about privacy and information. I'm eager to see free software written to build customer expectations of "good" UI and information control, before the commercial stuff really hits. I estimate there's a gap right now of at least 12 to 18 months where a Bluetooth or 802.11 "universal remote" or "neighborhood integrator" type of program could find a niche. The right tool/program could embed itself so deeply into the user community that they'd never be satisfied with a non-integrated solution,

Wireless networks and broadband will not create new problems so much as provide a rich agar to nourish the swift spread of existing problems.

much less one that doesn't preserve privacy and configurability. Look at Napster as both a good example of creating an expectation space and a bad example of how to handle privacy and security issues.

Numerous studies have shown that the penetration of PCs and handhelds has never approached that of television, VCR, CD, DVD, and the like. The determining factor is always listed as "ease of use" but might instead be phrased as "what can I do easily." All of them use tools, programs, and objects that have more features than we really use. Unless one has a strong need for a complex, hard-to-configure feature, one just uses the easy features. One of the answers to the perennial question, "What do sysadmins really do?" is my smart-alecky iceberg quote above.[3]

A clearer, more direct version of that answer is that sysadmins serve as an integration buffer to make things transparent to users. There is now an enormous industry based on enabling ever more sophisticated transactions and capabilities to be harnessed by so-called "naïve users." This industry may not yet understand that it needs us. We should be out there demonstrating beyond doubt that our expertise has value in this domain. How do we get there? One path involves taking the next steps to professionalize system administration and to dramatically increase its academic rigor.

> "The other day I heard a person in storage systems dismiss the efforts in quality of service research being done in networking as just people who look at packet loss. By that flip remark, he dismissed many good ideas which would have advanced his research. . . . It is easier to try to re-invent than to read past literature and filter the good from the not so good . . . . I know there are exceptions to what I have ranted about but from my experience they are few and getting fewer. It is time for the senior people in the field to demand that people behave like scientists."
> – Dave Farber, CS/IT/Telecom *éminence grise*

Here's another example of where we need to push back, as a profession, against the perception that our skill set is limited to taking care of what others have built. We're seeing the proliferation of unplanned, emergent systems used for important business and consumer activities. These systems are being built with an eye toward accomplishing market goals and minimizing capital expense. They are often assembled out of ad-hoc components or networks from failed competitors and are minimally integrated. They are not being designed for security, or maintainability, or stability in overload conditions. The most egregious visible abuses are seen in the area of wireless, since those make excellent press right now. As we know from experience, there is no area or function that somebody can't try to put together with bubble gum and baling wire. Even worse, secondary systems are being planned and implemented which take these jury-rigged systems as a given.

These systems are constructed primarily of software and applications rather than hardware, yet Joe and Jane Manager tend to regard them as "the network" and thus out of the domain of traditional system administrators. In fact, most of their value lies in doing more or less traditional Internet or intranet transactions at the edge of the protocol network, or in emulating traditionally sysadmin'd TCP/IP services across a wireless network. Our profession understands more about the inherent instability and trade-offs involved in making these services work than do traditional telecom engineers, yet we are increasingly out-of-the-loop in design and deployment of these next-gen services. It's possible, even likely, that some of these services will be composed in a way to preclude some of the more irksome fundamentals. One example is prototype

3. Thanks go to Benjy Feen for correcting my initial use of "glacier" in the phrase!

file-sharing networks that store multiple copies of a document, handling locking, versioning, and references without explicit user intervention. Wow – no more backups! There's a little Catch-22 here, which I'm sure you've already spotted. Without knowing the fundamental concepts, such as backups, the implementers would not have known the desirability of such a feature.

This is all a train wreck waiting to happen, and/or happening now. Sysadmins will be needed to "save the world," but first we have to convince the world. Even a few train wrecks won't make the world beat a path to our door unless they perceive us as *much* more highly trained and capable than they do now. We need to demonstrate not only our technical specialties, but formal problem-solving skills and knowledge of specific, already recognized domains of engineering.

With opportunity comes responsibility. We must integrate with traditional professions and take on more academic rigor in order to maximize our contributions. Yet we must also retain aspects of an independent specialty to retain a voice outside of other professional domains. We must continue to professionalize ourselves and to aggregate a specialized body of knowledge and group of best practices, while at the same time reaching out to the engineering disciplines. Cultivating a "guild" mentality will only ensure that conventional engineering specialties reinvent our wheels and acquire systems experience within the tenets of their established domains of knowledge. Worse, they will make all of our old mistakes, just as they are now, but with real-world systems like automated subway cars and wireless cash registers. A look at the RISKS Digest archives should be enough to convince even the most hardened skeptic.

Me? A Sysadmin? No, I'm a . . .

As the profession matures, we will find ourselves less isolated and more integrated into the "normal" flow of professions. I think that we will find this mainstreaming comes with something of a price: System administrators in large part will lose their identity as a specific profession. Instead, we will come to view system administration as a body of knowledge and a collection of skill sets. This has already happened, from the other direction: There are sysadmins out there who don't know they are sysadmins or who view administration as one of their technical job responsibilities.

A couple of years ago, changing planes for my flight to LISA in New Orleans, I met someone in the airport who really made me stop and think. He was carrying a book, whose title escapes me right now, that clearly identified him to me as a system administrator. I struck up a conversation with him, thinking he might also be on his way to LISA.

He had never heard of LISA or USENIX. He was familiar with SAGE and was surprised to hear they were sponsoring a conference of which he was unaware. After all, as a manufacturer of cutting-edge A-to-D chipsets, SAGE was well-represented on the shop floor, and his group had purchased a number of their offerings. His full-time job was to run a production optics shop making lenses out of specialty materials for manufacturing use. His computer-controlled lathes and production equipment were run by Solaris and Linux boxes. He had a degree in materials science and thought of himself as an optics technician. I showed him the current conference program and talked to him about any "open issues" he might be having with his machines. He was completely convinced that things like (our) SAGE, USENIX, and the LISA conference were of no interest to him. His *nix boxes were simply front ends for his tools. Sure, he could patch the OS, do new installs, etc., but that wasn't his *real* job.

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Looking at the job marketplace for engineers, project/product managers, and quality assurance people, one finds job ads aimed at various "flavors" rather than a generic "engineer" or "project manager." Common orientations are civil engineering, aero/astro/military, biomedical, pharmaceutical, manufacturing. A civil engineer is not the same as a software engineer. A pharma/biomed project manager is not the same as an IT project manager. As system administration becomes more normalized and professionalized, individual sysadmins will find it increasingly necessary to have expertise in some conventional domain of engineering sciences, or commerce. Acquiring the expertise on the job, as we have done in the past, may not be a valid option in the future. System administration skills will be seen as a necessary but secondary component to the domain knowledge, and good schools will offer system administration electives which engineers and scientists can use to equip themselves to do much of what we do.

Sysadmin: The Next Generation

We are at a crossroads, where individual careers can take many paths, but the profession as a whole needs to move in certain directions. System administration needs a well-defined body of knowledge, formal course curricula, careful attention to research & publication, meaningful certification programs, and increased cohesiveness and commitment to evolving as a profession.

As more sophisticated technology is deployed in day-to-day living, the lessons we've learned can help prevent negative outcomes along the continuum from disappointment to disaster. Civil engineering and finance are just two of the areas where good outcomes are mandatory, and both the public and private sector will spend money to ensure this.

In order to enable the transparently functional technology demanded by the consumer-technology market, we must become obtrusive and insist that a systems management perspective be applied. Since consumer goods constitute one of the largest pieces of the economic pie, jobs are now and will be available as our value is recognized.

The individual paths look very odd and nontraditional to those of us who have been here a couple of decades. Some may decide to stay the course as generalists and end-use integrators rather than moving into the technology-creation process. Others are looking for the next niche to move into, or the next migration path to follow. All of the directions indicated in the references are navigable for those who are just starting out as well as those who are wondering where to go next. All of them represent well-funded but underutilized employment demographics with opportunities along the whole spectrum from struggling startups to established companies. Self-promotion, re-training, on-the-job learning, and a certain amount of "street smarts" are likely to be necessary to make the jump into some of these parallel tracks. They may be options you never realized were available. Not only are they out there, but we need to cultivate them to ensure the future of system administration as a profession.