Digital Nomads: The Computerization of a Professional 5-Year Undergraduate Program

Invited Paper

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...After three thousand years of explosion, by means of fragmentary and mechanical technologies, the Western world is imploding. During the mechanical ages we had extended our bodies in space. Today, after more than a century of electric technology, we have extended our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned. Rapidly, we approach the final phase of the extensions of man—...MarshallMcLuhan

INTRODUCTION

A Notepad in Every Backpack

The School of Architecture is presently entering a new paradigm in the theoretical and technological education of an architect. The curriculum requires that sophomore students purchase their own personal computers; and this machine must be capable of being easily transportable (i.e., notepads) and have the processing power necessary to run high-performance computer-aided-design software (i.e., MicroStation, Autocad, Studio 3-D, Form Z, Upfront). The hardware platform which the student chooses will be pluralistic and a matter of personal preference within the following parameters: DOS/Windows (IBM clones); Mac OS (Macintosh); and SUN OS (Sun sparc clones). Software, on the otherhand will be standardized and utilized very much like textbooks. This curriculum requirement was officially launched in the Spring semester of 1993. We are still *spinning* from the impact of witnessing those 50 *digitally nomadic students* wandering around within the confines of the architecture building. The program (which is now in its fourth year of operation) has introduced the computer to about 200 students. At present, the upper 4 years of our 5-year program are fully technologized with respect to digital media.

This portable (notepad) machine raises pedagogical issues which relate to general education as well as architectural studio work. The intention is that this machine will go with the student everywhere (including to classes for note-taking) and will also complement (and not replace) the more traditional medium of the architectural sketchbook. But even more critical, is that the nature of this portable tool can allow the architecture student to transport his/her design solution (and process) with them back to their apartment, dorm, or pub; development ideas which occur to them outside of the studio can be instantly recorded and/or tested. This new technology can make possible a significant leap from the traditional studio; the student's physical studio desk can now be electronically extended to anywhere the notepad physically exists. With the MSU fiber optic campus network (which is connected to the telephone net) the student can also *log-in* to regional, national, and international networks (INTERNET); and with a modem be able to communicate (from off campus) via E-mail (etc.) with faculty and databases at other institutions. This notepad computer becomes more than just a design tool, it introduces a whole new strategy for communication. By having their own personal machine, the students can truly embrace the technology (and not just as a design tool).

THE ANTI-LAB

Breaking the Digital Barrier: Merging with Tradition

The traditional model employed in most schools of architecture utilizes the more isolated *computer laboratory* as the primary method for introducing the student to these powerful electronic tools. This traditional approach consists of a limited number of computer stations organized in a separate area from the design studio (usually under lock and key). This laboratory is usually on a first come first serve basis. Locating the computer labs separate from the design studios implicitly (if not explicitly) establishes a pedagogical position which suggests that these design processes (traditional design studio methodology and the computer tool) are not sympathetic to each other. It is our contention (along with many others) that these two components, design studio and computer, *should not be separated.* It is critical to fundamental education that these two positions merge (both conceptually and physically). In the most basic sense, the student's individual notepad will challenge the *digital vs. traditional* paradox; the true nature of this small portable machine allows it to fit comfortably in the student's traditional studio desk space---and in a non-threatening manner it can be readily accessible for integral use in

their design processes. This complementary relationship (between traditional media and digital media) challenges the faculty and students to find the appropriateness of each media within their own design process. Each type of media has unique biases which make them more appropriate for certain types of investigations.

This approach also insures that the students are using the latest technology on an annual basis. They are not confronted with out-dated labs (which are sometimes 4-5 years old) or broken equipment. The institution's monies (when they exist) can now be spent on equipment which is more enduring and becomes less antiquated with time (ie: printers, scanners, and networking); even when this stuff gets old, it is not limiting to the student. Sure, there might be better printers, but that is nothing compared to a slow machine with inadequate memory (with old versions of software applications).

As a result, these students at the MSU School of Architecture have complete access to the computer; they will not have to compete with other students for access to a limited number of machines in the traditional computer laboratory. This model assures that these students will become computer literate and embrace the technology on many levels (not just in the design studio). The personal notepad also promotes the concept of integrating the machine with other more traditional tools used in the studio. In effect, it places this *technology tool* on the student's desk (next to the triangles and circular saws) and reinforces the notion that it is *just another tool* to be used in the studio. This approach takes the computer out of the "specialized" lab and puts it in the student's hands; the machines are now not to be viewed through a *looking glass* remote from the studio. The elevated status of the machine disappears; it is demystified. The digital barrier has been broken.

THE PORTABILITY FACTOR
An Administrator's Dream

A computer requirement has the potential to compromise the traditional design studio. If students purchase a *desk-set* machine (a standard non-portable desk model), the machines will probably be located in a permanent position at the student's apartment. This remote location will fragment the student population and undermine the studio environment. Many architecture programs which encourage (but not require machines) are witnessing this exodus. Issues of security are the primary reasons associated with students locating their machines outside of studio.

From an administrative standpoint, the physical implications of locating *desk-sets* at each student's studio work space could require *significant* electrical and mechanical upgrading of the building. . . this will translate into significant costs. As well, desk-sets take up lots of space; a commodity which most design students are not prepared to sacrifice in their already cramped environments. However, the nomadic machine can lie comfortably on the student's desk without demanding specific physical needs (it does not draw much power nor generate heat); keep in mind that this is not an insignificant issue.

But as educators, I suppose the most important impact that this roving tool might offer is its instant accessibility to the owner (the student). By all of our experiences, we can all relate to the understanding that if we had our very own machine, we *in all likelihood* would be compelled to embrace it. It is always extremely difficult to convince a student who is not comfortable with digital technology to *on their own* make use of a computer in a remote lab; it usually requires highly structured exercises in limited doses. But it takes little effort to encourage them to use their own machine. The freedom it allows the faculty in generating studio assignments ensures that the studio projects will be a function of design issues and not be limited by the equipment in the computer labs.

Culturally, our societal biases also encourage nomadic tendencies. We expect our students to travel, not just abroad, but to sites related to studio projects. The ability to record site data digitally is a capability that has not been available to designers of the past. It is not just efficient, but profoundly new. To be able to see the site captured three dimensionally on your screen while simultaneously experiencing the site--and then to be able to draw or model right on top of that image while still immersed in the physical surrounds, seems to suggest a transcendental step in the design processes. When new tools suggest new strategies, quantum leaps are allowed to happen; as opposed to using new tools to do traditional things quicker or more efficiently. Taking this digital technology out of the lab (and studio) and into the environment opens new territory for studio exploration. The *extensions* of technology that McLuhan speaks of are now physical computer extensions (also nomadic in nature) which are capable of following (and complimenting) man wherever he goes.

The major limitation to the portable machine lies in the video display screen. We are currently exploring a *visual display unit* (Virtual i-glasses) which is not only portable, but capable of producing much larger and higher resolution images (preferably, stereographic in nature) than the small LCD displays on current portable computers. This kind of device will be capable of handling an RGB signal directly plugged into a portable computer. It does this in stereo; and produces an image which appears to be 3-D and *float* out of the viewer's field of vision; only to be adjusted with controls as to its size and transparency. It can be up close and fully envelope the viewer's field and be fully opaque, suggesting an immersive virtual reality; or the apparent screen can be off in the distance where the computer generated virtual model can actually be located in the physical environment, similar to a hologram. At worst, it is a superior visual display unit which allows for one to have portability and flexibility without being tied to a cathode ray tube. We are prototyping *apre-packaged* box which houses all the necessary stuff to plug into a student's machine so they can actually *check-it* out of our reserve library to be used in the studio.

Our ultimate goal is for our students to be able to use this

device as a *low-end* Virtual Reality Display unit which enables them to experience their spatial models at their *conception* early in the process; where it can have a significant impact on conceptual design ideas.

DOCKING STATIONS

Jacking-in to the Infra-structure (The Student Net)

A prototypical *docking station* network for the students has been established which is physically located in the school's library adjacent to the studio spaces. The first phase of this local area network (LAN) consisted often docking positions for the portable computers (five DOS compatible and five MAC compatible stations) and a post script laser printer (11"x17" and 8 1/2"x11" format). The students could also access this LAN by *dialing-in* via modems. This LAN is connected to the campus NET which is connected to Internet; the students have unlimited (and free) access to the Internet.

Ideally, according to our own logic, these docking stations should be at the student's desk in the studio. Economic concerns and studio flexibility make this an unlikely response at this time. Instead we have expanded the docking station network to include ten more positions in a location that is also easily accessible to the students. This second phase of the student LAN provided additional input and output devices (plotters, printers, scanners). Each station has its own space with adequate counter area for drawings and/or models; but we are really encouraging the design work to occur at the student's desk; these stations are primarily used for scanning and printing, and to access the internet, and e-mail. Plans are underway to fully network the studios at the student's work space.

One might expect that design software for the students would be available on the student net; but we are instead requiring that each student purchase their own (legal) copies of the software just like text book acquisitions. Again, a different kind of reciprocity exists between the student and their own copy; and the networking dilemmas associated with distributing these software products to every possible combination of student hardware is unsolvable with present technology. Special bundle packages (through negotiated grants and site licensing from vendors) are available to architecture students. The software currently being used is Upfront for the conceptual modeling tool, Autocad for the basic drafting engine, and Canvas for graphic design and digital imaging. The visualization package is AutoDesk's Studio 3-D which can be checked-out from the reference library for student use. These vendors have provided significant discounts to our students because of the curriculum requirements.

THE HOLDOUTS

Upgrading the Faculty

Experience here at MSU has demonstrated that it is not the student (nor their parents) who are reluctant to embrace the technology along with the economic consequences. When the computer requirement was first announced to the incoming freshman (in their letter of acceptance to the architecture program), there was not one cry of protest; in-fact, the concerns were: *what machine should we buy?* We actually spent more time trying to convince the students (and parents) to wait on their purchases until we could officially publish the hardware and software requirements. Students know that the operations and integration of the computer in the profession they have chosen is a necessary reality to future employment. And furthermore, the NCARB Architect Registration Exam will be issued on computers in all states in 1996 (followed by the design vignettes later in 1997).

So, why haven't other schools adopted this philosophy? In communicating with colleagues at other institutions it is clear that the faculty have become the major obstacle. It is also evident that a schism seems to exist between the *pure* design faculty and the *so-called* computer literate faculty. History makes matters worse, since, in the past computer labs were often a place for the weaker designers to hide-out (where they could at least learn a slull). And unfortunately, some of faculty running those labs did not command nor demand that the strong designers be encouraged to access this tool. By default, CAD often meant Computer-Aided Drafting—and not Computer-Aided Design. Many *design* faculty are still embracing this mind set. But I am not sure that it isn't just a rationalization for not wanting to learn how to use a new (and sometimes scary) tool.

Through strong lobbying and accessible *rrorr-jargon* language, we were successful in proposing and convincing the S/ARC faculty (5 years ago) to adopt the computer requirement; and included in this approval was an explicit mandate that all studios will find a way to integrate this technology into the studio pedagogy. The discussions at the time centered around the excessive costs which we would be burdening our Mississippi students. The counter-argument to the excessive costs was the suggestion that if one amortizes a +/- $3,000 cost over the course of a five year professional program, it basically costs about $300 per semester for the student. Keep in mind that many institutions are now charging their students as much as $200 per semester for lab fees. The faculty came to accept the economics. (The Vet School here at MSU had already implemented a similar computer requirement over 5 years ago; this precedent here on campus played a major role in the adoption of our proposal. Upper administration had also already been conditioned.) It was also argued that this computer requirement should not occur until the second semester of their sophomore year. This would satisfy a pedagogy which still demands that our students understand traditional media and skills; (as well as allow the student to be sure that architecture is the career they will pursue . . . before having to make this expensive commitment).

Actually, a bigger issue to be confronted was one of *upgrading* the faculty. A majority of the faculty were digital illiterates when it came to graphics; and a few were just naive word-processors. It was determined that each faculty member

must have a graphics engine of their own; and this phase must occur at least one year before the first student purchases. A faculty network was established in a timely manner. *Did the faculty welcome and use the machines?* Maybe half did at first; the rest used them as either ornamental bookends or places to stick yellow post--its (creating a true electronic bulletin board). How to encourage the others to use their machine was actually already calculated into the overall plan. We had always envisioned that when the students started using their machines, the *hold-out* faculty would become uncomfortable and try to come to terms with this tool; and this is the current situation. The students have actually figured out how to monitor log-in time of faculty workstations and see which faculty are even using their machines; or sending e-mail to faculty to also check on us. And they are not shy about sharing this information in the studios.

Ultimately, what we proposed is a grass-roots approach ... put the machine in the students' hands and the faculty have no choice but to confront the issue; otherwise they will be *shut-out* by the students. The students (especially the good designers) do not share the same biases and aversions to the computer as we all once did. It has become clear to our faculty that the students expect their teachers to have this type of information.

We are not really interested in making our faculty into digital wizards, that true expertise lies in other places on this campus. We are architects and designers. What SIARC is providing is the framework for fundamental knowledge to be used and explored; and in many cases these explorations are collaborative between student and faculty... often with the student taking the lead.

PUSHING THE LIMITS

High-end Visualization Virtual Reality

The students are quickly exceeding our expectations; a few have already *outgrown* their Pentiums and need a Silicon Graphics fix. So, the next evolutionary step (our third major phase) is to establish a high-end visualization lab to augment the more pedestrian machines which the students own. The School's visualization skills have propelled our faculty and students into other arenas on campus. We have become major players in film and video presentations. As a result, we have recently received significant grants from the state (addressing master planning and economic development proposals). The spin-off of these grants has funded a *Digital Research and Imaging Lab.* This lab, located in our building, is providing high-end video/animation resources for our students and faculty.

Also, the MSU National Science Foundation's Engineering Research Center (NSFIERC) provides a specialized component curriculum for the architecture students who wish to pursue professional film-making digitally and Virtual Reality. We have one of a few undergraduate programs in the country which provides unlimited high-end VR technologies to its students. The NSFIERC Computer Graphics and Virtual Environments Lab provides a comprehensive resource. The expertise which exists at this center is of international stature. Thus far, it has not been a problem to encourage students to take advantage of these resources. The most exciting part is that it is the better design students who are challenging these limits; we make a conscious effort to screen-out the students who are avoiding design issues to hide and draft in cyberspace. The high-end equipment is reserved for those who are challenging the media in their design processes. Currently, the School of Architecture is in a joint partnership with the NSFIERC; allotted space and machines are provided for the faculty and students. And it is these types of planned relationships which make our computerization program very comprehensive in nature (even when funding is unavailable for our own internal lab).

A MODEL FOR THE NEXT MILLENNIUM

Luxury vs. Necessity

This *Notepad in Every Backpack* proposal is clearly a model for the 1990s (and the twenty-first century). This *technology tool* is not a luxury anymore; and it should not be housed in highly specialized showcase rooms. There are precedents for this model at this university and at other institutions nationwide; however, SIARC is the first school of architecture (in the U.S.) to officially implement this plan. The model solves many economical and pedagogical factors in the education of an architect; and more importantly it immediately makes the digital technology available to the student even if the institution has limited funds and cannot provide those minimal resources. As the pocket calculator emerged and flourished in the 1970s, so goes the computer in the 1990s.

We have empowered our students, and the impact it has already made within the architectural community at the state level is overwhelming. Its true measure lies in the response which we have received from the students within the program; whether it exists or not, the students here feel that they have *an edge* in their education. When upper level students, without the original curriculum requirement started purchasing machines as well, this also indicated an acceptance far beyond our expectations.

In closing, it seems to me that if a private institution (with Ivy League prestige) was presenting this proposal, then its apparent significance would be questionable as a viable model; but when a state institution in Mississippi can make this work, then it truly establishes a precedent for the inevitable digital paradigm still facing other architectural programs.

NOTES

This model presented was developed by the author along with the support of the dean, John McRae, the associate dean (current), Rodner Wright, the associate dean (at the time), Christos Saccopoulos, and senior faculty member Professor Michael Fazio. Without their advice, passion, and consultation, this program would not have become a reality.

Faculty/Staff Network: network consists of fifteen Sun Sparc IPC Workstations tied together with a Sun Sparc II server and Sparc printer, and 5 Macintoshes.

Student Net (Docking Stations): 20 Docking Stations located within S/ARC Bldg. close to studios; the student net is accessible via modem; equipment hanging off this net includes: two 11x17 post script laser printers; one 11x17 color ink jet printer; E-size color plotter; one color dot matrix printer; one Mac workstation with flat-bed and slide scanning devices and removable disk drives. (This network is driven by a Novell Netware product on a 486 server; the actual docks consist of modified library study carrels tied in a daisy-chain ethernet with a portable ethernet adapter at each locale.)

Student Required Hardware: The Fall '95 portable computer (minimum) standards will be: a 486-based PC (math coprocessor as necessary) with 16 Mb RAM (minimum) and 250 Mb Hard Disk (minimum); or a Macintosh Power PC w/16 Mb RAM (minimum) and *250* Mb Hard Disk (minimum). Both platforms must support VGA Color output.

Student Required Software: Conceptual Modeling Software will be Upfront (latest version); Autocad Release 13 w/ AME; Canvas; Director; and required network software provided by the school free of charge.