Visualizing Digital Atlas Information Products and the User Perspective

The digital revolution and associated advances in multimedia and electronic information transfer have opened hitherto unthinkable opportunities for atlas design and distribution. As a result, the status quo of the conventional atlas is being challenged by a research community eager to move towards sophisticated digital atlas products. The assumption made by the digital atlas research agenda is that atlas users share the researchers' enthusiasm for digital atlas products. It is argued that contemporary advances in digital atlas design are driven by computing innovations; that is, researchers are embracing faddish technologies to advance imaginative new atlas products with little attention given to the atlas user community's wants and needs. It is proposed that the design of innovative digital atlas products be paralleled and influenced by atlas consumer research. Atlas user surveys are called for to evaluate the market's reaction to conventional atlas products and to test the atlas users' willingness to use and pay for innovative digital atlas products.

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THE DEFINITION DILEMMA

The advent and popularization of the digital computer and associated digital data management capabilities have not gone unnoticed in the atlas research community. A number of commercially available electronic atlas products began to surface in the latter half of the 1980s, and there appears to be a growing interest in the design and production of digital atlases in the 1990s.

The term "digital atlas" is now being used to market quite an array of products. Some digital atlas products, such as the *Electronic Atlas of Arkansas*, have the appearance and feel of a facsimile of the analog atlas, where flipping of the page has been replaced by the keypad or mouse. Other digital atlas products, for example the *Digital Atlas of Sweden*, are moving away from the traditional atlas concept. Their look and feel is more akin to that of an electronic information browser including hypertext data access and basic analytical capabilities. In addition, there are now some products marketed as digital atlases that are difficult to distinguish from sophisticated multimedia regional information systems where the map is but a small part of the overall information base. To muddle matters even more, some government agencies have decided to call their growing digital topographic basemap coverage a "digital atlas," as is the case in the province of British Columbia in Canada.

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The emergence of all these different products under the name of "digital atlas" is confusing to both the research community and the atlas users. In response, the research community is attempting to define what a digital atlas ought to be. A problem here is that the progression from the conventional paper atlas to some form of digital atlas product is in an early stage of transition; it is foreseeable that the digital atlas concept will continue to evolve as long as we continue to be confronted with innovations and the rapid rate of change imposed on society by the computing

industry. In short, the digital atlas is in an evolutionary stage; it will not stabilize for quite some time and any attempt at firming up a definition may be premature. Indeed, the digital products that might eventually end up replacing the traditional atlas may no longer be "atlases" according to established conceptions; instead, they may be some form of digital atlas information system (AIS).

TOWARDS VISUALIZING THE ATLAS OF THE FUTURE

Evolving computing technologies will continue to widen opportunities for innovation in digital atlas design. On the one hand, this is desirable since research ought to investigate as many avenues of innovation as possible (of course this assumes that research funds are available to conduct this work). On the other hand, the risk is that atlas researchers will jump on every technology bandwagon while losing sight of why they are developing digital atlas products and for whom. In other words, we may be getting so excited about playing the high technology game that we are letting computing innovations set the digital atlas research agenda, instead of the reverse.

This beckons the question of what the ideal atlas of the future should look like. What are our goals when designing digital atlas products and what are the ultimate objectives? Who is our market? In order to answer these questions, we need to re-direct some of our thinking towards visualizing atlas products of the future irrespective of computing innovations or computing constraints. In short, we need to reflect on and to re-think the concept of an atlas.

How ought the atlas of tomorrow differ from yesterday's atlas? Four areas come to mind. First, one could speculate that the future atlas will contain expanded information contents; that is, the future atlas should contain information previously thought impossible to include in an atlas. Second, one might expect that the atlas of the future should allow us to move beyond merely viewing information; that is, the user should be allowed to interact with and analyze the information contents. Third, one could argue that the layout and design of the future atlas should change. We already know that we can digitally re-package information contained in a traditional atlas using multimedia capabilities and hypertext, but there may be other desirable changes to layout and design. Finally, one might wish to re-think the method of atlas information access. Fiber optics, the information super highway, and satellite data transmission are offering opportunities to go beyond floppy diskettes or CD-ROM to access atlas information, and the atlas of the future could easily make use of these technologies. The following sections will examine the above four areas of possible change in more detail.

CHANGE IN ATLAS THEMATIC CONTENTS

In order to contemplate expanding or otherwise changing thematic contents in future atlases, it would help to determine whether or not an established tradition of atlas contents actually exists. If such a tradition is found, the next step is to evaluate whether or not the atlas user community has been satisfied with it.

A number of studies (Stephenson and Galneder 1969; Kent and Tobias 1990; Hocking et al. 1991; Keller 1993) have examined contents of traditional regional atlases. A number of conclusions can be drawn from these studies. First, it would appear that the conventional regional atlas commences with a general and physical introduction to a region. This is followed by thematic coverage of economic activity and the socio-cultural environment. There appears to have developed, therefore, a tradition of

well-established atlas themes and topics; a tradition first identified by Salichtchev (see Fremlin and Sebert 1972).

Second, over time, there appears to have been a gradual switch in emphasis from topics covering "General" and "Physical" themes towards topics covering "Socio-cultural" themes. In other words, there has been a shift in emphasis away from the physical and towards the human dimensions of landscape and environment.

Third, one can conclude that there has been a trend to move away from strict depictions of spatial distributions and relationships towards the "telling of a story." This trend has manifested itself in two ways: (1) atlases contain increasing amounts of non-map information items (notably text, figures, photographs, and tables), (as opposed to simply depicting primary spatial information gathered in the field), and (2) in terms of information presented, preference has been increasingly given to data that has been "knowledge engineered" and "expert interpreted." This trend appears to parallel a move in the news media where there exists a shift away from a strict reporting of facts to the broadcasting of experts' interpretations of the facts from different viewpoints.

From the literature, it would appear that surprisingly little market research and surprisingly few user surveys have been conducted to solicit the atlas readerships' reactions to our products. We appear to have been content to produce atlases that please ourselves, the experts.

Is the atlas-user community satisfied with the above noted traditions of atlas contents and the observed trends through time? Does the atlas user community want change? We have not given this line of questioning a high priority in the past; indeed, it could be argued that, so far, we have not cared to address the atlas users' wishes at all. From the literature, it would appear that surprisingly little market research and surprisingly few user surveys have been conducted to solicit the atlas readerships' reactions to our products. We appear to have been content to produce atlases that please ourselves, the experts. Thus, the honest answer to the above questions about user satisfaction with respect to traditional atlases is: we don't really know.

Pilot user surveys conducted by the University of Victoria's Spatial Science Laboratories (Hocking 1991; Hocking and Keller 1992a/b; Keller et al., under review) found that atlas users are generally satisfied with the traditional themes and topics, they do not crave highly specific topics, and they lack enthusiasm for maps showing information based on complex calculations and excessive expert interpretations. However, this study's sample may be too small and the surveys too local to draw general conclusions.

Given the above observations, are we in a position to speculate what the expanded information contents of the future digital atlas should look like? We can assume with some certainty that atlas editors will not suddenly get involved in primary data collection. Future atlas initiatives, therefore, will continue to be constrained by what data are gathered and made available at reasonable cost by somebody else. As a result, we need to accept that we do not know what sort of additional information the atlas user community wants.

Overall, it would appear that we are at present poorly prepared to visualize and plan for the expanded information contents of the atlas of the future. It would seem reasonable, therefore, to dedicate research efforts towards two goals. First, we need to learn more about the needs and wishes of the atlas market, which is something we could achieve by conducting wider ranging user surveys and market research. Second, we should allocate time to identifying what hitherto unavailable information sources of potential relevance to an atlas may become available in the future. We should investigate whether there is a demand for these

information items and, if so, how these information items can best be included in an atlas.

ADDING INTERACTIVE AND ANALYTICAL CAPABILITIES

The traditional atlas has supported no interactive capabilities and only very limited analytical ones. The main reason for this has been that images printed on paper simply do not lend themselves to easy manipulations for query and analysis. The main purpose of the traditional atlas, therefore, has been to provide information for visual analysis. The digital revolution may change all this. The geographic information systems (GIS) research community has made tremendous advances in the digital analysis, interactive query, and selective combination of spatial data and associated attribute information. There is nothing to stop the atlas of the future from including some or all of these analytical capabilities. Inclusion of all the analytical capabilities offered by contemporary GIS in a digital atlas would, of course, imply that the GIS is a form of digital atlas and visa versa.

However, given the excessive cost and lack of user-friendliness associated with most GIS systems on the market today, it is unlikely that the atlas user community will endorse a GIS as the atlas of the future for some time to come. A subset of all GIS analytical capabilities will therefore need to be selected for inclusion in a digital atlas. This raises the question of how to select which capabilities should be included. The traditional approach would be to let the atlas experts decide this question. A more appropriate approach, however, might be to consult the atlas-user community.

A number of pilot user surveys conducted by the Spatial Science Laboratories at the University of Victoria (Hocking 1991; Hocking and Keller 1992a/b; Grant 1994; Keller and Grant 1994; Keller et al., under review) have found that the user has some very clear ideas about what analytical capabilities to add to digital atlases and maps. It would appear that, most of all, the user wants analytical capabilities to explore comparison and change. The so-called "Jones Syndrome" appears to be inherent in human nature; we wish to draw comparisons and to evaluate how we are performing relative to somebody or something else. Users thus wish to have available analytical capabilities to answer questions such as:

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- How am I doing compared to . . . ?
- How many regions pay higher property taxes . . . ?
- How bad is air pollution in my neighborhood relative to . . . ?

We also appear to be fascinated by the temporal dimension of change–both absolute and relative. Users thus wish to have access to analytical capabilities that could answer questions such as:

- By what percentage have house prices increased in my neighborhood since last year . . . ?
- Where have house prices increased more in the same time period . . . ?
- How has air pollution in my neighborhood changed since . . . ?
- Where has the change in air pollution been better . . . ?

Beyond a doubt, there are other query and analysis capabilities of interest to the atlas user community, and the temptation exists to assume that the atlas user wants everything. If the latter will prove correct in the long term, then a digital atlas will become a digital atlas information system that closely resembles a GIS. Some day this may be possible, as long as the GIS community advances its products to become more user-friendly and intuitive. Our present experiences with GIS, however, tell us that we have not succeeded in packaging all analytical capabilities in a user-friendly and memory efficient manner. Atlas researchers, therefore, should direct research efforts towards identifying and prioritizing what GIS analytical and query capabilities the atlas user community really wants. The next step, of course, is to figure out how best to package these capabilities in an intuitive and user-friendly manner.

CHANGES IN LAY-OUT AND DESIGN

A third area where the future atlas may differ radically from the traditional atlas is in the layout of information and in the design of the user interface. Atlas products already exist on the market that have demonstrated that we can digitally re-package information contained in a traditional atlas by using multimedia capabilities and hypertext, and the first animated atlas modules are emerging out of the research laboratories.

Judging by some of the atlas products under development and on the market, it would appear that experts' visions of the design and layout of the atlas of the future vary widely. Some appear to believe that the future atlas should maintain that traditional air of authority by preserving a strong pedagogic feel. Others seem to place efforts on improving the atlas's "Fahrvergnügen" by moving towards an emphasis on atlas "Disney-fication"; the emphasis would make the digital atlas fun to use. Some are including lots of electronic "gee whiz" gimmicks while others favor the "KISS" (keep it simple silly) approach. Some are trying to offer a large set of analysis and query capabilities, while others favor adding minimal analysis or none at all. Some emphasize innovative ways of viewing information, including animation, while others are sticking to conventional map formats.

One thing that has become obvious from all these diverse research efforts is that we are serious about abandoning the traditional atlas concept in favor of something different. We appear to be searching for a new atlas vision and we obviously need room for experimentation to find it. In the search for this new vision, the question should not be whether the atlas of the future should be animated and make noises or whether it should emphasize what insight and knowledge one can gain from it; rather, the question ought to be whether the atlas user community will endorse and pay for the atlas products we are developing. After all, the users' willingness to purchase and use our new products will be the ultimate yardstick of success or failure.

One thing that has become obvious from all these diverse research efforts is that we are serious about abandoning the traditional atlas concept in favor of something different.

In the past, we have paid little attention to the needs and wishes of the atlas user community; we have not worried about the market's endorsement of our products. However, the only way to find out which of the innovative digital atlas ideas have merit is to prototype them and subject them to rigorous market scrutiny. We need to develop research methodologies to allow user groups to compare and contrast the relative merits and drawbacks of different, innovative digital atlas prototypes, and we need to conduct the necessary user surveys to find the answers.

CHANGES IN METHOD OF DATA TRANSFER AND ACCESS

How will the atlas of the future be marketed and delivered to the user? The traditional media for atlas production was paper, and the traditional market place was the book store. More recently, however, we have experimented with floppy diskettes and we are now well into endorsement of CD-ROMs. Marketing of the new digital products tends to be less through bookstores than through computer hardware vendors, software brokers, and catalogs. We are beginning to talk about side-stepping retailing altogether by exploring the possibility of allowing the consumer direct access to atlas information using the electronic super highway. Finally, there is some talk of the application of virtual reality to deliver atlas images; and futurists are warming us to the idea of experiencing a geographic region and its social environment using the idea of media like the Star Trek series' Holodeck.

It should become obvious from the above that the technologies underlying the packaging, transfer, and visualization of digital data are undergoing rapid advances. These technologies represent moving targets in the mid 1990s that are hard to keep up with.

Given the instability of these technologies, we should not worry about them when conceptualizing the atlas of the future. We should not let our creativity be constrained by the limitations of today's information technology. We should assume that future data transfer and manipulation technologies will exceed all of today's constraints. We should accept that we are close to a computing environment where the overriding technical criteria of importance will become the physical dimensions and capabilities of the receiving and display units, and that the weakest link in the information processing chain may well become our own limited capacities to handle neural information processing.

SUMMARY

The digital revolution will impose considerable change on atlas cartography. Traditional paper atlases will be produced and marketed for quite some time to come. However, their merit and viability will be increasingly challenged by innovative digital atlas products. These new atlas products will change the image of the atlas as we know it today. In fact, they may well advance the concept of "an atlas" towards that of a sophisticated atlas-based, integrated information system.

Today, we can only speculate what exact shape these new atlas information products will take; the digital technology revolution and the information revolution are still too young to forecast their exact impacts. A point made in this paper is that, in the process of visualizing innovative atlas products, it is not appropriate for atlas makers and cartographers to be guided by and drift with technology trends, adopting and adapting technology. We need to visualize the next generation of atlas products by looking beyond the limitations of today's technology capabilities. Instead of following technological innovations, we should identify what technological capabilities we need and direct the computing industry to deliver on our needs.

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A second point elaborated in this paper is that we should start seriously to consult the atlas user community when visualizing the next generation of atlas products. We should ask the atlas readership to tell us what information contents and what query and analytical capabilities we should be adding to the future atlas, and we should give the users a chance to tell us their preferred methods of information access and retrieval.

A question that this paper has failed to address is: who should conceptualize, operationalize and maintain the next generation of digital atlases?

It is anticipated that the future digital atlas information systems will be beyond the skills and capabilities of the traditional team of individuals putting together a paper atlas. The know-how, funding, administration, and technological requirements necessary to make the next generation of digital atlas information systems work will exceed the capabilities of any one individual or stakeholder group. These new atlas products will need to be conceptualized, developed, and administered by a consortium of experts from universities and research institutes, industry and government.

The biggest challenge facing any new atlas initiative in the 1990s is to secure the considerable financial support required to make it all work. The atlas research community needs to share information about how to politic and bid successfully to secure the necessary funds. One thing is for sure: having a well-defined and exciting product vision that has received endorsement from the atlas user community will lend credibility and weight to an effort to secure atlas funding.

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RESUMEN La revolución digital y los avances relacionados con la transmisión de información han abierto grandes oportunidades para la distribución y el diseño de atlas. Como resultado, el atlas convencional ha sido retado por un grupo investigativo deseoso de alcanzar atlas digitales sofisticados. La hipótesis hecha por el programa para investigación de atlas digitales es que los usuarios de atlas comparten el entusiasmo de los investigadores por atlas digitales. Se discute que los avances contemporáneos en el diseño son manejados por innovaciones computarizadas; esto quiere decir que los investigadores están adoptando tecnología caprichosa para conseguir nuevos atlas imaginativos con poca atención dada a las necesidades de los usuarios de atlas. Se propone que el diseño de atlas digitales innovativos sea paralelo e influenciado por investigación de usuarios de atlas. Los estudios de usuarios de atlas hacen un llamado para evaluar la reacción en el mercado de atlas convencionales y para examinar la buena voluntad de los usuarios para usar y pagar por atlas digitales innovativos.

SOMMAIRE La révolution numérique et le transfert de l'information multi-médiatique et électronique a mis au jour des opportunités jusqu'à présent inimaginables de conception et de distribution des atlas. Il en résulte que le status quo de l'atlas conventionnel est mis au défi par une communauté de chercheurs anxieux de passer aux atlas numériques sophistiqués. Les chercheurs ont émis l'hypothèse que les utilisateurs d'atlas partagent leur enthousiasme pour les atlas numériques. On prétend que les avances contemporaines dans la conception des atlas numériques sont entraînées par les innovations informatiques, c'est-à dire que les chercheurs embrassent les technologies à la mode pour produire de nouveaux atlas imaginatifs, sans prêter grande attention aux désirs et aux besoins des utilisateurs. On propose que la conception d'atlas numériques innovateurs se développe parallèlement avec, et subisse l'influence de la recherche auprès des utilisateurs d'atlas. Les enquêtes menées auprès des utilisateurs sont nécessaires à l'évaluation de la réaction du marché aux atlas conventionnels ainsi que pour tester la volonté des utilisateurs d'employer des atlas numériques innovateurs et d'en payer le prix.