COMPUTER VIDEO-IMAGING: SIMULATION TECHNOLOGY FOR DISTURBED LAND REHABILITATION[1]

by

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Abstract. This paper describes the major issues associated with the use of computer video-imaging simulation as a planning and evaluation tool for disturbed land rehabilitation. Hardware and software specifications and capabilities as currently used are discussed, along with advantages and disadvantages. Specific guidelines for use of the technology on disturbed lands are illustrated with several case studies.

Additional Key Words: landscape architecture, landscape visual analysis, visual simulation.

Introduction

Landscape scenic quality is a major concern in landscape management (U.S.D.I. Bureau of Land Management, 1980), including surface mined land planning, transportation planning and design, and forest management. The public will consistently describe the negative effects on the scenic quality of surface disturbed lands as highly important. The public may or may not be aware that surface disturbances frequently have negative impacts on environmental resources such as water quality, soils, vegetation, and wildlife; but they have no doubt of the impacts on visual quality and are very concerned about them. They will often pass judgement on the acceptability of a surface mine or highway, for example, based on the visual disturbance to the landscape.

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[1]Paper presented at the 1991 American Society for Surface Mining and Reclamation "Reclamation 2000" Conference, Durango, Colorado, May 13-17, 1991.

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Proceedings America Society of Mining and Reclamation, 1991 pp 669-676
DOI: 10.21000/JASMR91020669
https://doi.org/10.21000/JASMR91010669

Visual Simulation

Definition and Uses

Visual simulation is defined as the realistic visual portrayal which demonstrates the perceivable changes in the landscape features of a proposed management activity through the use of photography, artwork, computer graphics, and other such techniques (U.S.D.I. Bureau of Land Management, 1980a).

Sheppard (1986; see also 1989) lists the ways in which visual simulations can be used in project analysis:

1. As a design tool in the development of a project.
2. As an analytical tool for those reviewing the project, for example, the project client, government agencies with regulatory powers, and third-party environmental consultants.
3. As an information device in presentations about the project to the public and interested parties.
4. As a stimulus for eliciting certain responses toward the project from public, key informant, or other groups.
5. As documentary evidence in environmental reports and legal testimony.

Chenoweth (1989) describes four roles for video-imaging technology in aesthetic policy development, implementation, and evaluation:

1. A tool for enforcement of public rights to know the aesthetic consequences of environmental modifications.
2. As negotiated legal documents.
3. In developing perceptually based performance standards.
4. For assessing aesthetic damages.

Sheppard (1986) says that the rising demand for visual simulations may be partly due to a lack of confidence in complicated methodologies for analyzing a proposed project's visual impacts, whereas simulations can often quickly confirm or deny an analysis or conclusion. "They permit laypeople and experts alike to put the project into an actual context, focus on specific hard issues, and form opinions independently of any methodology" (pp. 188-189).

Characteristics of Simulations

Sheppard (1986) lists the characteristics of visual simulations:
representative - portray views and conditions which typically would be experienced by significant numbers of viewers at important times.
accurate - a direct relationship is assumed between levels of accuracy and human response, although research has not clearly defined the boundaries of this relationship (Sheppard, 1982; Bishop and Leahy, 1989; Ellsworth and Palmer, 1990). The achievement of absolute accuracy is not possible because simulations cannot predict the exact nature of a future reality; there are too many variables that can change before a project is completed. Simulation accuracy must be based on the information currently available for the project.
credible - involves the effective communication of information; how convincing is the simulation to the viewer.
comprehensible - related to credibility and involves the ease with which simulations are understood by the public and are applied to project evaluation.
bias free - simulations are meant to elicit evaluations which are as unbiased as possible and which will not mislead the viewer.

Computer Video-Imaging

Video-imaging computer systems can produce highly realistic two-dimensional images, of near photographic quality. With the introduction of affordable systems in the mid-1980s, computer video-imaging has received much attention from landscape architects and other environmental designers (Orland, 1986; 1987; Vining and Orland, 1988). Using off-the-shelf computer and video technologies, video-imaging is an exceptional technique for simulating landscape changes. The process uses the computer/video equipment to "capture" an image of the existing site and of other sites where similar landscape changes have already been made (these images are usually photographs which have been scanned or video-photographed). These images are electronically combined to produce a simulation of the proposed project. The simulation is then recorded onto video tape, film, or hard copy print for presentation. The quality of the equipment used, an understanding of graphic principles and design implementation, operator skill and familiarity, as well as an understanding of the potentials and limitations of the technology will determine the quality of the final image. The product is a two-dimensional, realistic image of the existing site and the proposed condition. Accuracy of the simulation is dependent on the capabilities of the software and hardware, the accuracy of the images captured, and the ability of the operator to interpret design intent through plans and drawings (Ellsworth, 1989).

Video-imaging systems can be configured using a variety of desk-top computer systems. The IBM/DOS environment is probably the most common at this time. Truevision's TARGA® and VISTA® video/graphics boards, operating with third party vendor software are used by many environmental designers and planners. The MacIntosh computer systems are supported by the Truevision NUVISTA® video/graphics board, among others, and several brands of software. These boards are available in a variety of models, yielding over 16 million colors in the 24 bit version. The 16 bit boards, with a capability of over 32,000 colors, are the most popular. There are also systems based on the Amiga computer products which are quite useful but not as common. It is possible to interface many of these systems with computer aided design software, such as AutoCad®, for projects that require high levels of accuracy relative to the proposed design drawings.

The advantages of video-imaging systems include high levels of realism, speed and flexibility in developing simulations and alternatives, and a variety of output formats and media. They are relatively inexpensive. They allow the simulator to hold constant all content variables except the exact surface disturbance being considered, thus facilitating the exploration of alternatives.

There are some disadvantages. It is very easy to lie with video-imaging technology, either by accident, omission, or on purpose. In some cases, clients may ask the simulation specialist to "make the project look good", and this is quite easily done. Clients may also reject the technology because it is *too* good -- artist's renderings are easier to "fudge". The realism of a video-imaging simulation can be deceiving and should be questioned at each stage of development by the simulator ("can it really be built that way?"), by the client ("will we really make it look like that?"), and by the public ("that looks just fine to me, as long as that is how it's built!"). Finally, although the cost of the hardware and software ($15,000 to $50,000) is generally within the range of many landscape architectural offices, significant expense can be incurred in actual development of individual simulations. There is time and expense in field photography work, computer time, designer's time, and any specialized hardware or software that may need to be purchased, rented, or subcontracted. A major expense that must be carefully controlled is the time in review and revision. Clients will often assume that to make "a few changes" will not involve much time or expense and should be done for little or no fee, whereas in reality the cost of each minor revision will accumulate rapidly.

Video-Imaging Simulation and Disturbed Land Rehabilitation

Pre-disturbance Planning

As noted previously, the visual consequences of surface disturbing activities are often severely criticized by the public. Video-imaging simulations can be effective planning tools. The visual characteristics of each alternative can be portrayed and the public response can be gauged. Users both familiar and unfamiliar can respond to the visual characteristics of the proposed landscape. The assumptions and judgments of experts can be tested.

Additionally, information on natural resource values other than visual impacts can be communicated with video-imaging simulations. For example, if wildlife habitat is a major issue, a properly developed simulation will describe the topography, plant species mix, cover availability, surface water conditions, and other factors important to animals. This visual information is valuable not only to habitat managers but also to users such as hunters and bird watchers. Lengthy text descriptions may specify the kinds and numbers of critters to be expected on the site after rehabilitation, but a picture is truly "worth a thousand words" in helping professionals and amateurs to evaluate the intent. Simulations of alternative schemes can illustrate the emphasis placed on wildlife, or water quality, or reforestation.

Post-disturbance Rehabilitation Evaluation

The level of rehabilitation success can be evaluated using the pre-disturbance simulations (Ellsworth, 1990). If the simulations are reasonable representations of the actual post-mining condition, then visual rehabilitation is achieved. Often rehabilitation success cannot be gauged immediately, but must be monitored over a number of years. Surface coal mining, for example, is regulated by the Surface Mining Control and Reclamation Act (US Congress in 1977), and requires five to ten years for assessment of successful revegetation before bond release.

Case Studies

The author described several case studies and showed examples of video-imaging simulations as a rehabilitation planning and evaluation tool on surface mines, highways, and forest management projects.

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