MIT GAMES-TO-TEACH PROJECT

Design Document for:

DAEDALUS' END: *CIVIL AND ENVIRONMENTAL ENGINEERING IN THE CONTEXT OF DEVELOPMENT AND GLOBALIZATION*

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DESIGN HISTORY

Version 1.10

Version 1.10 includes some design changes incorporated after making my initial at the design, based on input we received from the team during informal evaluation sessions. Changes made include:

1. A re-evaluation of the primary educational objective of the game to focus more extensively on development ethics training and awareness of globalization issues for civil and environmental engineering students.
2. Based on input from MIT Civil Engineering professors, we have broadened the scope of the game to a more general development-management orientated "simulated world" rather than focusing heavily on dam construction.
3. Re-assessed the balance between the immersive "real-world" aesthetic to be more accommodating for gameplay without sacrificing the compelling relevance of addressing real-world issues.

DAEDALUS' END:

CIVIL AND ENVIRONMENTAL ENGINEERING IN THE CONTEXT OF DEVELOPMENT AND GLOBALIZATION

Hook / Introduction

"THE INTERNATIONAL WATER EXECUTIVES WHO WERE ACTUALLY DOING THE WORK IN THE CITY WERE ENGINEERS, NOT MARKETERS, AND, BEING FROM ABROAD, THEY WERE NOT ATTUNED TO THE PROBLEMS AND PASSIONS OF THE BOLIVIAN PUBLIC [WHICH LED TO WIDESPREAD URBAN RIOTING]. THE CONSORTIUM HAD ALSO AGREED TO FINISH A STALLED DAM PROJECT, WHICH WOULD PIPE WATER THROUGH THE MOUNTAINS. THIS ASPECT OF THE DEAL SEEMED TO MAKE LITTLE SENSE – THE WORLD BANK HAD COMMISSIONED STUDIES THAT PRONOUNCED [THE PROJECT] UNECONOMIC. BUT THE DAM LESS TO DO WITH HOW PRIVATIZATION WORKS IN THEORY THAN WITH THE REALITY OF HOW MULTINATIONAL CORPORATIONS MUST COME TO TERMS WITH LOCAL POLITICS."

extract from "Leasing the Rain", *The New Yorker Magazine*, April 8, 2002

- The teaching of ethics in a global/societal context is now becoming a standard priority for 21st century university engineering courses. At the same time, surveys of engineering students and faculty indicate a widespread cynicism, wariness, or nonchalant attitude to the teaching of engineering ethics. But traditional methods of engineering ethics teaching fail both in attracting much student interest. But the same surveys also indicate that engineering students *are* interested in social issues, and cross-cultural relations in a globalized world. This situation strongly suggests that there is a great opportunity for developing and marketing an engineering ethics educational game that provides immersive and authentic access to real-world global/societal concerns and cross-cultural communications.[see URL:onlineethics.org/essays/education/herkert2.html?text]

- A non-computer based simulation which is a precedent for *Daedalus' End* is the commercially marketed live action globalization roleplay simulation, *Global Simulation*, which has been hired by corporations such as IBM, General Motors, and Motorola, and by university institutions such as the Yale School of Management and the Wharton Business School.URL: www.worldgame.org/mba/menu.shtml

Premise / Overview: negotiation-centered turn-based MMORPG where students roleplay consulting engineers trying to find technical solutions in the complicated web of economic tradeoffs, social unrest, ecological pressures, and *realpolitik* compromise in the world of Third World development.

Target Audience: engineering, economics, business, development students; NGOs, development agencies, corporations, engineering firms, consultancies.

Pedagogical Approach: immersive roleplay; information gathering, evaluation, negotiation; demographic/ecological simulation; cross-cultural, cross-political multiplayer experience

GAME OVERVIEW

Backstory

It's the beginning of the 21st century, and the tasks of industrial and infrastructural progress in the developing world face as much social unrest, political compromise, economic scarcities, ecological disruption, international disputes, and cross-cultural misunderstandings as ever. The new generation of global engineers are called upon to undertake managing these tasks with a more holistic and active ethics than ever - but can these ideals survive the pressures of the real world? You take on a consulting role as a civil and environmental engineer advising one of a variety of factions involved in a realistic developing country environment. Each faction, advised by a different player in a cross-cultural, globally online multiplayer platform, has a different agenda that is likely to conflict with, or complicate others' - national governments, local rights activists, environmentalist groups, international financial institutions, aid donors, and development agencies. Your goal is to balance technical engineering ideals and solutions, demands of your faction, the *realpolitik* and economic struggles of development, and the short and long term consequences of the projects you are involved in on the country's progress.

GamePlay

A/ Development Projects

In *Daedalus' End*, development projects represent the "mission structure" of the game. Each development project (several may be occurring simultaneously at different individual stages of progress, with interlinked and overlapping impacts and effects on the ecology, economy, etc etc) consists at heart of a series of critical decisions about the technical specifications and scale of a project (for instance, how much land a dam should flood; how polluting a power plant to build etc). Projects are preset in their initial configurations to favor the agendas of certain (but not all) powerful factions. Players must work in the game to either defend their preferred configuration or to influence a configuration more favorable to them. These goals will require data-gathering and negotiation. Players affiliated with weaker faction may start off with a better position for data-gathering or access to local social networks.

In *Daedalus' End*, players choose from a range of faction affiliations. These affiliations may include international development agencies, regional governments, multination corporations, and environmental activists. Many factions will be roleplayed by players based anywhere with a connection to the *Daedalus'* online servers. Some factions may be played by computer AI, depending on player configuration and preference (for instance, in one game, all the most powerful factions could be AI-controlled, to give all human players an experience at playing the underdog.

B/ Gameplay Environments

To succeed at furthering their agendas, players must explore and effectively exploit the three information environments of a game . The three environments are

- the "live and actual" landscape populated by AI-driven characters who can be encountered by the player. This landscape is seen through a freely mobile first-person perspective. Graphically, this will look like the experience of walking/driving around an actual landscape. The landscape (buildings, vegetation, water landmarks etc) would change as development projects impact the area;
- a "computer-analyzed" landscape, graphically represented as a muli-function "satellite map" with a range of selectable information overlay tools representing the actively changing demographics, ecologies, economic flows etc.;
- and the engineering information map and archive. The map illuminates the various flows, relations, and histories of the multiple development projects

across the landscape. The archive provides access to library simulations of technical engineering concepts.

C/   Investigation and Data Collection Gameplay

The general aim of the player in all three environments is to collect "data modules". These will have both informational (i.e. educational) content in themselves, *and* gameplay significance. In the negotiation/decision-making stage, they may act as items in trading gameplay with other factions, or as a modifier of relationships with other factions. In further data-gathering stages, previously obtained data modules may act as access modifiers to social networks and technology trees. Certain sensitive, or "classified" data modules may be "made public" (i.e. revealed to all players) in order to trigger arena-wide effects.

Time and Money Limitations to Data Collection

All players are constrained in the amount of data discovery and collection each turn by two limited resources – time and money per turn (your faction's funding of your consulting engineering team). Different actions in the three gameplay environments require different amounts of time and money (for instance – walking in the first-person perspective – time-consuming but free; taking a helicopter in the first-person perspective – very expensive but fast. Buying a computer downlink from a weather station in satellite mode – instant but expensive. Researching engineering designs in archive/library mode – costly and time-consuming.). Your faction affiliation will determine your time/money resources per turn, and will also affect the costs, or even availability, of actions relative to other factions. For instance, if you roleplay an engineer affiliated with a powerful, wealthy faction, such as the World Bank, you may have very large financial resources, but be under more time pressure to prove success. Prices of local services (such as taxi service in first-person mode) will be higher for wealthier or more notorious factions. For contacts with very bad relations with your factions, services or information may be completely available. Satisfying your faction's agenda for you, or strengthening your faction's influence and authority can provide further funding and time for you after successful project completions.

Data Modules
Data modules would represent a range of valuable information types. Examples of data modules, which have varying impacts and bonuses towards a player's success, depending on faction affiliation and limitiations, might include:

Data from the first-person encounter environment:
• encounter with international news network television journalists covering the growing social unrest sparked by a unpopular development project

[effect: an arena-wide effect (unless supressed) of increasing the weight given to local social concerns and problems in the trading/negotiation process.]
- contact with a special local dignitary of influence who can mediate access to and potential influence with previously alienated local factions
[effect: access to new contacts and relations; this also increases your time efficiency in the local area]

Data from the satellite map environment:

- scientific read-outs predicting previously unanticipated seasonal changes to pollution patterns following an engineering scheme.
[effect: high value for an environmentalist faction. May be made public to damage the negotiating strength of all industrialist factions – such factions might trade/negotiate to supress such data]
- the market analyst's report from a Western investment bank identifying one potential site for an engineering project as a promising investment opportunity.
[effect: high value for economically or financially motivated factions. Public arena-wide effect of lowering local resistance. Increases players' financial resources through new funding by investors]

Data from the engineering archives environment:
- the classified negative social assessment of an engineering design by an international development agency
[effect: public release of this data undermines the value of a certain engineering design – whether in other players' design libraries, or you own.]
- the blueprints, and usage rights to them, a new engineering design for a cheaper, cleaner power generator
[effect: expansion of technology tree – one more development project design possibility is available to the player's faction. this also has a high trade value for ecologically or developmentally minded factions]

D/ Negotiation, Trading, Decision-Making

One key aim of collecting data modules is to increase the authority and influence of your faction's agenda in the decision-making process behind the various development projects in the game region. Effective and canny trading and negotiation may include gambits combining such items as promises of cooperation, blackmail threats to publically release sensitive data, and the trading of data modules with different values for different factions. These complicated interactions can be performed through the multiplayer chat window and through preset negotiation interfaces similar to those used in *Civilization III*. These interactions will provoke reflection and discussion amongst the students of how

the relative values of traded items are arrived at, as well as about the problems of real-world information-imperfect, politically-imbalanced negotiation of technical projects.

NOTE: to prevent stalemate, and to encourage thinning-under-deadline roleplay, trading/negotiation will be under time-constraints. When the time runs out, whatever's "on the table" (or the default decision) will be implemented as the decision.

E/ Outcomes and Evaluation

The final implementation decisions of the development projects being constructed in the landscape (as well as some of the sub-decisions in the process of construction) can be evaluated in two ways. Firstly, how well it matches the agenda and interests of each player's particular faction. And secondly, how the development projects, in combination with other projects occurring all over the game landscape impact the simulated demographics, ecology and economy of the game region. Since the game timeframe will typically aim to represent a 10 to 50 year span, players will be forced to think beyond a case-by-case consideration, and pay attention to the long-term stewardship of a "live" landscape, and the maintenance of reputation with local and international influence networks over time (for instance, making an enemy of the World Bank or a local tribe in one project, may cause problems in a later ones). The outcome of completed projects will help determine what further projects take place, if global flows of technology and capital increase to the region, and even if competed projects will in the future require repair, or radical revision.

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Decision Stages, Controversial Issues, and Learning Objectives for an Example Project:
Dams development for energy, river control, and agriculture

Key Decision Making Stages:

Stage	Description
Needs assessment	Validating the needs for water and energy services
Selecting alternatives	Identifying the preferred development plan from among the full range of options. Is building the dam the best solution? Go/no go decision point
Project Preparation	Verifying that agreements are in place before tender of the construction contract;
Project implementation	Confirming compliance before commissioning
Project Operation	Adapting to changing contexts
Immediate Impact Assessment	Assessing immediate developmental environmental and social impact of dam construction
Longitudinal Impact Assessment	Assessment of project success based on identified success criteria over period of time

Case Specific Considerations:

1	Energy options
2	Water Supply
3	Sedimentation
4	Greenhouse Gas Emissions (from flooded vegatation)
5	Flooded habitats, culture and homes
6	Recreation possibilities
7	Displaced People Protest
8	Licencing Issues
9	Hydropower for electricity
10	Maintenance or decommissioning
11	Salinity, waterlogging
12	Food from irrigation
13	Loss of livelihood from fisheries

14	Transboundary water competition
15	Environmental flow requirements
16	Loss of Downstream aquifers
17	Riverbank erosion

Learning Objectives: (www.dams.org)

Level specific learning objectives:
1.Understanding Need for Gaining Public Acceptance
Public acceptance of key decisions is essential for equitable and sustainable water and energy resources development. Dams have historically been particularly controversial, provoking social unrest. Acceptance emerges from recognising rights, addressing risks, and safeguarding the entitlements of all groups of affected people, particularly indigenous and tribal peoples, women and other vulnerable groups. Decision making processes and mechanisms are used that enable informed participation by all groups of people, and result in the demonstrable acceptance of key decisions. Where projects affect indigenous and tribal peoples, such processes are guided by their free, prior and informed consent.

2. Comprehensive Options Assessment
Alternatives to dams do often exist. To explore these alternatives, needs for water, food and energy are assessed and objectives clearly defined. The appropriate development response is identified from a range of possible options. The selection is based on a
comprehensive and participatory assessment of the full range of policy, institutional and technical options. In the assessment process social and environmental aspects have the same significance as economic and financial factors. The options assessment process
continues through all stages of planning, project development and operations.

3. Addressing Existing Dams
Opportunities exist to optimise benefits from many existing dams, address outstanding social issues and strengthen environmental mitigation and restoration measures. Dams and the context in which they operate are not seen as static over time. Benefits and
impacts may be transformed by changes in water use priorities, physical and land use changes in the river basin, technological developments, and changes in public policy expressed in environment, safety, economic and technical regulations. Management and
operation practices must adapt continuously to changing circumstances over the project's life and must address outstanding social issues.

4. Sustaining Rivers and Livelihoods
Rivers, watersheds and aquatic ecosystems are the biological engines of the planet. They are the basis for life and the livelihoods of local communities. Dams

transform landscapes and create risks of irreversible impacts. Understanding, protecting and restoring ecosystems at river basin level is essential to foster equitable human development and the welfare of all species. Options assessment impacts, followed by the minimisation and mitigation of harm to the health and integrity of the river system. Avoiding impacts through good site selection and project design is a priority.

Releasing tailor-made environmental flows can help maintain downstream ecosystems and the communities that depend on them.

5. Recognising Entitlements and Sharing Benefits

Joint negotiations with adversely affected people result in mutually agreed and legally enforceable mitigation and development provisions. These recognise entitlements that improve livelihoods and quality of life, and affected people are beneficiaries of the

project. Successful mitigation, resettlement and development are fundamental commitments and responsibilities of the State and the developer. They bear the onus to satisfy all affected people that moving from their current context and resources will improve their livelihoods. Accountability of responsible parties to agreed mitigation, resettlement and development provisions is ensured through legal means, such as contracts, and through accessible legal recourse at the national and international level.

6. Ensuring Compliance

Ensuring public trust and confidence requires that the governments, developers, regulators and operators meet all commitments made for the planning, implementation and operation of dams. Compliance with applicable regulations, criteria and guidelines, and project-specific negotiated agreements is secured at all critical stages in project planning and implementation. A set of mutually reinforcing incentives and mechanisms is required for social, environmental and technical measures. These should involve an

appropriate mix of regulatory and non-regulatory measures, incorporating incentives and sanctions. Regulatory and compliance frameworks use incentives and sanctions to ensure effectiveness where flexibility is needed to accommodate changing circumstances.

7. Sharing Rivers for Peace, Development and Security

Storage and diversion of water on transboundary rivers has been a source of considerable tension between countries and within countries. As specific interventions for diverting water, dams require constructive co-operation. Consequently, the use and management of resources increasingly becomes the subject of agreement between States to promote mutual self-interest for regional co-operation and peaceful collaboration. This leads to a shift in focus from the narrow approach of allocating a finite resource to the sharing of rivers and their associated benefits in which States are innovative in defining the scope of issues for discussion.

Broader engineering ethics learning objectives:

In addition to more traditional ethical concerns pertaining to engineering (such as protection of public health, safety and welfare) the *Daedalus' End* strives to prepare future engineers for the rapidly changing workplace, and particularly the expanding role of consultancy and strategic advisory. The broader goals include:

- Issues relating to sustainable development
- Globalization
- Growth of information technology
- And team oriented engineering practice (particularly in virtual contexts)

Philosophy / Design Goals

THE HIGH CONCEPT PITCH:
"SimIsle meets Ashes of Empire meets Tropico meets Hidden Agenda meets Capitalism meets Railroad Tycoon meets Age of Empires meets…"

Welcome to *Daedalus' End*

Although the importance of engineering education in promoting ethics and professionalism has long been appreciated, it is only in recent years that various factors have come together to form a critical mass of activity in the area of engineering ethics education. Professional societies like the IEEE (Institute of Electrical and Electronics Engineers – www.ieee.org), in providing a vital link between academia and engineering practice, are today playing an vocal role in promoting engineering ethics education. The concern about ethics in the context of Third World development, environmentalism and economic/technological globalization is a particularly important area of concern, as the controversies of the role of advanced economy governments, multinationals, international institutions have risen to the top of the global public agenda at the beginning of the 21st century.

Indeed, these priorities are reflected in the fact that there is now a mandatory requirement for the teaching of both professional ethics and globalization/cross-cultural issues in the IEEE's new Criteria 2000 standard for 21st century university engineering courses.

At the same time, surveys of engineering students and faculty indicate a widespread cynicism, wariness, or nonchalant attitude to the teaching of engineering ethics. For instance, a survey investigating undergraduate engineering student attittudes towards Criteria 2000 shows that most rank ethics in a global/societal context, by a wide margin, as the least important priority in engineering education. The traditional methods and positioning of engineering ethics teaching fail both in attracting much interest from students, and convincing them of the relevance of holistic, globally-aware ethics to the professional practice of engineering. But the same surveys also indicate that engineering students, like students in general, *are* interested in social issues, and cross-cultural relations in a globalized world. This situation strongly suggests that there is a great opportunity and demand for developing and marketing an engineering ethics educational game that provides immersive and authentic access to real-world global/societal concerns and cross-cultural communications.

[for information and statistics on these concerns see
URL: onlineethics.org/essays/education/herkert2.html?text]

The debates about ethics and civil engineering in developing country contexts are at once complex and fundamentally simple. The debates are complex

because the issues such projects encounter are not confined to design, construction and operation of "technical improvements", but embrace a range of social, environmental, and political choices which are critical in defining the success or failure of any civil engineering endeavor. Civil engineering undertakings (like dam construction, improvements to transport infrastructure) impact local environments and economies, and thereby often entailing a reallocation of benefits from local users to new groups of beneficiaries at a regional or national level. At the heart of many civil engineering endeavors in developing countries are issues of equity, governance, justice and power – issues which lie at the heart of the globalization debate.

At the same time, civil engineering in developing country contexts can be seen as simple because behind the array of facts, figures, economic statistics and engineering calculations, lie several basic and guiding principles. If adhered to and applied on a case by case basis, these principles could go a long way towards incorporating multisectoral perspectives into technical assistance projects in a way that help projects achieve toward short-term and long-term success criteria.

Through civil engineering case studies in a constant simulated developing country context, *Daedalus' End* encourages civil/environmental engineering students and early career professionals to evaluate the ethical, social, cultural and environmental complexities of technical assistance projects. Are there universally applicable, politically uncontroversial operational models for delivering electricity, water, sanitation, transportation infrastructures in developing country contexts? Is there a role for cross-sectoral debate on in technical assistance projects? What roles public, private and civil society interests play in successful construction, maintenance and operation of such projects. *Daedalus' End* forces students to question the ipso facto universal applicability of technical solutions in developing country contexts. Its immersive roleplay and environmental simulation will help students to break through the traditional boundaries of thinking and look at development civil engineering issues from a more holistic and ethically sensitive perspective. At the same time, students will not learn about technical ideals and holistic ethics in a politically unrealistic context. Rather, *Daedalus' End* will emphasise that in the context of the *realpolitik* of development, there are very rarely short cuts or completely agreeable paths to equitable and sustainable development; there are only imperfect solutions.

Frequently Asked Questions

- *What is the game?*

  Daedalus' End is a turn-based negotiation-and-decision centered online MMORPG/resource-and-ecology management game designed for civil and environmental engineering students, and others involved in development training (including development students, MBA students, NGOS, consultancies etc). They roleplay members of engineering teams consulting for various constituencies/factions with opposing agendas involved in the long-term (25 to 50 year) infrastructural and industrial development of a specific country or region. The focus of the simulation is to immerse the players in the social, political, economic, and ecological complexities and controversies of engineering in the context of development policy. The players will also be confronted with how technology, expertise, and capital flows, must be negotiated across cultures and borders in an era of globalization.
  Development engineering projects addressed by the game will include energy production/transmission (hydroelectric dams, solar plants, oil/coal plants); water and sanitation management; transport infrastructure; ecological engineering (flood control, reforestation).
  The game will emphasize how these various projects are politically/economically interdependent and mutually impact upon each other in the long-term view of development.
  The core skills players will learn will be beyond technical but still key to being an engineering professional in the global context. These core skills include virtual teamwork, intercultural negotiation, and a complex awareness of how engineering projects are formulated, for better and for worse, in real-world contexts of political struggle, technological scarcity, economic pressures, social protest, and ecological imbalance.

- *Why create this game?*
  Becoming a professional development civil/environmental engineer requires a deep knowledge of the processes of politics and society at work, if the impact of major engineering projects is to be understood. But traditional engineering teaching is dominated by an assumption of perfectible or near-perfectible technical solutions, typically outside the broader long-term context of society and politics. The international and cross-institutional (players will include members of consultancies, schools, and NGOs who are unlikely to have met for such a sustained exercise in real life), multiplayer, negotiation-based format of the gameplay is designed to foreground the non-technical imperfections, irrationalities, trade-offs and external motivations of a real-world decision-making process. This kind of interactive, cross-institutional, and interrelational educational experience is difficult to reproduce

conveniently, convincingly, or for a sustained period in traditional physically-localized settings. Despite the drawbacks of this physically-localized approach, there is clearly a demand for such simulations. A non-computer based simulation which is a precedent for *Daedalus' End* is the commercially marketed live action globalization roleplay simulation, *Global Simulation*, which has been hired by corporations such as IBM, General Motors, and Motorola, and by university institutions such as the Yale School of Management and the Wharton Business School. There is then, a demonstrable and lucrative market beyond the engineering education setting, for a computer-based roleplaying globalization simulation.
URL: www.worldgame.org/mba/menu.shtml

- *Where does the game take place?*
Either in an AI-generated, simulated and evolving, fictional country representative of specific real-world conditions, or one of special historically-based and contemporary "what-if?" scenarios such as Three Gorges dam development, China, 1980-2030; the Aral Sea, Soviet Union, 1950-2000; Hoover Dam/Colorado River, USA, 1930-1980.

- *What are the core game mechanics?*
Negotiated decision-making involving the acquistion, trading and comprehension of "data modules" about specific technical, social, economic, cultural, political aspects of engineering in a developmental context on a turn-basis within a time-frame simulating between 10 to 50 years of development. Interaction with simulated landscape – ecology/demographics. Personal encounters with representative characters of factions in first-person roaming perspective. Negotiation and discussion with human players from around the world, playing a range of roles.

- *What platform and audience are you aiming for?*
Central online servers, multiple PC-based; the players would be members of universities, consultancies, and NGOs from around the world.

- *Describe the look and feel?*
The interface should look as close to a professional, technical aesthetic as possible – interactive satellite maps, virtual teamwork environments, use of multimedia news/documentary footage.

- *Why is the game fun?*
Being a powerful, influential expert engineer working in a global policy context is itself a seductive fantasy. Communicating and negotiating with players from a variety of cultural and professional backgrounds from across the world, with differing perspectives would also be fun.

- *Give 3-5 verbs that describe the gameplay.*
Investigate, Comprehend, Negotiate, Compromise, Cooperate

GAME CHARACTERS

Overview

The players take on roles of civil engineers representing different organization with vested interests in completing any given project. The game assumes a basic level of civil engineering technical competence. Depending on the organization/entity they represent, the players also have access to different information sources. For example, a civil engineer employed by the government has access to all public records but may have a hard time accessing villagers directly. Conversely a civil engineer representing a grassroots mobilization NGO (non-governmental organization) has access to the general population but may not be able to access corporation business models.

Creating a Character/Roles

While modest modification is possible at the beginning of each game, characters are by and large assigned.

Role Descriptions for an Example Level:

ROLES	DESCRIPTION
National govt. and line ministry representatives	a contracted engineering institution **Narmada Control Authority (NCA)** The **Narmada Control Authority (NCA)** has been setup under the final orders and decision of the Narmada Water Disputes Tribunal (NWDT) as a machinery for implementation of its directions and decision. The authority started functioning from 20th December, 1980. The authority is a body corporate with representatives of the four States of Madhya Pradesh, Gujarat, Maharashtra, Rajasthan and representatives of Govt. Of India. The authority is funded in equal proportions by all the four states. Secretary (Water Resources), Govt. of India is the ex-officio Chairman of the Authority, whereas the routine administration is the responsibility of Executive Member of the Authority. NCA presently has six subgroups. The Narmada Control Authority has its headquarters at Indore. http://www.nca.nic.in/aboutus_ind.htm
Civil society organizations	Friends of River Narmada http://www.narmada.org/
Private sector	
Bilateral aid agencies and multilateral devt. banks	UNEP (Dams Development Project) http://www.unep-dams.org/document.php?doc_id=93
Indigenous group representatives	Narmada Bachao Andolan http://www.narmada.org/pressrelease.html
Contracted l	Sardar Sarovar Narmada Nigam Ltd.

engineering corporation	http://www.sardarsarovardam.org/default.htm
	SARDAR SAROVAR NARMADA NIGAM LTD. Along with the other major River Valley Projects, India's leaders had conceived a project for the utilization of the waters of Narmada, the largest West-flowing river in the country. It was the dream of Sardar Vallabhai Patel, the Iron Man of India, to harness the waters of the Narmada River to bring prosperity to the people of the Western Region. Pt.Nehru had laid the foundation stone for the project on 5th April 1961. However, it was only in 1987 that the implementation of the Sardar Sarovar Project could commence. Sardar Sarovar Project is an Inter-State Multi Purpose project of National importance. It is one of the largest projects under implementation anywhere in the world. It is sponsored by the states of Gujarat, Maharashtra, madhya Pradesh and Rajasthan. Sardar Sarovar Narmada Nigam Limited has been set up by the Government of Gujarat as a 100% Government owned undertaking, to implement this project. The benefits and the costs of the project have been allocated to the four sponsoring states by the Narmada Water Disputes Tribunal, which gave its Award after 10 Years of deliberations. The Award of the Tribunal has laid down the responsibility of each participating State in the implementation of the project. In particular, it has laid down detailed guidelines for the Rehabilitation and Resettlement of Project Affected Families. It also provides for a statutory mechanism to monitor the implementation of the project, as also to ensure that the provisions of the Award are complied with. The major benefits of the project are as follows: * The SSP would provide assured irrigation to 1.8 million h.a.(445 million Acre) in Gujarat and 75,000 ha (185 thousand Acre) in Barmer and Jalore districts of Rajasthan.

AI Characters:

The game is equipped populated with AI characters who complete the game environment. AI characters include: villagers, city-dwellers, journalists, local rights activists, scientists, administrative officials in ministries, public relations spokepersons for corporations, environmentalists, World Bank officials.

TECHNICAL INFORMATION

Overview
Daedalus' End is a multiplayer game that is a cross between massively multiplayer games and Multiplayer RPG games. All times, players have access to a chat interface and contacts. The game can be thought of in terms of three landscapes.

Live Landscape
- the "live and actual" landscape populated by AI-driven characters who can be encountered by the player. This landscape is seen through a freely mobile first-person perspective. Graphically, this will look like the experience of walking/driving around an actual landscape. The landscape (buildings, vegetation, water landmarks etc) would change as development projects impact the area. This part of the game does not evolve in real time; rather, objects are created and placed in the landscape as is suggested by the simulations. To save costs, this could be a top-down isometric view.

Information Landscapes.
- The player also has access to a "computer-analyzed" landscape, graphically represented as a muli-function "satellite map" with a range of selectable information overlay tools representing the actively changing demographics, ecologies, economic flows etc. This interface is very similar to that in Tropico and allows users opportunities to view information about the world graphically.

Engineering Information / Archive
- Players have access to historical maps and archives that illuminate the various flows, relations, and histories of the multiple development projects across the landscape. The archive provides access to library simulations of technical engineering concepts as well.

Technical Notes:
The graphic appearance of Daedalus' End draws inspiration from Tropico, a third person, top-down game developed by Poptop software. Tropico was built for just over 1 million dollars using the Railroad Tycoon Engine. In Tropico, the player is the governor of a small Caribbean island. The player can interact with dozens of characters, finding out demographic information about them ranging from their age to education to satisfaction with the player's performance, through a simple mouseclick. Further, the player can examine the island's demographics through a a wide range of factors, such as property value, pollution, or corruption. The player manages the island through a wealth of information that is communicated to the player map overlays on the island itself.

The visualizations in Daedalus' End are very similar to those in Tropico, with the only difference being that the player must enter 3D mode to collect information in the environment. Because Daedalus' End tries to situate the player in a very specific role where she has access to limited information, it employs a 1st person perspective. A third person perspective good be employed to save costs and integrate the gameplay into a more seemless interface; however, players need to be limited in the kinds of information they have access to, which is difficult to achieve through an ominpotent top down view.

Programs such as ActiveWorlds provide another interface model for Daedalus' End. Activeworlds is an enhanced browser program that allows players to interact in a 3D environment, chat, and access static information in 2D through a web-like interface. Daedalus' End could be developed with a platform such as Activeworlds, with the only challenge being integrating the simulation that underlies the development models with the 3D engine. With more resources, creating a multiplayer game where the simulated world runs in real time would not be unfeasible.

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PEDAGOGY

Daedalus' End draws on a long - standing tradition of face-to-face and paper-based role playing negotiation games. Daedalus' End takes the basic conflict role playing game that is well established within social studies education, and adapts it into a digital environment for an engineering ethics audience.

As such, Daedalus' End shares much in common with Roger Schank's Goal-Based Scenarios. Goal-Based Scenarios are predicated on the idea that people learn best by doing. Players ask questions, gather resources, and formulate positions in the context of competition.

Unlike many Goal-Based Scnearios, Daedalus' End is designed to be multi-player from the ground up. We recognize the difficulties of presenting emotionally compelling or strategically interesting AI, and instead, use massively multi-player gaming as a context for students' learning.

Daedalus' End uses multi-player gaming structure so that players confront environmental education situations with real consequences. In multi-player gaming, there is no "save and restart"; there is no turning back. A player's decision to bulldoze a community or flood a native buriel ground cannot be undone. They will have to live with the consequences of their decisions.

Daedalus' End is designed to be used within a larger instructional context where players debrief, reflect, and take a step back from the gameplay to see what they might learn from the experience. Such debriefing will take place online using standard chat, bulletin board or messenger technologies, which is standard practice in online problem-based learning enviornments.

MUSICAL SCORES AND SOUND EFFECTS

Musical Scores:
The musical scores for Daedalus's End should enhance the immersive experience of playing the game. Culturally appropriate music to evoke the atmosphere of a particular region a game is set in will help consolidate the player's authentic identification with the cultural milieu represented. After the initial data gathering/exploratory phase in which the music largely functions as a complement to the environment, the absence/presence of music should be used to create drama and enhance tension at the negotiation table.

Sound Effects:
Sound effects for the game should be purely functional and should include: beep notification of new information, alarm clock reminders for negotiation meetings etc. It is important that the sound effects do not create a distracting comic effect.

MATH/SCIENCE ENGINEERING / CONTENT

Overview

Conventional design in engineering is often concerned with the creation or modification of artifacts that stand alone or form larger systems. Often, the scope of engineering education tends to focus on the technical, executional elements of design. This is often the case even when the potential consequences of design and implementation are " have far reaching human and environmental implications.
(http//:www.isye.gatech.edu/~tg/publications/ecology/tgMDW20010529/nodel.html)

Recently, engineering ethics debates have emerged as a key discussion point in engineering education discourse. The emergence of this debate is "at least in part, a result of the attention that media has given to cases such as the Challenger disaster, the Kansas city Hyatt-Regency Hotel walkways collapse, the Exxon oilspill, and massive dam construction projects in developing countries (including the Sardar Sarovar and the Three Gorges Dam Project). Unfortunately, many engineering professors are not professionally equipped to teach engineering ethics in conventional classroom settings. (http//: ethics.tamu.edu)

The educational purpose of *Daedalus' End* is to enhance engineering students and junior professionals' ability to identify and critically analyze ethical, human value, and philosophical issues that arise in and underlie contemporary civil engineering practice in developing country contexts. The areas of focus include: environmental/water, structural and construction.   The indepth examination of case studies through role playing of specific interest groups, organizations or corporations allows the players to explore the socio-technical complexities, identify ethical responsibilities of engineers and identify factors conducive to exemplary   conduct   and   misconduct   in   civil   engineering.
(http//:onlineethics.org/edu/courses/civil.issues.html?text)
The educational objective of *Daedalus' End* strives to impart a proactive approach to civil engineering design that emphasizes the integration of values, ethics, and ecological considerations.

Often engineering ethical lessons are learned only once something has gone wrong. Currently no adequate substitute exists for simulating the actual engineering   experience   in   an   educational   context. (http//:ethics.tamu.edu/pritchar/an-intro.htm) *Daedalus' End* addresses this current shortcoming in civil engineering education.

Resources

http://www.spectrum.ieee.org/INST/dec97/ethics.html
http://www.onlinethics.org
http://www.niee.org/
http:/www.american.edu/projects/mandala/TED/water.htm
http://www.isye.gatech.edu/~tg/publications/ecology/tgMDW20010529/nodel.html
http://ethics.tamu.edu