Virtual Worlds

Lessons from the Bleeding Edge of Multiplayer Gaming

Greg Corson
Dave McCoy

State of the Community 1990

- Artists often used as “subcontractors”
- Many dominant 3D tools are SGI based and very expensive
- 2D and 2-1/2 games dominant
- A few games dabbling in full 3D
- A lot of 3D graphic content for games is generated with graph paper

Inspiration

- Academia
- Film and Video
- Arcade Games
- Military Simulators

Academia

- Virtual Reality was about to take over everyone’s life
- Scientific Visualization with computer graphics

Film & Video Effects (my background)

- TRON
- Last Starfighter
- Abel & Associates commercials
  - Sexy Robot
  - Levi's
- PDI

Arcade Games

- Mostly sprite based
- Cinematronics vector display wire frame 3D
  - Tail Gunner
  - Red Baron
  - Battlezone
- I-Robot – Filled Polygons
- W Industries Virtuality – Dactyl Nightmare

Military Simulators

- Evans & Sutherland
- GE
- Hughes/Loral – Simnet
- Multigen tools

Problem 1 – Setting the Bar

What can we do?

What can we do?

- As game technology capabilities accelerate this question becomes ever more important
- Greg and I have both been in support roles for new graphics technology – this is the most common question
- Then and now the answer from experts can never be complete

What can we do?

- $25,000 proprietary graphic system
- Graphics board is $8,000 with volume discount
- Hard to find experts in the field in art or code – most real-time graphic experts in military simulation

The Up Side

No established limitations

Benchmark

- Never trust the manufacturers numbers
  - (or delivery dates)

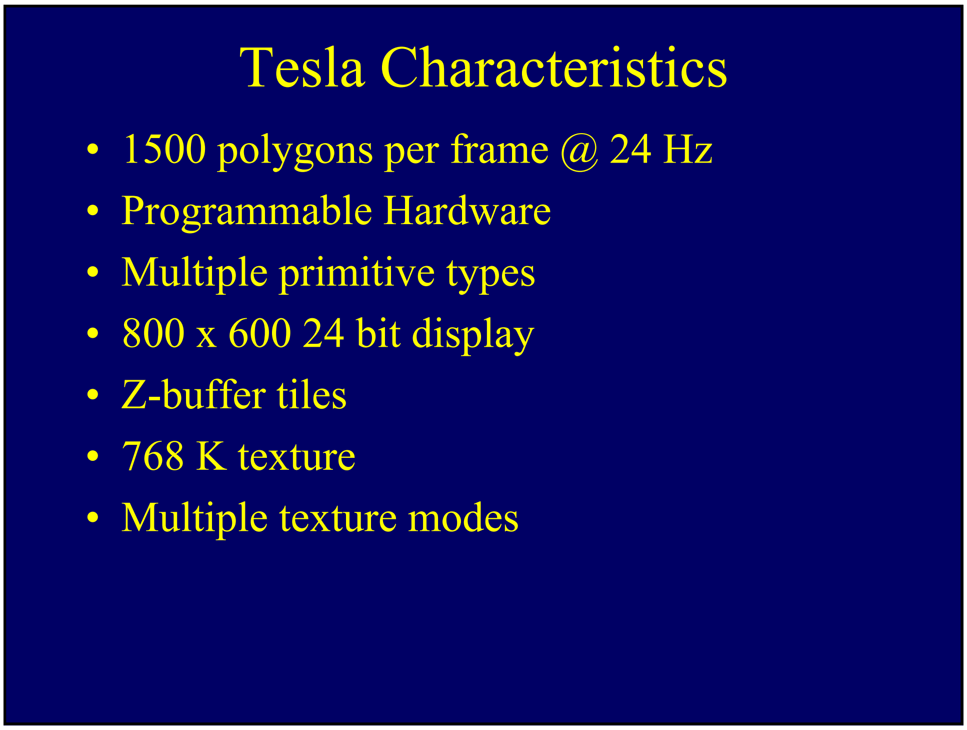
Benchmark

- Test what the system characteristics and performance are under game circumstances
    - Display resolutions
    - Polygon size
    - Position and animation updates
    - Hierarchies and state changes
    - Lighting

- Display characteristics
- Geometry performance
- Fill-rate performance

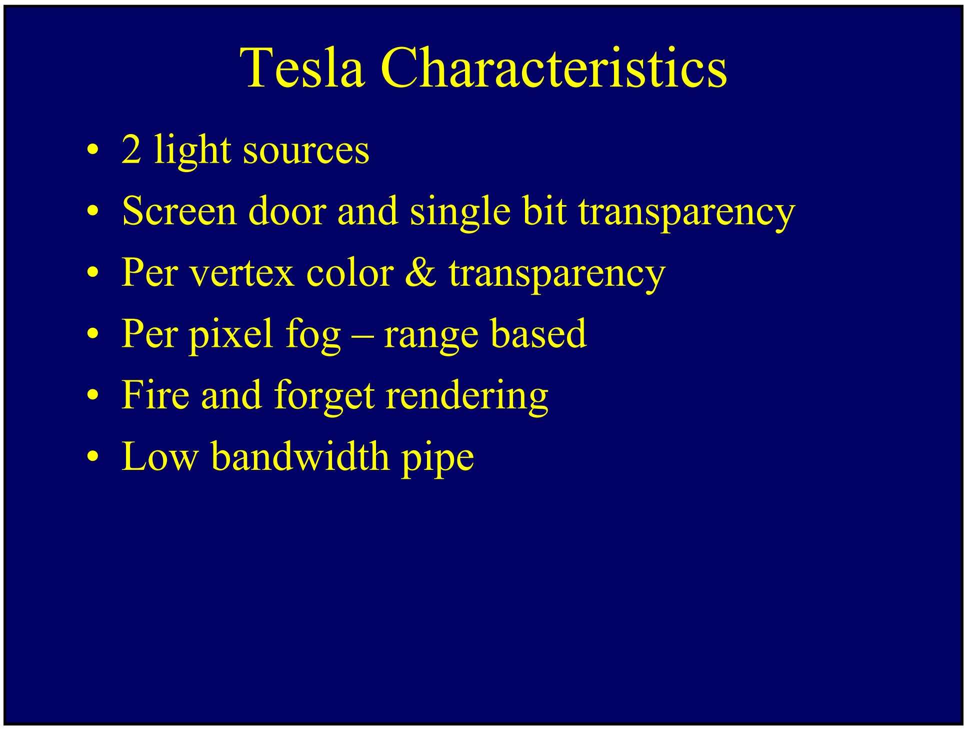
System 2 Characteristics

- 600-700 polygons per frame @ 12 Hz Floating
- 640 x 480 24 bit display
- No Z-Buffer – draw order, BSP and centerpoint sorting graphic language
- Flat shading
- Background image
- RGBI color definition
- Bitmap transparency
- 16 light sources
- Per vertex fog



Tesla Characteristics

- 1500 polygons per frame @ 24 Hz
- Programmable Hardware
- Multiple primitive types
- 800 x 600 24 bit display
- Z-buffer tiles
- 768 K texture
- Multiple texture modes



Tesla Characteristics

- 2 light sources
- Screen door and single bit transparency
- Per vertex color & transparency
- Per pixel fog – range based
- Fire and forget rendering
- Low bandwidth pipe

“Nothing so focuses a man’s mind as the knowledge that he will be hanged in the morning”

Problem 2
What Should We Do?

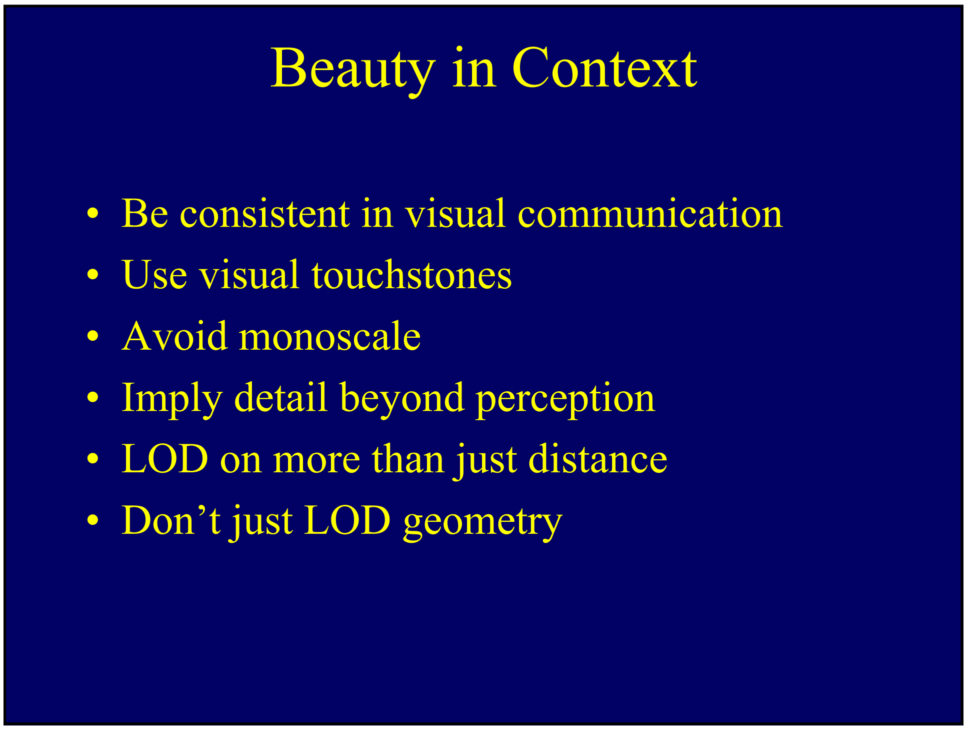
Limitations focused our efforts

Play to your audience

Exploit your unique strengths

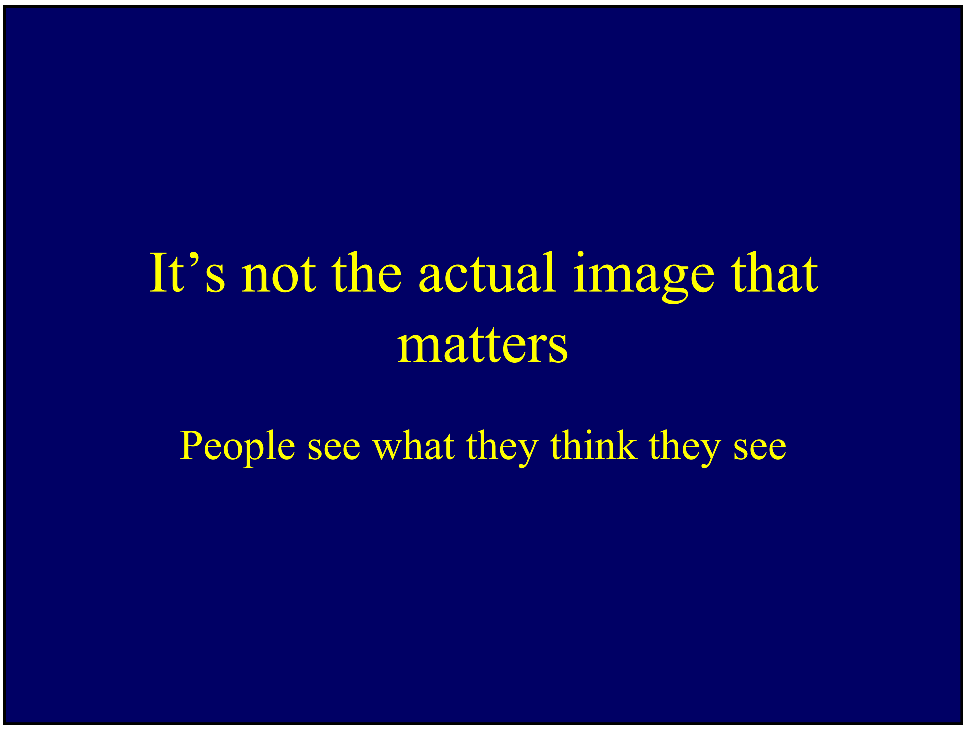
Beauty in Context

- Design all art in context of game usage
- Evaluate all art under actual gaming conditions
- Focus time on most common game conditions – similar to programming
- Don’t let very unlikely or very uncommon conditions prevent the use of techniques



Beauty in Context

- Be consistent in visual communication
- Use visual touchstones
- Avoid monoscale
- Imply detail beyond perception
- LOD on more than just distance
- Don’t just LOD geometry



It’s not the actual image that matters

People see what they think they see

CHEAT! CHEAT! CHEAT!

Rely on non-graphic resources for graphic solutions

Game Design

- Limit viewpoints
- Distribute visual complexity
- Channel attention
- Consider when people will have time to focus and when will they be harried

Game Design

- Game design and art must be thematically consistent to reinforce both
- What are you both trying to say?
- Avoid errors of diversity over quality
- How should the player feel?

Audio

- Film knows its power – watch dailies
- With early systems we had no choice but to rely on audio for 50% of the image
- Supposedly everyone knows this now, but do they really practice it?
- Audio is now where art once was

Audio

- For Tesla, repeated concessions on visuals were made for top quality audio
- It worked

Audio

- Sound and music generally follow – sometimes they should lead

System 2 Strengths

- Background image
- Fog
- Graphic Language
- Lighting
- RGBI

Tesla Strengths

- Optics
- Programmable Hardware
- Texture Modes
- Fire & Forget Features
- Hardware Particle Language
- Primitives (spheres)
- Fill rate

Problem 3 – How do we get it done?

(in time)

System 2 and Tesla both simultaneous code/art development

- As with many current projects, a production necessity - but not the way to work
- More tenable with small teams
- Art and code have different development cycles
- Leads to significant waste

Common Project Progression

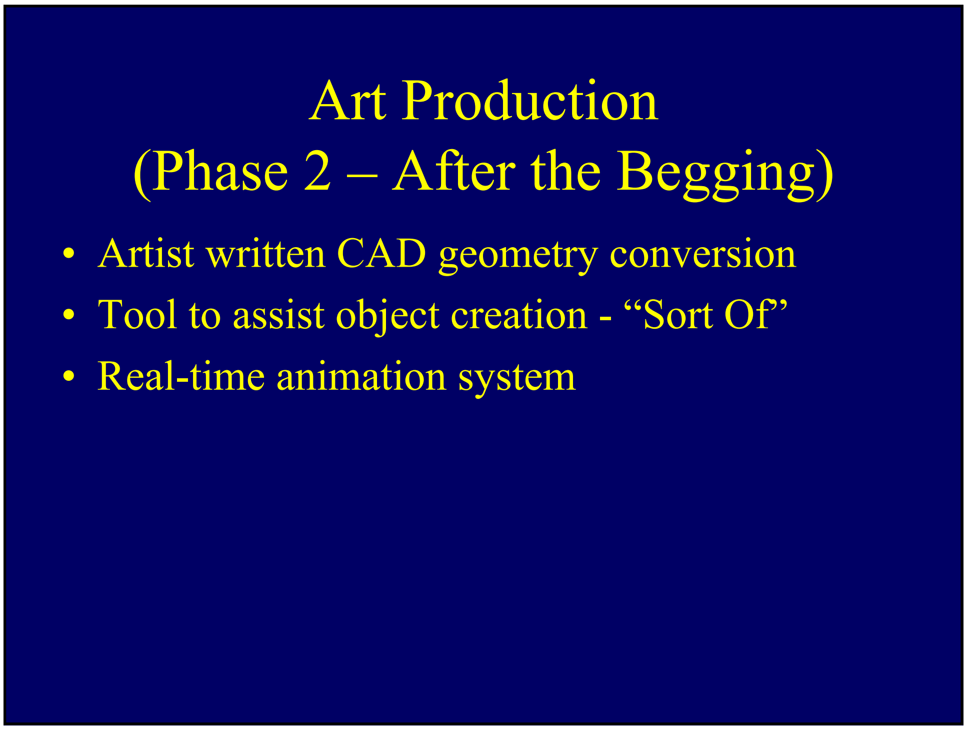
- Concept
- Design prototyping = design doc outline
- Art prototyping = concept art
- Concept art and design doc used to sell project
- Project sells
- Programming prototyping begins
- Art and design production begin

System 2 Production Begins

- Functional Game Design complete
- 2 Programmers – 1 Artist (game, UI, publicity)
- Uncompleted hardware
- No code base
- No tools
- Legacy graphic language (BSP)

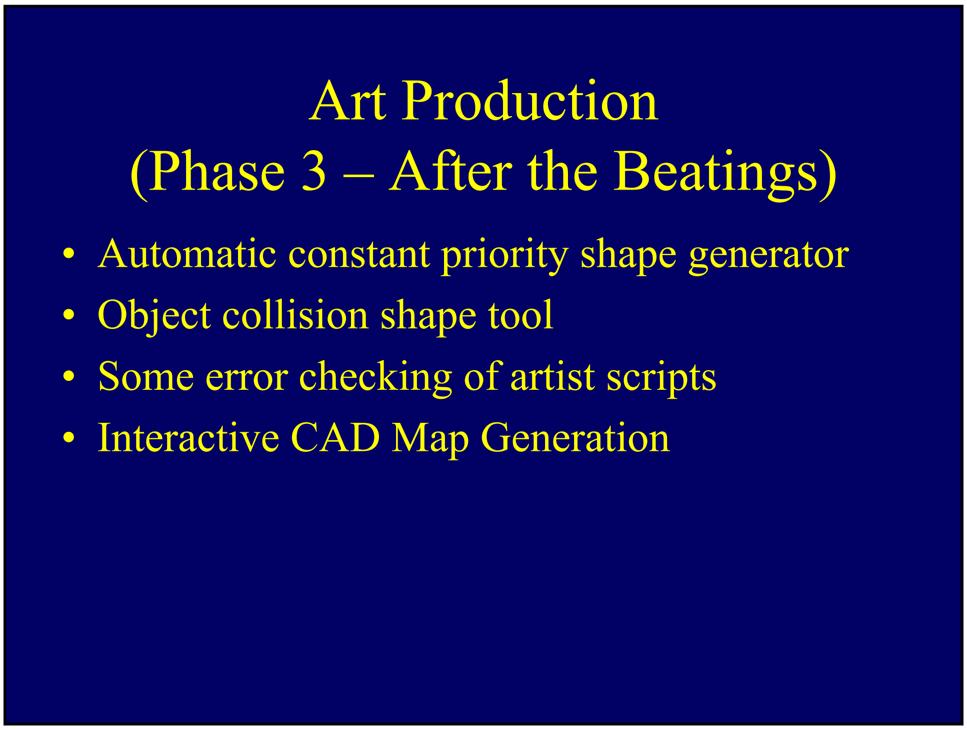
Art Production (Phase 1 – The Beginning)

- ASCII Script Graphic Language
  - Error in scripting can crash whole system
  - Graphic Language Scripts written by artist
    (art code is worse than programmer art)
- Graph paper & coordinates visual geometry creation
- Graph paper & coordinates collision geometry creation
- Graph paper & coordinates map generation
- Manual sorting of objects
- PC Based animation system



Art Production (Phase 2 – After the Begging)

- Artist written CAD geometry conversion
- Tool to assist object creation - “Sort Of”
- Real-time animation system



Art Production (Phase 3 – After the Beatings)

- Automatic constant priority shape generator
- Object collision shape tool
- Some error checking of artist scripts
- Interactive CAD Map Generation

Art Production

- Code & Content completely intermingled

Learned & Resolved

Firewall between code & content

Gallery / Studio Model

Tesla Production Begins

- Legacy game design (major revision)
- 4 Programmers – 4 Artists
- Programmable hardware/New Architecture
- New Code

Tesla Production Begins

- Legacy game design (major revision)
- 4 Programmers – 4 Artists
- Programmable hardware/New Architecture
- New Code
- Some tools – additional tools programming scheduled

Art Production (Phase 1 – The Beginning)

- Separation of art & code
- Art production is largely off-the-shelf tools with conversion utilities
- Script based model files with references to other file types (collision, visual, etc.)
- Perfly model viewer
- Additional Tools Scheduled

Art Production (Phase 2)

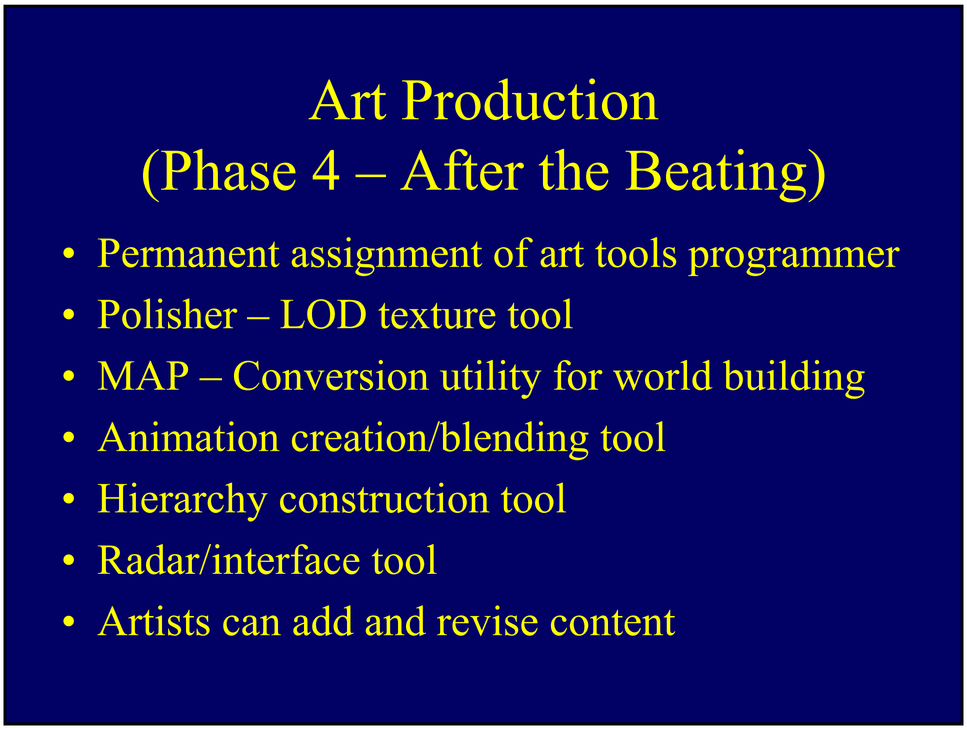
- Additional art production tools scheduled

Art Production (Phase 3)

- Art tools production month scheduled

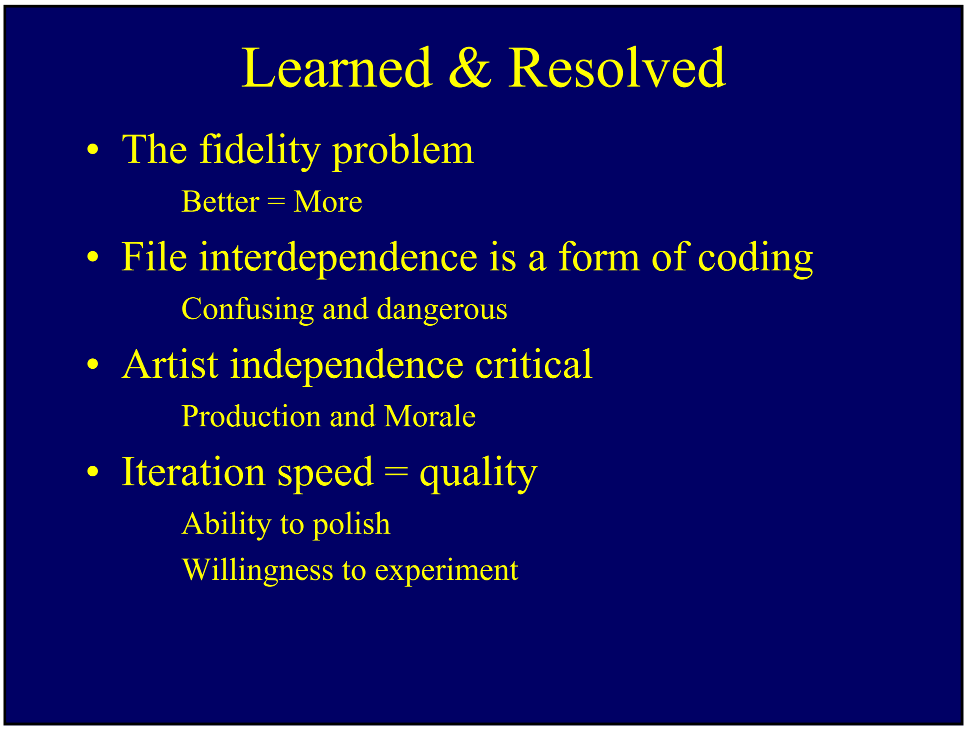
Art Production (Phase 4)

- Art tools production month delayed



Art Production (Phase 4 – After the Beating)

- Permanent assignment of art tools programmer
- Polisher – LOD texture tool
- MAP – Conversion utility for world building
- Animation creation/blending tool
- Hierarchy construction tool
- Radar/interface tool
- Artists can add and revise content



Learned & Resolved

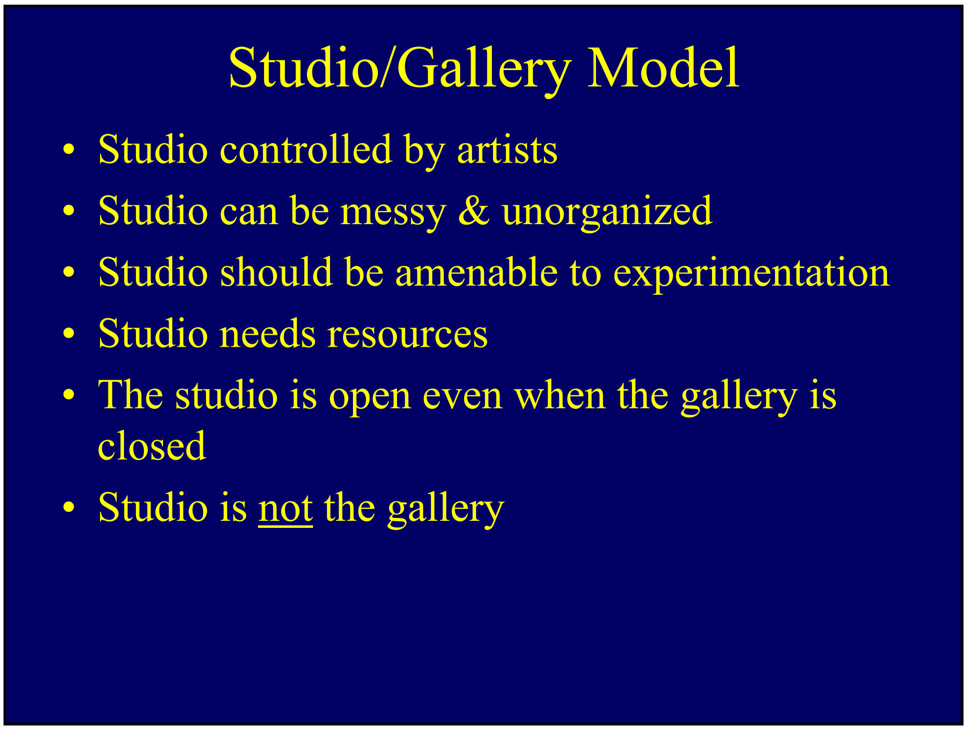
- The fidelity problem
  - Better = More
- File interdependence is a form of coding
  - Confusing and dangerous
- Artist independence critical
  - Production and Morale
- Iteration speed = quality
  - Ability to polish
  - Willingness to experiment

Learned & Resolved

- Artists determine needed art tools
- Tools maintenance is critical
- Dogfood approach
- Tools suite – not omni tools
    - Too hard to extend
    - Too hard to fix
    - Too long in development
    - Too hard to predict production issues

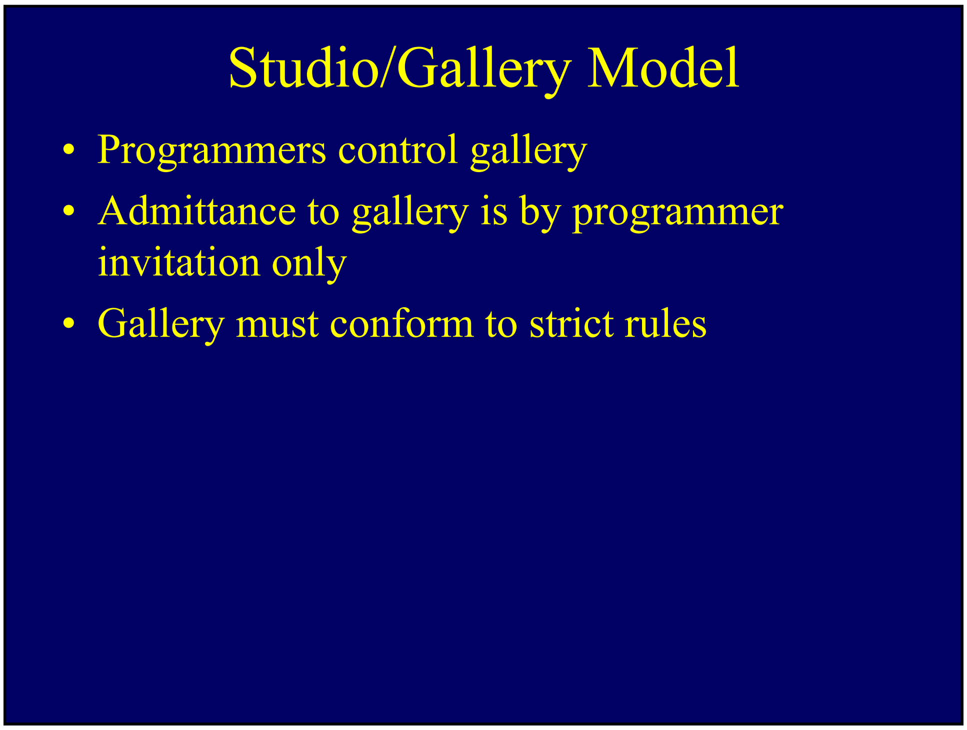
Studio/Gallery Model

Trying to reconcile the concerns of programmers and artists



Studio/Gallery Model

- Studio controlled by artists
- Studio can be messy & unorganized
- Studio should be amenable to experimentation
- Studio needs resources
- The studio is open even when the gallery is closed
- Studio is not the gallery



Studio/Gallery Model

- Programmers control gallery
- Admittance to gallery is by programmer invitation only
- Gallery must conform to strict rules

Studio/Gallery Model Problems

- Studio must be able to create anything gallery can display
- Studio disorganization can be a real problem for large projects
- Moving from studio to gallery can be cumbersome
- Sometimes programmers & artists argue about what should be in gallery

A technological medium

Requires code and art

Comments to Programmers

- Artists actually know some things you don’t
- Paintings are not judged by the quality of the paint

Comments to Artists

- Programming requires extreme creativity – if suggestions are offered, listen. If they aren’t, ask
- Doing is much harder than dreaming

Problem 4 – Learning for the Next One

Assuming there is a next one

Remember

- The impact of demos
- The unpredictable
- The impact of delay on the product's quality
- The time required to revise based on testing
- The impact of assigning personnel prematurely
- The man/month fallacy
- The absolute statements that were wrong

Games

Unused Assets can equal 80%

Movies

Unused Assets can equal 95%