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The White Oak Institute issues bulletins occasionally to announce relevant research that informs the decisions currently facing museum managers and stakeholders.

Bulletin 1
THE WHITE OAK INSTITUTE

This Issue: The Global Network of Museum Giant-Screen (GS) Theaters Needs Attention

Credit

The DISCUSS Colloquium was made possible by a grant from the National Science Foundation (NSF-ISE 0946691).
John Jacobsen, PI; Jeanie Stahl, Co-PI

Summary

Top management action is needed to sustain museum GS theaters in the digital age. Formal evaluation of museum GS professionals shows a need for museum-specific shared standards. The GS field has developed the first iteration of those standards in the NSF-funded Digital Immersive Giant Screen Specifications (DIGSS 1.0). The GSCA's technical committee has undertaken responsibility to refine those specifications that are still provisional.

Now, the museum community needs to support the DIGSS process so that suppliers and innovators will see our commitment, and supply us with digital systems and programs that are responsive to the museum field's needs for an economically sustainable *immersive learning experience*.

Context by Jeffrey Kirsch, Ph.D.

To newcomers it may seem strange that we have come this far without definitive standards, but it is the legacy of the years when IMAX Systems Corporation had their own very high standards for IMAX GS installations. However, with competition and digital projection, the situation changed. IMAX has adopted a new corporate direction that focuses on Hollywood blockbuster films, and the newer digital installations incorporate screen sizes and aspect ratios that have departed from the original Giant Screens installed by IMAX.

The DIGSS industry-wide effort and its resulting recommendations for the transition to the new generations of high resolution digital projection systems are vital. It will enable the institutional giant screen theaters to establish themselves as the standard bearers for the utmost in on-screen visual performance.

Findings

The White Oak Institute (WOI) and its team, including the Giant Screen Cinema Association (GSCA), the Institute for Learning Innovation, the LF Examiner, and the MacGillivray Freeman Films Educational Foundation, were awarded conference funding by the National Science Foundation (NSF-ISE 0946691) to bring together a team of giant-screen (GS) industry leaders and experts to reach consensus on the Digital Immersive Giant Screen Specifications (DIGSS). Additionally, 61 other GS professionals signed up for discussion on a wiki website, totaling 79 GS professionals engaged.

The objective is a specification for immersive digital GS theaters that creates a viewer experience as good as or better than the film-based GS theaters now in place in museums and science centers. DIGSS aspires to address the challenges of the largest theaters through specifications for GS flat and dome screens, in 2D and 3D. Such

Findings Continued

shared protocols will set the stage for transformations and innovations in museum-quality equipment and productions in the digital age. DIGSS 1.0 is intended to be the first important step in establishing a shared language of exchange among museum experiential theaters.

For STEM-based museums with giant screen theaters, the strategic management question is not about finding the right technology system vendor. It is first how to use immersive digital technologies to build 21st century learning skills and build the bottom line. There are lots of digital technologies out there, and they are evolving rapidly. There are also multiplying sources of digital feeds and films. The real question is what to do with our current theaters, and why? How can these huge spaces further our museum's goals in the digital age? And how can we do this with enough other museums to create a sustainable business model?

Fortunately, answers are on the horizon if museum managers and the GSCA can move quickly enough:

- The NSF-funded Digital Immersive Giant Screen Specifications (DIGSS) 1.0 are a field-based, open-access family of aspirational specifications for theater geometry, projection and audio playback, and digital distribution (Jacobsen et al, 2011). Many are achievable now, but others are goals to encourage technology. Some specifications are being tested by GSCA's Technical Committee and are provisional. DIGSS addresses 2D, 3D, flat and dome theaters.
- The specifications support a museum's mission of experiential learning through the immersive aspects of the giant screen experience, particularly with regard to screen size and image aspect ratio (4:3, +/-), the characteristics that most clearly differentiate the current global GS network from conventional movie theaters.
- Immersing audiences can result in significant STEM learning outcomes, especially when understanding physical and dimensional concepts (Flagg, 2005; Sumners, 2008).
- ILI evaluated support for DIGSS after its presentation at the Chattanooga, TN GSCA (2010) conference and reported "Overall findings reflected a significant increase in knowledge and positive attitudes toward the DIGSS effort." (ILI, 2011).
- A successful business model for a museum giant screen digital theater might involve a strategic mix of 1) internationally produced, high-budget feature performances – the digital equivalents of GS classic films like *Everest* and *Tornado Alley*, 2) Current Hollywood studio films (optional), 3) Local programming, and 4) Experimental digital experiences that use the new technologies in new ways. The first two assume global format compatibility, and they are likely to drive the business model for a while.
- A global network of potential DIGSS-compatible GS theaters already exists physically. There are also at least 70 fulldomes in museums that meet GS size requirements (Loch Ness, 2010), and digital convergence may allow some of them to also be DIGSS-compliant. Hypothetical economic models, built on an economic survey of U.S. STEM museums with GS theaters (Stahl, 2011) found that 143-323 GS theaters could support five new classic films/year at a budget of $3.6 to $9.0 million, as long as they are compatible and in an open exchange network (see Attachment E).

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Findings Continued

- DIGSS supports at least three operating modes: GS shows; DCI Hollywood; and an open format, innovation channel. It has no intellectual property rights restrictions.
- At least one system supplier – Global Immersion, Ltd., has embraced the non-proprietary DIGSS approach and is working towards a DIGSS-compliant system for the new Peoria Riverfront Museum and other clients.
- Leadership at the GSCA is changing, so the time is ripe for museums to influence policy and to encourage them to be active stewards of DIGSS.

Action

The museum sector of the giant-screen (GS) field has distinct needs for immersive learning that are different from Hollywood cinemas. Technical experts and the field have recently developed and reviewed the NSF-funded Digital Immersive Giant Screen Specifications (DIGSS 1.0). You can help by a) specifying that your GS theater will convert to a DIGSS-compatible system, and b) giving direction and support to the GSCA to take an active role in stewardship and development of DIGSS (see Attachment A).

Resources

Organizational Partners: Giant Screen Cinema Association, Institute for Learning Innovation, LF Examiner, MacGillivray Freeman Films Educational Foundation, Association of Science-Technology Centers, International Planetarium Society

Technical Experts and Project Team (Titles/Positions at the time): **Victor Becker**, Theater Geometry; **John Fraser**, Evaluator; **James Hyder**, Editor; **John Jacobsen**, PI; **Ed Lantz**, Playback; **Andrew Oran**, Distribution; **Walt Ordway**, DCI Process and Standards; **Mark Peterson**, Business Model; **Christopher Reyna**, Recording; **Jeanie Stahl**, Business Model and Co-PI

Project Advisors (Titles/Positions at the time): **Diane Carlson**, Pacific Science Center; **David Duszynski**, Cincinnati Museum Ctr.; **Mark Katz**, National Geographic Society; **Doug King**, St. Louis Science Center; **Jeff Kirsch**, Fleet Science Center; **Greg MacGillivray**, MacGillivray Freeman Films Educational Foundation, **Toby Mensforth**, Smithsonian Institution; **Tammy Seldon**, Giant Screen Cinema Association

Source Documents (available at www.whiteoakinstitute.org):

1. GS Managers Survey Findings
2. Economic/Business Survey
3. Literature Review
4. Relevant Bibliography
5. GSCA Conference Attendees Attitudes Toward DIGSS

Citations/References

Flagg, B. (2005). Beyond Entertainment: Educational Impact of Films and Companion Materials. *Big Frame*, 22(2)

Jacobsen, J. et al. (2011). DISCUSS *Proceedings*

ILI, (2011). *GSCA 2010 Conference Attendees Awareness and Attitudes Towards DIGSS*

Lochness Productions. (2010). Retrieved from http://www.lochnessproductions.com/lfco/lfco.html

Stahl, J. (2011). Current & Potential Business Models from *DISCUSS Proceedings*. WOI: Marblehead, MA.

Sumners, C., Reiff, P., and Weber, W. (2008). Learning in an immersive digital theater. Advances in Space Research. 42(11), 1848-1854.

Attachments

A. Actions and Support Letter to GSCA
B. Logic Model and DISCUSS & DIGSS Participation
C. DIGSS 1.0 (summary)
D. Economic Survey Findings
E. Current and Future Business Models
F. Glossary of Terms

About the Institute

The White Oak Institute is a non-profit formed by the owner/principals of White Oak Associates, Inc.

The mission of the White Oak Institute is to further innovation in the museum field through research, analysis and dissemination of data-based findings drawn from museum operations.

Attachment

Title Actions and Support Letter to GSCA

Actions Showing support for DIGSS is easy and free and will be helpful to your GS theater: a) Specify that when you convert your GS theater to digital, it will be to a DIGSS-compliant format, or as close to it as current technologies permit, with an upgrade path, and b) Direct and support the Giant Screen Cinema Association (GSCA) to further develop and administer DIGSS, its screen testing and its global buy-in using some version of the following:

[This letter can be downloaded from www.whiteoakinstitute.org]

Mr. Mark Katz, Chair
Dr. Jeffrey Kirsch, Vice-Chair
Giant Screen Cinema Association
Attn: Ms. Tammy Seldon
Conference & Meetings Director
Giant Screen Cinema Association
26 Lakewood Landing Drive
Lake Anna, VA 23024-4603
tammyseldon@giantscreencinema.com

Dear Mr. Katz and Dr. Kirsch:

We support the need for Digital Immersive Giant Screen Specifications (DIGSS), and we urge the GSCA to adopt DIGSS 1.0 now as the baseline for an evolving set of specifications, and to be the force testing the provisional specifications, and issuing periodic updates of DIGSS 1.0 as the remaining provisional specs are informed by screen tests.

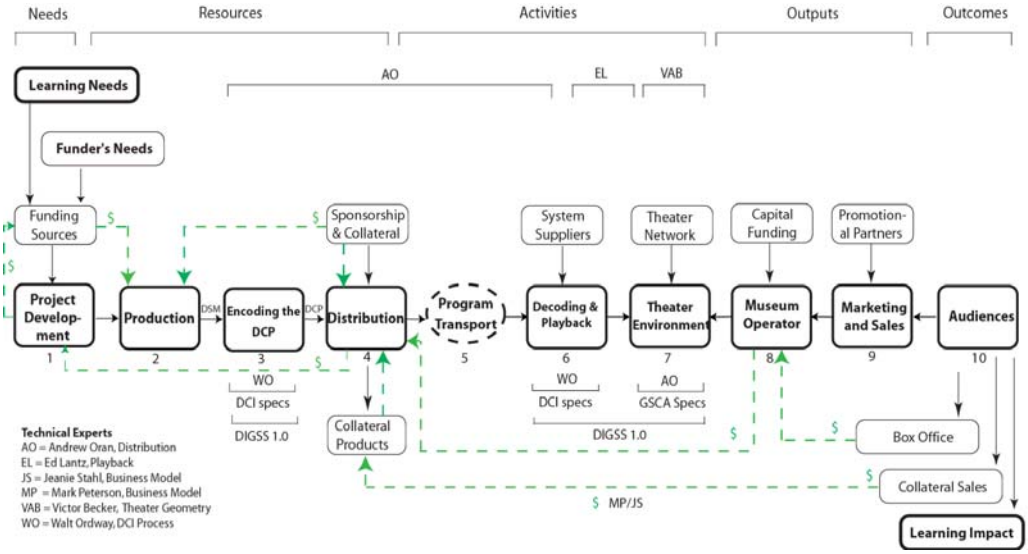
The Giant Screen Cinema Association (GSCA), by title, represents the giant-screen field; as such, the GSCA is both the logical and the necessary organization for museum GS theaters to rely on to establish open standards that reflect our needs as museum theaters.

The GSCA and the museum community need to support the DIGSS process up-front, so that suppliers and innovators will see our commitment, and supply us with digital systems and programs that are responsive to the museum field's needs for an economically sustainable *immersive learning experience*.

Action now by the GSCA that recognizes DIGSS 1.0 as the baseline will send a clear signal to the global network, and pave the way for innovation. No action, however, will continue the balkanization and erosion of the GS network.

Sincerely Yours,

Title Logic Model and DISCUSS & DIGSS Participation



DIGSS IS DEVELOPED BY THE FIELD

The museum GS field has developed DIGSS 1.0. It has gone through four drafts circulated among the DISCUSS participants, who represent the top experts and leaders of the field and who are independent of any system supplier. Co-Principal Investigators John Jacobsen and Jeanie Stahl outlined DISCUSS and DIGSS at the all-member meeting during the annual GSCA conference (Sept 25, 2010). DIGSS Draft C was opened for professional comment, with invitations to the DISCUSS wiki site sent by the association partners (GSCA, IPS and ASTC) to their members. Between September 23, 2010 and November 7, 2010, this Online Forum engaged 79 GS professionals with the draft and with the 48 discussion comments made. All these steps by GS professionals and experts have shaped the current specifications.

After DIGSS 1.0 is disseminated to the field and posted on ISE sites, it will be turned over to the GSCA for further development and later versions. The GSCA's Technical Committee has accepted responsibility for the screen testing.

PROJECT ADVISORS, TECHNICAL EXPERTS AND COLLOQUIUM PARTICIPANTS

(PROJECT ROLES IN BOLD; TITLES/POSITIONS AT THE TIME)

Victor Becker, White Oak Associates, **Link 7**	**Greg MacGillivray,** MFFEF, **Project Advisor**
Diane Carlson, Pacific Science Center, **Project Advisor**	**Toby Mensforth**, Smithsonian Institution, **GSCA**
David Duszynski, Cincinnati Museum Center, **Project Advisor**	**Andrew Oran**, FotoKem, **Link 3**
John Fraser, Institute for Learning Innovation, **Evaluator**	**Walt Ordway**, CTO of Hollywood's **DCI Specs**
James Hyder, LF Examiner, **Editor**	**Mark Peterson,** White Oak Associates, **Business Model**
John Jacobsen, White Oak Institute, **PI, Other Links**	**Christopher Reyna,** New Paradigm Productions **Recording**
Valentine Kass, National Science Foundation	**Rebecca Robison,** White Oak Institute, **Project Mgr.**
Mark Katz, National Geographic Society, **Project Advisor**	**Tammy Seldon,** GSCA
Doug King, St. Louis Science Center, **Project Advisor**	**Jeanie Stahl,** White Oak Inst. **Co-PI, Business Model**
Jeff Kirsch, Fleet Science Center & **IPS Observer**	**Sandra Welch,** National Science Foundation
Ed Lantz, Visual Bandwidth, Inc., **Link 6**	

Attachment

Title: DIGSS 1.0: Summary Specifications, Recommendations and Testing

DIGSS = Digital Immersive Giant Screen Specifications
Specifications = Aspirational Minimum
Recommendation = Ideal (in full version only)
DCI = Digital Cinema Initiatives

GENERAL (Note: This section is freely adapted from the DCI specifications, Section 1.4)		
	0.1	DIGSS shall have the eventual capability to present a theatrical experience that is perceived as good as or better than what one could achieve now with a traditional 70mm 15 Perf ("15/70") Answer Print and in a giant screen theater meeting GSCA's definition.
	0.2	This system should be based around global standards, or "DIGSS", that are embraced around the world so that content can be distributed, played and experienced anywhere in the world as can be done today with 15/70, 8/70 or 10/70 film prints. These standards should be open, published industry standards that are widely accepted and codified.
	0.3	To the extent that it is possible, DIGSS shall emulate and improve on theater operations and the institutional GS theater business model, as it exists today.
	0.4	DIGSS projection and audio systems shall be capable of operating in several modes: • DIGSS Mode (the subject of this spec): Giant screen experiences compatible with others and able to carry the "Bigger, Better, Bolder" identifier • DCI (Digital Cinema Initiative) Mode: Conventional movies based on the Digital Cinema System Specification, v.1.2 (March '07, 2008) plus addenda and/or later versions. This may require a separate projector. • Open Mode: to handle other digital inputs and innovative programming, from PowerPoint to satellite feeds, to fulldome productions and lower-resolution inputs
	0.5	DIGSS has specifications for Flat 2D/3D and Dome 2D/3D
	0.6	Playback System Reliability (up-time) shall be 99.5% or better.
	0.7	DIGSS follows all DCI specifications except those listed in DIGSS
	0.8	DIGSS is open access, although branded services may choose to operate within DIGSS
	0.9	DIGSS may be achieved with tiling projectors if no seams are visible in projecting live action photography, but it is the supplier's responsibility to map a DIGSS-compliant Digital Cinema Package (DCP) to their array. The on-screen output of multiple projectors shall meet DIGSS on-screen specifications as measured from the reference seat.

LINK 1: PROJECT DEVELOPMENT (ADVISORY ONLY)				
	1.1	Be scientifically and historically accurate and culturally sensitive		
	1.2	Meet audience appropriate standards		
LINK 2: PRODUCTION (ADVISORY ONLY)				
	2.1	Specifications to be determined in a future step		
	2.2	Production should be recorded for use in GS domes and flat screens with dimensional sound.		
	2.3	Production to result in a Digital Source Master (DSM) of sufficient quality that it can be converted into a DIGSS-compliant Digital Cinema Package (DCP) during Link 3.		
LINK 3: ENCODING: The Digital Cinema Package (DCP)				
Note: Italics are used to designate "provisional specifications," which reflect current expert judgments, but which will benefit from on-screen and in-theater testing.				
			Specifications	**Notes**
	All Screens			
	3.1	Compression	JPG2000	DCI testing complete
	3.2	Frame Rate (unique frames)	24 frames per second for 2D; 48 FPS for 3D	
	2D Flat Screen			
	3.3.1	*Resolution*	*4K All screen*	*To be tested* Must be even multiples — 4K, 8K, 16K to use JPG 2000
	3.4.1	Color Bit Depth	12 bit	
	3.5.1	*Bit Rate Compression (maximum; studios can use lower)*	*250 mb/s*	*To be tested*
	3.6.1	Brightness (measured off screen)	20:22 FL for 2D silver screens 6–8 FL. for 3D silver screens	GSCA Task Force
	3D Flat Screen			
	3.3.2	*Resolution*	*4K All screen*	*To be tested* Must be even multiples — 4K, 8K, 16K to use JPG 2000
	3.4.2	Color Bit Depth	12 bit	

			Specifications	Notes
	3.5.2	*Bit Rate Compression (maximum; studios can use lower)*	*250 mb/s*	*To be tested*
	3.6.2	Brightness (measured off screen)	20:22 FL for 2D silver screens 6–8 FL. for 3D silver screens	GSCA Task Force
	2D Dome Screen			
	3.3.3	*Resolution*	*8K*	*To be tested*
	3.4.3	*Color Bit Depth*	*8 Bit*	*To be tested*
	3.5.3	*Bit Rate Compression (maximum; studios can use lower)*	250	*To be tested*
	3.6.3	*Brightness (measured off screen)*	*3-4 fL*	*To be tested*
	3D Dome Screen			
	3.3.4	*Resolution*	*8K*	*To be tested*
	3.4.4	*Color bit depth*	*8 Bit*	*To be tested*
	3.5.4	*Bit rate compression (maximum; studios can use lower)*	*250*	*To be tested*
	3.6.4	*Brightness*	*3-4 fL*	
	Audio			
	3.7	*Specs over DCI to be determined*	*16 channels*	*To be developed*
	Security			
	3.8	DCI compliant security processes and encryption		
LINKS 4 & 5: DISTRIBUTION AND TRANSPORT				
	5.1	Like DCI, DIGSS makes no stipulations about distribution arrangements or how programs (DCP's) are sent (hard drive, satellite, etc.) to the theater.		DCI Compliant

			Specifications	Notes
LINK 6: DECODING AND PLAYBACK (PROJECTION & AUDIO SYSTEMS)				
	Flat Screens			
	6.1	Aspect ratio	1.33:1 (4:3)	DISCUSS advisors' & experts' vote
	6.2	Peak White Luminance	20:22 FL for 2D silver screens 6–8 FL. for 3D silver screens	
	6.3	Luminance Uniformity Variation	No greater than 20% for the projected image	
	6.4	Narrow angle luminance uniformity for measuring tiling seams from overlapping projectors)	5% or less	
	6.5	*Image Resolution*	*4K*	*To be tested*
	6.6a	*Sequential Image Contrast Ratio (from projector)*	*2000:1 minimum*	*To be tested*
	6.6b	*Sequential Image Contrast Ratio (in theater)*	*To be measured*	*Take readings in current theaters*
	6.7a	*Checkerboard Contrast (from projector)*	*150:1 minimum*	*To be tested*
	6.7b	*Checkerboard Contrast (in theater)*	*To be measured*	*Take readings using StEM footage*
	6.8	Color Gamut and Color Accuracy	DCI compliance	
	6.9	Pixel Structure		
	6.10	Contouring	Invisible at the reference viewing distance.	DCI compliant
	6.11	*Frame Rate: refreshing unique image frames:*	*24 frames per second for 2D; 48 FPS for 3D*	
	6.12	*Ghosting: For 3D systems, Crosstalk between eyes*	*Less than 15%*	*To be tested*

			Specifications	Notes
	Dome Screens			
	6.13	*Dome image:*	*A minimum of 130° in the vertical field of view and a minimum of 180° in the horizontal.*	*To be tested* *Matches 7.19 and 7.20*
	6.14	*Peak White Luminance*	*3–4 fL measured at a 45 degree elevation*	*Substantiated through testing*
	6.15	*Luminance Uniformity Variation*	*No greater than 20% for the projected image*	
	6.16	*Narrow Angle Luminance*	*5% or less*	
	6.17	*Image Resolution*	*4K*	*To be tested*
	6.18a	*Sequential Image Contrast (from projector)*	*2000:1 minimum*	*DCI compliant to be validated*
	6.18b	*Sequential Image Contrast Ratio (in theater)*	*To be measured*	*Take readings in current theaters*
	6.19a	*Checkerboard Contrast*	*12:1 minimum*	*To be tested*
	6.19b	*Checkerboard Contract (in theater)*	*To be measured*	*Take readings using StEM footage*
	6.20	Color Gamut and Color Accuracy.	DCI Compliant	
	6.21	Pixel Structure	Invisible at the reference viewing distance	DCI compliant
	6.22	Contouring	DCI Compliant	
	6.23	*Frame Rate: refreshing unique image frames*	*24 frames per second for 2D; 48 FPS for 3D*	
	6.24	*Ghosting 3D systems, crosstalk between eyes*	*Less than 15%*	*To be tested*
	6.25	Dome Master mapping	*Equidistant polar/azimuthal*	Draft fulldome master standard
LINK 7: THEATER GEOMETRY				
	All Screens			
	7.1	Angle of the seating plane	No less than 12° no more than 30°	20° to 25°

			Specifications	Notes
	7.2	Height of the reference seat	0.28 and 0.33 the height of the screen.	
	7.3	Screen quality: surface	Free from all visual defects detected by the human eye: spectrally neutral, free of visible specular reflections: not more than 2% in gain and color	
	7.4	Ambient sound	Shall not exceed Noise Criterion 25 (NC-25)	
	7.5	Screen quality: audio	Neither the screen nor its structure shall produce audible sound.	
	7.6	Reverberation time	0.5 seconds when screen narrower than 80' or a seating capacity of under 400	
	7.7	Intelligibility	ALCONS of not more than 5%. Speech Transmission Index (STI) rating of no less than 0.68 for the reference seat.	
	7.8	Sound characteristics	The audio system shall have audio characteristics that conform to the relevant Digital Cinema Initiative specifications for bit depth, sample rate, and reference level (DCI Specification 3.3.2).	
	7.9	Audio systems channel count and the placement of speakers	The audio system shall have 16 full-bandwidth channels and a physical placement of speakers in the theater that conform to the Digital Cinema Initiative specification of channel count and speaker placement (DCI Specification 3.3.3).	

			Specifications	Notes
	Flat Screens			
	7.10	Screen width	Not less than 70' (21.34 meters)	
	7.11	Screen height	Not less than 50' (15.24 meters)	
	7.12	Farthest seat from a flat screen	No farther than the width of the screen.	
	7.13	Center seat of the row or seats closest to the screen	No closer than .33 times the width of the screen	
	7.14	Seat location: front	No seat between the screen and a 45° line extending from the center of the screen	
	7.15	Seat location: width	No seat farther from the centerline of the theater than 45% the width of the screen.	
	7.16	Dome diameter	No less than 60' (18.3 meters)	
	Dome Screens			
	7.17	Center seat of the closest row of seats to the dome	No closer than 0.30 times the diameter	
	7.18	Seat location: perimeter	No viewer's eyes shall be located within 48" of the inside edge of the dome	
	7.19	Dome and projection system image: vertical	A minimum of 130° in the vertical field of view	
	7.20	Dome and projection system image: horizontal	A minimum of 180° in the horizontal field of view	
	7.21	Dome quality: surface variance	No greater than 12.5 mm	
	7.22	Dome quality: seams	All seams invisible under full color projection	
	7.23	Center top speaker in a dome environment	Audio channel #9 of a minimum of 16 available channels.	

LINKS 8 & 9: OPERATIONS, MARKETING & SALES (ADVISORY ONLY)		
	8.1	Maintain the integrity of the GS Theater experience
	8.2	Record operating data internally according to GSCA accepted data definitions
	9.1	Represent the Theater and the Programs accurately
LINK 10: AUDIENCE (ADVISORY ONLY)		
	10.1	At a minimum, the audience in a GS theater shall be three (3) years or older

Title: Findings from the DISCUSS Economic Surveys

Methodology

Two surveys were conducted to ascertain parameters for the current business model for the GS theaters and film producers showing and producing classic films. These surveys informed the assumptions for the future business models for a global network of DIGSS-compliant digital leasing theaters. (See Attachment E of this Bulletin). One survey was sent to U.S. Giant Screen theaters showing STEM-related films and had 24 respondents (May, 2010). The second survey was sent to film producers and distributors and had four respondents. The aggregate data and the range of data from these surveys was shared with those attending the June 2010 DISCUSS Colloquium, whose participants, among others, included theater managers, museum directors, film producers and distributors. Aggregate data from the surveys and a draft of the future business models were reviewed in breakout groups and the assumptions for the future business model were refined.

Four of the 24 U.S. theaters who responded to the survey were excluded from the group data calculations: two because they were closed for part of the year, one because they are a destination attraction showing predominantly one film, and the fourth because they are primarily a planetarium. In some instances individual theaters were excluded from a particular calculation because of significant anomalies in the data or apparent errors in the way the data was reported. Respondent data were for 2009 or 2010. Of the 20 theaters included in the calculations, twelve show both classic and DMR films and eight show only classic films. It is important to remember that the survey of theaters was for only one year of data, though 13 of the 20 respondents included in the calculations indicated that it was a "typical" year. Several theaters stated that in the 12-month period for which they were reporting, they added more DMR® (Hollywood feature films enhanced by IMAX) programming than usual with the intent to counter the economic downturn. Several reported that popular DMR films helped boost attendance in the reporting year. The inclusion of DMR films has a significant impact on a theater's operating numbers and, as a result, classic film data and DMR data were calculated separately. Based on screening hours per year, the theaters were divided into two groups: Those showing predominantly classic films and those showing predominantly DMR films.

Findings: GS Theaters

Overall, based on the averages for the respondents showing predominantly classic films, classic film-only programming had 2,515 hours of screening time (assuming one hour per screening) and served 189,000 public and school visitors who collectively paid $1.0 million in gross admissions revenue, or $5.25 per individual served (the ATP). Another way to look at the data is per screening hour. Average data showed $403 of admissions revenue per screening hour and 76 visitors.

For theaters showing predominantly DMR films, the DMR film-only programming had average annual screening hours of 2,473 hours (assuming two hours per DMR screening), served an average of 151,000 visitors, who collectively paid $1.7 million in gross admissions revenue, or $11.33 per individual served. Per screening hour, the median data calculated to $637 in admissions revenue per hour and 99 visitors in seats.

Table 1 presents these summary findings and breaks out classic versus DMR data for each group. Based on averages, those showing predominantly classic films had lower annual attendance, admissions revenue, average ticket price and number of screenings. The average ticket price (ATP) for DMR showings was $11.33 for theaters showing predominantly DMR films, more than double that of their classic showings. On a per hour basis, the DMR showings still had a higher ATP, $5.67, than classic shows. And even with higher lease costs (DMR films do not have actual print costs, though they may have some "virtual" print costs), the admissions revenue net of lease and print costs for the DMR films was significantly higher than for the classic only showings. Yet annual admissions revenue per screen hour, net of print and lease costs, were higher for classic films. The costs do not take into account other expense categories for programming such as additional staff, 3D glass cleaning, cost of 3D glasses, advertising costs (generally higher for classic shows), maintenance, etc.

Of the respondents in both groups that show both classic and DMR, screening hours totaled more than 3,000 hours for seven of the eight theaters. For the six theaters showing classic only films, only two theaters had annual screening hours of 3,000 or higher. The range was 1,276 to 3,200.

Summary Findings from DISCUSS Survey of Theaters (Averages)[1]

	Theaters Showing					
	Predominantly Classic			Predominantly DMR		
Categories Present Average Data	Classic Only	DMR Only	AVG All Thtrs	Classic Only	DMR Only	AVG All Thtrs
Screen Hours per Year (DMR 2 hours)	2,515	632	2,768	1,144	2,473	3,617
% of Screenings Hours per Year	n/a	n/a		36%	64%	100%
Annual Theater Attendance	189,000	23,000	202,000	83,000	151,000	235,000
Visitors in Seats per Screen Hour	76	72	n/a	74	99	n/a
Annual Admissions Revenue	$1,021,000	$255,000	$1,170,000	$405,000	$1,714,000	$2,119,000
Average Ticket Price (ATP)	$5.25	$8.94	n/a	$5.13	$11.33	n/a
Less Lease and Print Costs/Capita	$ 3.77	$ 4.52	n/a	$ 2.88	$ 4.68	n/a
Net ATP after Lease and Print costs	$1.48	$4.43	n/a	$2.25	$6.65	n/a
Admisssions Revenue/Screen Hour	$403	$222	n/a	$468	$637	n/a
Less Lease and Print Costs/Screen Hour	$108	$95	n/a	$191	$394	n/a
"Net" Admisssions Rev./Screen Hr.	$295	$127	n/a	$276	$243	n/a

Table 1
Source: DISCUSS Survey of U.S. GS Theaters

[1] The averages for all theaters showing predominantly DMR programming will total the sum of the classic only and DMR data. That will not be the case for the theaters showing predominantly classic programming because of theaters that have no DMR data.

Table 2 presents more detailed data for each category and includes average, median, maximum and minimum data as well as data for annual lease fees and media buys/production costs.

Findings from the DISCUSS Survey of U.S. Giant Screen Theaters

	Theaters Showing					
	Predominantly Classic			Predominantly DMR		
	Classic Only	DMR Only	AVG All Thtrs	Classic Only	DMR Only	AVG All Thtrs
# Respondents	*10-14*	*4-7*	*12-14*	*3-5*	*3-5*	*3-5*
AVG Annual SCREENING HOURS (DMR 2 hrs)	2,515	632	2,768	1,144	2,473	3,617
Median SCREENING HOURS (DMR 2 hours)	2,656	697	2,979	1,168	2,361	3,594
Maximum	3,210	1,080	3,590	1,501	2,954	3,823
Minimum	1,276	54	1,276	739	2,216	3,456
Average Annual ATTENDANCE	189,000	23,000	202,000	83,000	151,000	235,000
Median Annual ATTENDANCE	197,000	18,000	216,000	100,000	117,000	235,000
Maximum	334,000	48,000	334,000	119,000	311,000	411,000
Minimum	64,000	2,000	95,000	41,000	42,000	98,000
Average Annual ADMISSIONS Revenue	$1,021,000	$255,000	$1,170,000	$405,000	$1,714,000	$2,119,000
Median Annual ADMISSIONS Revenue	$1,109,000	$153,000	$1,259,000	$393,000	$1,626,000	$2,079,000
Maximum	$2,012,000	$678,000	$2,012,000	$574,000	$3,391,000	$3,965,000
Minimum	$300,000	$10,000	$450,000	$193,000	$472,000	$665,000
Average "AVERAGE TICKET PRICE"	$ 5.25	$ 8.94	$ 5.81	$ 5.13	$ 11.33	$9.81
Median "AVERAGE TICKET PRICE"	$ 5.01	$ 8.69	$ 5.22	$ 5.15	$ 11.22	$9.59
Average "AVERAGE TICKET PRICE" PER HOUR	$5.25	$ 4.47	n/a	$ 5.75	$ 5.66	n/a
Median "AVERAGE TICKET PRICE" PER HOUR	$5.01	$ 4.35	n/a	$ 4.47	$ 5.61	n/a
Maximum ATP per HOUR	$ 7.30	$ 7.32	n/a	$5.75	$ 6.19	n/a
Minimum ATP per HOUR	$ 3.39	$ 1.97	n/a	$4.47	$ 5.24	n/a
Average ANNUAL LEASE FEE	$203,000	$129,000	$273,000	$145,000	$1,145,000	$1,290,000
Median ANNUAL LEASE FEE	$213,000	$60,000	$260,000	$146,000	$1,084,000	$1,248,000
Maximum	$375,000	$390,000	$456,000	$206,000	$2,112,000	$2,281,000
Minimum	$58,000	$6,000	$75,000	$84,000	$301,000	$384,000
AVG MEDIA BUYS/PRODUCTION Costs/Visit	n/a	n/a	$ 0.63	n/a	n/a	$ 0.24
Median MEDIA BUYS/PRODUCTION Costs/Visit	n/a	n/a	$ 0.45	n/a	n/a	$ 0.20
Maximum	n/a	n/a	$ 1.63	n/a	n/a	$ 0.51
Minimum	n/a	n/a	$ 0.24	n/a	n/a	$ 0.09

Table 2

Source: DISCUSS Survey of U.S. GS Theaters and the White Oak Institute

Table 3 compares theater percentages for classic vs. DMR films for annual screening hours, admissions revenue and attendance for theaters showing both classic and DMR programming. In some, but not all instances, the percentage of screening hours per year correlates to the percentage of theater admissions revenue.

DISCUSS Survey Findings: Annual Data for Theaters Screening both Classic and DMR Films

(Screening hours assume one hour for classic and two hours on average for DMR.)

	Screening Hours		Admissions Revenue		Attendance	
Tthr	Classic	DMR	Classic	DMR	Classic	DMR
Showing Predominantly DMR						
1	36%	64%	37%	63%	57%	43%
2	39%	61%	32%	68%	50%	50%
3			15%	85%	31%	69%
4	31%	69%	29%	71%	41%	59%
5			14%	86%		
6	20%	80%	14%	86%	24%	76%
Showing Predominantly Classic						
7	63%	37%	61%	39%	64%	36%
8			53%	47%	80%	20%
9			31%	69%	60%	40%
10			99%	1%	99%	1%
11	98%	2%	99%	1%	98%	2%
12	77%	23%	93%	7%	96%	4%
13	82%	18%	88%	12%	93%	7%

Table 3

Source: DISCUSS Survey of U.S. GS Theaters and the White Oak Institute

Theater Characteristics of Survey Respondents

Table 4 presents the theater characteristics of the DISCUSS survey respondents as compared to the estimated 66[2] U.S. institutional theaters identified as predominantly showing STEM-related programming, and the estimated global network of 395 theaters (from the LF Examiner Database as of May, 2010) that have ever shown one or more classic films.

Compared to the U.S. STEM theaters, the DISCUSS survey respondents had a much higher percentage of 3D flat screens. Compared to the group of 395 global theaters, the DISCUSS survey respondents had a higher percentage of dome theaters and a higher percentage of 2D theaters. The DISCUSS respondents did not have any 10/70 or digital theaters

[2] Theaters were identified by White Oak and LF Examiner based on their knowledge of the theater's programming.

Theater Characteristics of DISCUSS Survey Respondents

(Note: One U.S. "STEM" theater and five global theaters have dual screens, dome and flat, which results in a count higher than the number of theaters indicated in the first row.)

	DISCUSS Survey GS Theaters		U.S. STEM GS Theaters		GLOBAL GS Theaters	
Number	*20*		*66*		*395*	
DOME	8	40%	33	50%	100	25%
Flat	12	60%	33	50%	300	75%
Imax	17	85%	53	80%	326	83%
Non-Max	3	15%	13	20%	69	17%
2D	9	45%	44	67%	152	38%
3D Capable	11	55%	22	33%	243	62%
1570	18	90%	56	85%	254	64%
870	2	10%	10	15%	50	13%
10/70	0		0		10	3%
Digital	0		0		81	20%
Total	20	100%	66	100%	395	100%

Table 4

Source: DISCUSS Survey of U.S. GS Theaters and the White Oak Institute

Film Survey The DISCUSS team identified the STEM-related classic films released between January 1, 2005 and December 31, 2009 (5 years). A questionnaire was sent to the film producers regarding their film. The number of survey responses to the survey was low, with only four firms responding. However, two of the firms have produced and distributed many films and have years of experience in the industry. Follow-up discussion and clarification of data was conducted with some of the respondents. Additional input was received from filmmakers and distributors attending the DISCUSS Colloquium.

There was a broad range in the answers from the respondents in all categories including film budget and funding sources. The responses informed the ranges used in the future business models presented in Attachment E. Survey responses included the following:

- Current estimated classic film production costs for both "bare bones" and optimal budgets:
  - 2D films: $2 to $5 million for a "bare bones" budget
    $2 to $8 million for an optimal budget.
  - 3D films: $3 to $6 million for a "bare bones" budget
    $4 to $12 million for an optimal budget.
- The distributor's share of box office income is in the range of 20–25%, though the percentage can be higher.
- Marketing and print costs are generally not included in classic leases, but are included in DMR leases.
- Estimated distribution costs from start-up through opening day range from a bare-bones budget of $150,000 for a 2D film to $1.5 million for 2D and 3D films.

Title: Current and Future Business Models

Caveat

This section is not intended to help calculate potential financial returns or other quantified calculations. The intended purposes of the economic models is to inform discussions about the size of the global network of giant-screen theaters, as part of an attempt to define a sustainable global network capable of supporting sufficient ongoing new programming. It is intended to look at the interaction of a few principal variables: a) network size; b) film budget; c) films per year; and; d) share of non-equity funds, recognizing that there are many other variables that can have an impact on the network's sustainability. Further, the methodology treats the behavior of sectors of the field as aggregated averages, when in fact every film is different, as is every theater and its market and operating context. The sample size is stronger for theater operations, but relatively thin for production/distribution data, although the latter include data from organizations with many years of experience and many completed and distributed films. When looking at the relative impact of key variables, we believe these anomalies cancel out and the aggregated methodology is appropriate. However, applying this business model to make forecasts for a specific project would not result in an appropriate analysis. *This study model should not be used as a financial forecasting tool.*

Overview

The tables in this section present a framework for a business model that allows for a range of scenarios based on various assumptions that can be changed. The goal of the model is to determine how many DIGSS-compliant digital GS theaters are needed to support a sustainable global economic network that will support all participants – film producers, investors, distributors and theaters.

Table 1 presents the assumptions driving the future models. There are three models for film budgets, each of which has two funding options, resulting in six scenarios. The differences in the funding options have to do with the amount of non-equity funds (sponsors, grants, etc.) supporting the film production budget.

Currently the business model for film production does not work without non-equity funding. The debt financing market has also been very tight in recent years, making it more difficult to borrow funds for new films. The number of theaters showing primarily STEM-related films is declining and the expected convergence, after their conversion to digital, with DIGSS compliant full-domes is currently viewed as limited, though with technical advances over time that could change. Showing 3D films on domes has been problematic, though recently a few theaters have installed 3D in their dome theaters, projecting films on only part of the screen.

A benefit to future film production costs will be filming digitally, which is cheaper than analog film.

A key assumption driving the model is that five film releases per year are needed to sustain the global network. The six scenarios show that a network of as few as 143 global theaters to as many as 323 are needed to support five films, depending on the funding and film budget assumptions. If the 193 current GS theaters showing STEM programming (as of May, 2010) all converted to digital, that would support three of the scenarios. With the assumption of relatively small growth in the global market of GS theaters showing STEM-related films, it is difficult to see how a steady stream of high-

budget, high-quality films can be sustained without continued non-equity funding.

Table 1 presents the key assumptions for the models. The assumptions were derived partially from the DISCUSS survey results (See Attachment D), which included data for film production budgets, lease fees, funding sources, commission percentages and distribution costs. The wide range of film production budgets in the future model accommodates both 2D and 3D films and reflects the ranges indicated by the respondents in the DISCUSS survey of film producers. In response to questions regarding minimal and optimal film budgets, the range indicated by the respondents was $2 - $5 million for a "bare bones" 2D film budget and $2 - $8 million for an optimal budget. The range for 3D was $3 - $6 million for a "bare-bones" budget and $4 - $12 million for an optimal budget.

Current And Future Business Models Assumptions

ASSUMPTIONS (in 2010 Dollars)	Analog Current Scenario	Digital - Future Scenarios					
		1a	1b	2a	2b	3a	3b
	35% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds
Film Productions Average Costs	$6,500,000	**$9,000,000**	**$9,000,000**	**$6,000,000**	**$6,000,000**	**$3,600,000**	**$3,600,000**
Film Format	All types	3D	3D	2D	2D	2D	2D
# of Current GS Theaters Showing STEM-Related Films	**193**						
Average number of films per year	**4.77**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**
Equity Financing	55.0%	55.0%	90.0%	55.0%	90.0%	55.0%	90.0%
Non-Equity Financing, i.e., "Free money"	35.0%	35.0%	0.0%	35.0%	0.0%	35.0%	0.0%
Debt Financing	10.0%	10% for All Scenarios					
U.S. Theaters Share of Global Theaters	40%	40% for All Scenarios					
International Theaters Share of Global Theaters	60%	60% for All Scenarios					
Relative Annual Lease Fees	Base	1.15	1.15	1.00	1.00	0.85	0.85
Average Lease Fees: U.S. Theaters	$203,000	$233,450	$233,450	$203,000	$203,000	$172,550	$172,550
AVerage Lease Fees: International Theaters	-10%	-10% for All Scenarios					
Ancillary income in Addition to Film Leases	+10%	+20% for All Scenarios					
Continuing Distribution Commission	25%	25% for All Scenarios					
Up-front Distribution Costs	$850,000	$850,000 for All Scenarios					

Table 1

Source: DISCUSS Survey of U.S. GS Theaters and White Oak Institute

Current And Future Business Models Assumptions (Part 1 of 3)

ASSUMPTIONS (in 2010 Dollars)	Analog Current Scenario	Digital - Future Scenarios					
		1	2	3	4	5	6
	35% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds
Average number of films per year	**4.77**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**
Film Productions Costs	**$6,500,000**	**$9,000,000**	**$9,000,000**	**$6,000,000**	**$6,000,000**	**$3,600,000**	**$3,600,000**
Film Production Revenue Goal							
Goal for Producer's Net Revenue and Start-up Distrib. Costs per film	**$6,531,000**	**$8,716,000**	**$13,063,000**	**$6,094,000**	**$8,992,000**	**$3,996,400**	**$5,735,200**
Calculated Goal for Revenue per year for 5 Films		**$43,580,000**	**$65,315,000**	**$30,470,000**	**$44,960,000**	**$19,982,000**	**$28,676,000**
Annual Classic Film Lease Fees per Year / per Theater							
Assumed Increase/Decrease over Current U.S. Annual Lease Fees	**Base**	**1.15**	**1.15**	**1.00**	**1.00**	**0.85**	**0.85**
AVG U.S. Annual Lease Payments for Classic films / year / thtr	**$203,000**	**$233,450**	**$233,450**	**$203,000**	**$203,000**	**$172,550**	**$172,550**
Factor for non-US Annal Lease Payments	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Ratio of US / Total Global Network	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%	40.0%
International AVG Annual Lease Payments for Classic Films	$190,820	$219,443	$219,443	$190,820	$190,820	$162,197	$162,197
Ancillary Revenue							
Ancillary Revenue to Distributor (as % of Film Lease Revenue)	**10.0%**	**20.0%**	**20.0%**	**20.0%**	**20.0%**	**20.0%**	**20.0%**
Attendance and Per Capita Lease Fees							
Average Annual Attendance	189,000	not assumed	not assumed	not assumed	not assumed	not assumed	not assumed
Calculated Per Capita Film Lease Fees	$1.07	not assumed	not assumed	not assumed	not assumed	not assumed	not assumed
Number of Theaters in 2010 Showing Classic Films on a Regular Basis							
Number of theaters in network that Show Classic Films	**193**	n/ap	n/ap	n/ap	n/ap	n/ap	n/ap

Table 2

Source: DISCUSS Survey of U.S. GS Theaters and White Oak Institute

Current and Future Business Models (Part 2 of 3)

	Analog Current Scenario	Digital - Future Scenarios					
		1	2	3	4	5	6
ASSUMPTIONS (in 2010 Dollars)	35% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds
Average number of films per year	**4.77**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**	**5.00**
Film Productions Costs	**$6,500,000**	**$9,000,000**	**$9,000,000**	**$6,000,000**	**$6,000,000**	**$3,600,000**	**$3,600,000**
ASSUMPTIONS (in 2010 Dollars)							
Film Cost and Financing							
AVG Cost of film (equity total + non-equity) = budget	$6,500,000	$9,000,000	$9,000,000	$6,000,000	$6,000,000	$3,600,000	$3,600,000
Non-equity funds (sponsors, pre-leases, grants) share of budget "Free mon	**35.0%**	**35.0%**	**0.0%**	**35.0%**	**0.0%**	**35.0%**	**0.0%**
Debt and other off-the-top reimbursements	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Equity Funds per Film	55.0%	55.0%	90.0%	55.0%	90.0%	55.0%	90.0%
Total Non-equity Funds per film	$2,275,000	$3,150,000	$0	$2,100,000	$0	$1,260,000	$0
Total Debt Financing per film	$650,000	$900,000	$900,000	$600,000	$600,000	$360,000	$360,000
Total Equity Funds per film	$3,575,000	$4,950,000	$8,100,000	$3,300,000	$5,400,000	$1,980,000	$3,240,000
Distributor							
Start-up Costs	$850,000	$850,000	$850,000	$850,000	$850,000	$850,000	$850,000
Commission / Share of Gross Revenues	**25%**	**25%**	**25%**	**25%**	**25%**	**30%**	**25%**
Timing and Payback of Financing							
Investors							
Years from mid-spending to mid-revenues	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Lost opportunity of other potential Investments as % / yr	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
Add'l Risk margin needed to motivate investment	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%	8.0%
Lost Opportunity (Equity Funds x % Lost opportunity x Years out) per film	$1,072,500	$1,485,000	$2,430,000	$990,000	$1,620,000	$594,000	$972,000
Add'l Risk margin amount	$286,000	$396,000	$648,000	$264,000	$432,000	$158,400	$259,200
Total minimum goal return to investors	$1,358,500	$1,881,000	$3,078,000	$1,254,000	$2,052,000	$752,400	$1,231,200
Plus equity funds to return to investors	$3,575,000	$4,950,000	$8,100,000	$3,300,000	$5,400,000	$1,980,000	$3,240,000
Total goal to return to investors (equity + return on investment)	**$4,933,500**	**$6,831,000**	**$11,178,000**	**$4,554,000**	**$7,452,000**	**$2,732,400**	**$4,471,200**
Debt Financing							
Percentage of Film Budget	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%	10.0%
Amount of Loan	$650,000	$900,000	$900,000	$600,000	$600,000	$360,000	$360,000
Rate	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%	6.0%
Years out	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Interest to Pay	$97,500	$135,000	$135,000	$90,000	$90,000	$54,000	$54,000

Table 2

Source: DISCUSS Survey of U.S. GS Theaters and White Oak Institute

Current and Future Business Models (Part 3 of 3)

		Analog Current Scenario	Digital - Future Scenarios					
			1	2	3	4	5	6
ASSUMPTIONS (in 2010 Dollars)		35% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds	35% non-equity funds	0% non-equity funds
Average number of films per year		4.77	5.00	5.00	5.00	5.00	5.00	5.00
Film Productions Costs		$6,500,000	$9,000,000	$9,000,000	$6,000,000	$6,000,000	$3,600,000	$3,600,000
RESULTING MODELS BASED ON THE ASSUMPTIONS								
Summary of Goal for Return on Investment and Start-up Distribution Costs								
Start-up Distribution Costs per Film		$850,000	$850,000	$850,000	$850,000	$850,000	$850,000	$850,000
Debt Repayment - Principle and Interest		$747,500	$1,035,000	$1,035,000	$690,000	$690,000	$414,000	$414,000
Equity Funds to pay back		$3,575,000	$4,950,000	$8,100,000	$3,300,000	$5,400,000	$1,980,000	$3,240,000
Return on Equity to pay back investors		$1,358,500	$1,881,000	$3,078,000	$1,254,000	$2,052,000	$752,400	$1,231,200
Total Minimum Needed for Net Revenue per Film		$6,531,000	$8,716,000	$13,063,000	$6,094,000	$8,992,000	$3,996,400	$5,735,200
Calculated Annual Lease Fees and Producer's Net Revenue								
Current Model Based on Total 193 Theaters in Network Showing Classic Films on a Regular Basis								
Future Model Based on Assumption of # of Thtrs in Network, 5 Films / Year and Revenue Goal per Film								
Total U.S. annual lease payments for all Classic Films per Year		$15,671,600	$20,076,700	$30,161,740	$14,047,600	$20,787,200	$9,869,860	$13,251,840
Total International annual lease payments for all Classic Films per Year		$22,096,956	$28,308,147	$42,528,053	$19,807,116	$29,309,952	$13,916,503	$18,685,094
Total Global Annual lease payments for all Classic Films per Year		$37,768,556	$48,384,847	$72,689,793	$33,854,716	$50,097,152	$23,786,363	$31,936,934
Plus Ancillary Revenue		$3,776,856	$9,676,969	$14,537,959	$6,770,943	$10,019,430	$4,757,273	$6,387,387
Total Revenue to Distributor		$41,545,412	$58,061,816	$87,227,752	$40,625,659	$60,116,582	$28,543,635	$38,324,321
Less Distributor's share (exclusive of start-up distribution costs)	25%	$10,386,353	$14,515,454	$21,806,938	$10,156,415	$15,029,146	$8,563,091	$9,581,080
Producer's Net Revenue and Pre-Distribution Start-Up Costs		$31,159,059	$43,546,362	$65,420,814	$30,469,244	$45,087,437	$19,980,545	$28,743,241
Producer's Net Revenue and Start-up Distribution Costs per Film		$6,531,000	$8,709,272	$13,084,163	$6,093,849	$9,017,487	$3,996,109	$5,748,648
Goal for Producer's Net Revenue and Start-up Distribution Costs per Film		$6,531,000	$8,716,000	$13,063,000	$6,094,000	$8,992,000	$3,996,400	$5,735,200
Variance		$0	($6,728)	$21,163	($151)	$25,487	($291)	$13,448
Annual # Films supported by the network		4.77						
Goal of Annual # Films Supported by the Network		n/ap	5.00	5.01	5.00	5.01	5.00	5.01
Number of Theaters Needed to Support 5 Films		n/ap	215	323	173	256	143	192
Calculated Total Network Annual Attendance		36,477,000	n/av	n/av	n/av	n/av	n/av	n/av
"Free Money" Needed / Yr (grants, sponsors, etc.) (free $ x films / yr)		$10,853,906	n/av	n/av	n/av	n/av	n/av	n/av
Cost of Impact / Visitor (free $ / total attendance)		$0.30	n/av	n/av	n/av	n/av	n/av	n/av

Table 2

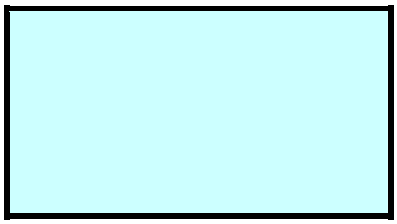
Source: DISCUSS Survey of U.S. GS Theaters and White Oak Institute

Title Giant Screen Digital Theater Glossary

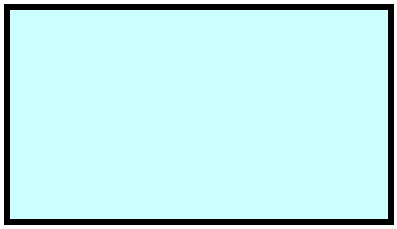
Aspect Ratio

An aspect ratio is a numerical way of describing a rectangular shape, like the screen. Professional cinematographers prefer a single number to describe screen shapes and refer to the 4:3 television ratio as 1.33:1, or just 1.33.

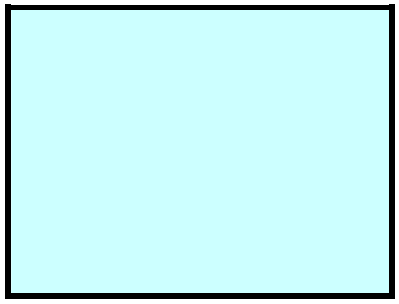
Wide Screen: sometimes available in conventional movie theaters –2.35:1



Conventional Cinema: for Hollywood movies – 1:85:1.



HD TV: The aspect ratio of HD televisions is 16:9, or 1.77:1



Giant Screens: The aspect ratio for IMAX classic films as well as of standard televisions, which before HD, were 4:3. This means that the picture is 4 "units" wide and 3 "units" high. Professional cinematographers prefer a single number to describe screen shapes and refer to the 4:3 television ratio as 1.33:1, or just 1.33.

Classic giant screen movies and screens usually seen in museums have an aspect ratio of 1.33.

The challenge for giant screens (GS) is that digital cinema projector chips have the same aspect ratio as conventional movies – 1.85. To be able to project both in a giant screen theater, there are currently two solutions: 1) use two overlapping or tiled projectors to fill a 1.33 screen, or 2) use only the middle 70% of the digital cinema projector chip when showing a movie with a 1.33 aspect ratio using a 1.85 projector. Current conventional wisdom is that there is not enough of a market to develop a 1.33 chip.

Immersive Experiences

Experiential theater works through the careful orchestration of multiple sensory inputs and through the equally important removal of reminders of the actual architecture and its machinery The National Research Council's study on informal science learning found that "The scale and setting of a giant-screen film may result in a uniquely immersive experience compared with other screen experiences. Because of the large frame size and extremely high resolution of the film, this technology immerses viewers into the projected image, whether photographed with special cameras or computer-generated."

Experiential theaters use dimensional and surrounding media technologies and architecture to create the illusion of being inside the action/frame. In conventional movie theatres, a rectangle inside the field of view from the reference seat separates the program from the audience, just as a proscenium arch separates the actors and stage set from the audience. A GS theater is designed for immersion by minimizing this separation, and should be marketed and perceived as an extraordinary immersive experience.

Answer Print

A color-corrected film print made Print directly from the cut film negative. It is also the culmination of the creative color timing process, where final creative approval is granted before the film is duplicated for release.

Common Acronyms

ASTC: Association of Science-Technology Centers

DCDM: Digital Cinema Distribution Master. A master set of files that have not been compressed, encrypted, or packaged for Digital Cinema distribution. The DCDM contains essentially all of the elements required to provide a Digital Cinema (DC) presentation.

DCI: Digital Cinema Initiatives, LLC, an organization formed in March 2002 by the seven major Hollywood studios (Metro-Goldwyn-Mayer, Paramount Pictures, Sony Pictures Entertainment, 20th Century Fox, Universal Studios, Walt Disney Company, Warner Bros.) to establish a specification for the architecture for digital cinema systems.

DCP: Digital Cinema Package, the set of files that are the result of the encoding, encryption and packaging process.

DIGSS: Digital Immersive Giant Screen Specifications is a process intended to help giant-screen theaters transition from film to digital projection while maintaining the superior image quality that has characterized the industry since its inception in 1970. It is an open process modeled on the Digital Cinema Initiatives that guided the commercial cinema industry through its conversion to digital projection.

DISCUSS: Digital Immersive Screen Colloquium for Unified Standards and Specifications convened giant-screen industry leaders and technical experts from June 14– 16, 2010 to develop a draft of the DIGSS.

DLP™: Digital Light Processing (a trademark of Texas instruments)

Dome Master: The program exchange protocol in the fulldome field

Fulldome: The planetarium world's term for a dome theater that uses one or more digital projectors to cover the entire dome. Contrasted with traditional analog planetariums, which used electro-mechanical star projectors and special effects projectors.

GSCA: Giant Screen Cinema Association

IPS: International Planetarium Society

JPEG: Acronym for Joint Photographic Experts Group, the international body that developed the JPEG 2000 standard.

LCoS™: Liquid Crystal on Silicon (a trademark of Brillian Corporation)

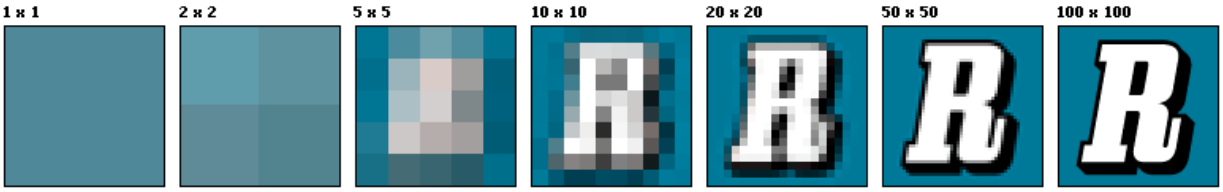
Metadata: Data about data or data describing other data. Information that is considered ancillary to or otherwise directly complementary to essence. Information that is useful or of value when associated with the essence being provided.

Reference Seat: The real or imagined center seat in the center row of the seating area.

See the Glossary Terms (from Section 10 of the DCI Digital Cinema System Specification v 1.2)

Pixels

A *pixel* is a dot of light on the screen, and it is the smallest visual unit of a projector of a certain *resolution*. The more pixels on the screen (i.e. smaller pixels), the higher the resolution, as illustrated in this sequence from 1 pixel/square to 10,000 pixels/square:



Pixel illustration downloaded on 1/26/11 from http://en.wikipedia.org/wiki/File:Resolution_illustration.png

Resolution – 2K or 4K

4K is an emerging standard for resolution in digital film and computer graphics. The name "4K" comes from its approximately 4,000 pixels of horizontal resolution (or 2,000 pixels for **2K**). The terms 2K or 4K describe the horizontal resolution, as opposed to home televisions, which refer to resolutions of 720p and 1080p, which both stand for the number of vertical pixels.

Digital Projectors

There are currently two types of projectors for digital cinema: Digital Light Processing (DLP) and Liquid Crystal on Silicon (LCOS). The DCI specification for digital projectors calls for two levels of playback to be supported: 2K (2048×1080) or 2.2 million pixels at 24 or 48 frames per second, and 4K (4096×2160) or 8.85 million pixels at 24 frames per second. A 4K DLP projector will be available in early 2011; LCOS 4K's are on the market already, but are not as bright.

Three manufacturers have licensed the DLP Cinema technology developed by Texas Instruments: Christie Digital Systems, Barco, and NEC. As of 2009, there were more than 6,000 DLP-based Digital Cinema systems installed worldwide, 80% located in North America.

Early DLP projectors, which were deployed primarily in the U.S., used limited 1280×1024 resolution or the equivalent of 1.3 MP (megapixels). They are still widely used for pre-show advertising but not usually for feature presentations.

The other technology is made by Sony and is labeled "SXRD"(LCOS) technology. The projectors, SRXR220 and SRXR320, offer 4096 x 2160 (4K) resolution and produce four times the number of pixels of 2K projection.

Compatibility Standards

DCI Compliance (exchange protocol for conventional digital movie theaters)
The Society of Motion Picture and Television Engineers began work on standards for digital cinema in 2001. Digital Cinema Initiatives (DCI) was formed in March 2002 as a joint project of many motion picture studios (Disney, Fox, MGM, Paramount, Sony Pictures Entertainment, Universal and Warner Bros. Studios) to develop a system specification for digital cinema. Giant screen theaters must have projectors that comply with the DCI standards if they want to show current hollywood movies. DCI standards are not necessary for showing traditional museum-oriented, classic giant screen films. DCI standards are concerned with protection against piracy, calling for a standardized method of picture encoding.

DIGSS 1.0 Standards and Compliance (exchange protocol for GS museum theaters)
These standards (some of which are provisional) for digital giant screen theaters emerged from a colloquium of Giant Screen professionals (DISCUSS) held in 2010 and hosted by the White Oak Institute with NSF support. DIGSS 1.0 is built on DCI, specifying additional levels of quality and size to meet museums' need for an immersive learning environment. Some DIGSS 1.0 specs are aspirational, as technologies are not yet equal to analog film.

Potential systems integrators can be asked to come as close to the DIGSS standards as they can. As this is a moving target, we want a flexible arrangement with a flexible vendor.

Giant Screen

The GSCA has adopted definitions for what theaters qualify as a GS theater that can use their "Bigger, Bolder, Better" certification and marketing program:

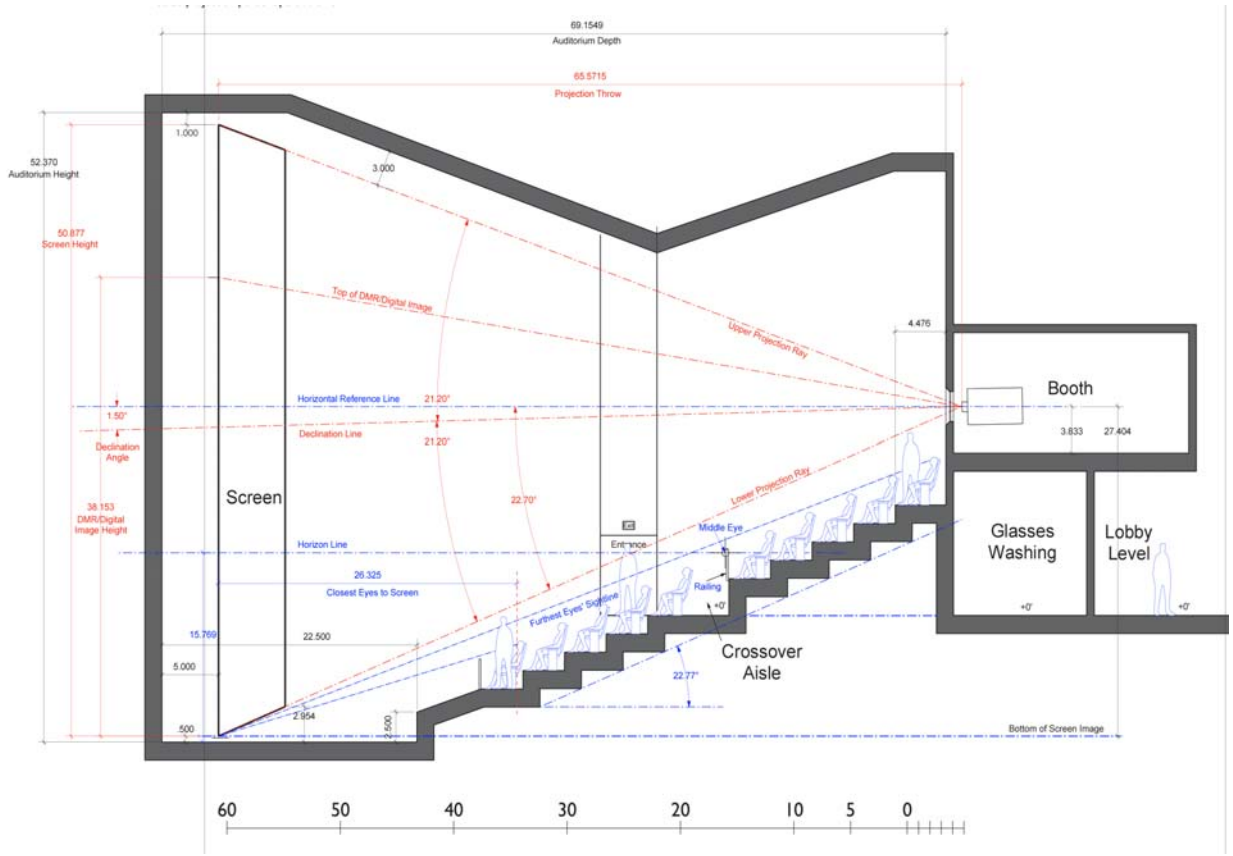
- 70 feet (21.3 meters) wide, or
- 3,100 square feet (288 square meters) in total area for flat screens, or
- 60 feet (18.3 meters) in diameter for domes, and
- Place all seating within one screen width of the screen plane

Classic and DMR® Films

Classic: Classic films are those that a) are produced specifically for giant-screen theaters, b) run an hour or less, and c) have learning objectives, often using science, technology, engineering, or math (STEM) content.

DMR®[1]: Hollywood blockbusters re-mastered for IMAX (digitally re-mastered Hollywood studio films), such as *Avatar: The IMAX® 3D Experience*.

Theater Geometry: DIGSS compliant



This section of the Peoria Riverfront Museum's GS theater shows the sightlines of an eye-filling immersive experience and complies with DIGSS' theater geometry specifications.

[1] DMR® and IMAX® are registered by the IMAX Corporation