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David Carlson, Brian Gaffney.

Design and Production:  
Craig Hildrew, Gareth Ewers.



# CODEx

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# JOKER SHOWS OFF VISUAL POWER OF THE ALEXA 65

A CODEX Workflow Maintains Efficiency



**Lawrence Sher, ASC has done what so many aspiring cinematographers can only dream of – in the space of two decades, he's gone from shooting no-budget productions to the biggest tentpoles in the circus.** With a non-standard background – he majored in economics at Wesleyan – Sher began in the mid-1990s, making some charming indies (*Kissing Jessica Stein*), followed by successful small-budget comedies (*Garden State*), and then a run of studio comedies and action flicks (*The Hangover* films, *The Dictator*, *The Dukes of Hazzard*). Then he made a graceful segue into action-VFX with *Godzilla: King of the Monsters* and put it all together with a socio-political drama that defies categorization and continues to crush it at the box office – *Joker*.



**CODEX PLAYED A CRUCIAL ROLE IN ADAPTING THE DATA SCIENCE TO THE EXPONENTIALLY BIGGER FILES PRODUCED BY THE ALEXA 65. THE RESULT HAS BEEN NEW VISUAL POWER FOR CINEMATOGRAPHERS AND DIRECTORS**

Lawrence Sher

**How'd he do it?** "I always say it's attitude," says Sher. "Enthusiasm is going to get you a whole heck of a lot farther than talent. The talent is going to get you somewhere, and ultimately talent will be what drives you creatively. But I think the interpersonal aspects of filmmaking are paramount to your success. The stakes are really high. Everyone I know who works in film, in all departments, cares deeply about what they do. Because of that internal pressure we all put on ourselves, and the time limitations, production can be so stressful."

On *Joker*, Sher reteamed with director Todd Phillips. It was their sixth film together. "I see my number one job as a cinematographer as taking away some of that burden for the director," says Sher. "Having now directed a film [*Father Figures*, starring Owen Wilson, Ed Helms and Glenn Close], I can empathize even more. As a director, you can feel alone on an island, peppered with a thousand questions every day. The most important thing you can get from your collaborators is some help with that weight, so it's not all on your shoulders. I wake up every day caring as deeply about the movie as they do and wanting just as much for it to succeed. And I think that's been a key part of what success I've had."

Sher says that one helpful habit of the mind is to approach each day as if he's already two hours behind. "Every single moment of shooting is a way to make sure that we get everything we want to get over the course of that day," he says.



On *Joker* and *Godzilla: King of the Monsters*, Sher and his team shot with the ARRI ALEXA 65, maintaining that efficiency with a CODEX workflow. DIT Nick Kay used a workflow built around the ARRI ALEXA 65 and CODEX tools like the Vault 65 and Transfer Drives. The additional data for 5K resolution was deemed worth it by the studio in part because the camera team knew it wouldn't slow things down appreciably.

"The workflow was seamless," says Sher. "For most of the time that we've been living in a digital world, the idea of gaining front-end resolution wasn't really a major factor. But I think there's been a tipping point this year. As we approached *Joker*, making the decision to shoot ALEXA 65 in 5K, people at Warner Bros. seemed to appreciate having a 4K master – something that wasn't usually an option just a year or two ago. With everything that comes into play – the various deliverables, future-proofing, and archiving – whatever the reason, I felt that this year there was a shift at the major studios. Once we made the decision, we pushed it forward with no problems at all."

Phillips and Sher agreed on the format in part because the larger sensor facilitated using depth of field to isolate Joaquin Phoenix in the frame. "It's a character study, and we knew it would be told a lot in close-ups," says the cinematographer. "A 40mm can give you a medium lens feel but still have the field of view of a wider lens and allowing the camera to be physically closer to the actor, which conveys a certain feeling."



Sher shot nearly two dozen features on film emulsion before making the switch to digital. "When Nick and I worked together on *The Dictator* [2012], the ALEXA had been out for a year or so and ARRIRAW didn't exist," he recalls. "*Extremely Loud and Incredibly Close* was being made at about the same time, so it was in the early stages. The recorders were external, and producers suddenly had to deal with new line items that had not previously existed, like data management. Nick was amazing at working that all out."

Soon after that, ARRIRAW was made dependable, convenient and fast by the advent of in-camera CODEX recording. Eventually, CODEX played a crucial role in adapting the data science to the exponentially bigger files produced by the ALEXA 65. The result has been new visual power for cinematographers and directors.

"When I'm considering changes in technology, I ask whether it comes with caveats," says Sher. "When digital got to the point where we could shoot it and treat it like film without any exceptions, then you could make the decision aesthetically. *Joker* was a game-changer. And now, with the ALEXA 65, the technology was the right tool for *Joker*. I'm very happy with the look of the film."



**Camera Type:** ARRI ALEXA 65  
**Camera Rental by:** ARRI Rental US  
**Director:** Todd Phillips  
**Director of Photography:** Lawrence Sher  
**DIT:** Nick Kay



An interview with Marc Shipman-Mueller, Product Manager for Camera Systems at ARRI



**ARRI was known for its great film cameras, how did you manage the transition to digital?**

That transition was carefully orchestrated over 15 years by Franz Kraus, who was our managing director and is now on the board of directors. It started with developing the ARRILASER from 1995 to 1998, when we learned a lot about digital technology and digital image making. With the development of the ARRISCAN and the ARRIFLEX D-20 "film-style" digital camera, both based on the same sensor technology, we really dove in and brought a lot of digital competence into the company. Working from 2000 to 2008 on the D-20 and its successor, the D-21 (which was used on the Emmy-award winning first episode of *Downton Abbey*), taught us how a digital camera for the high-end market has to function. Developing and manufacturing digital motion picture cameras turns out to be a lot more complex than making film cameras.

**And when was the ALEXA project started?**

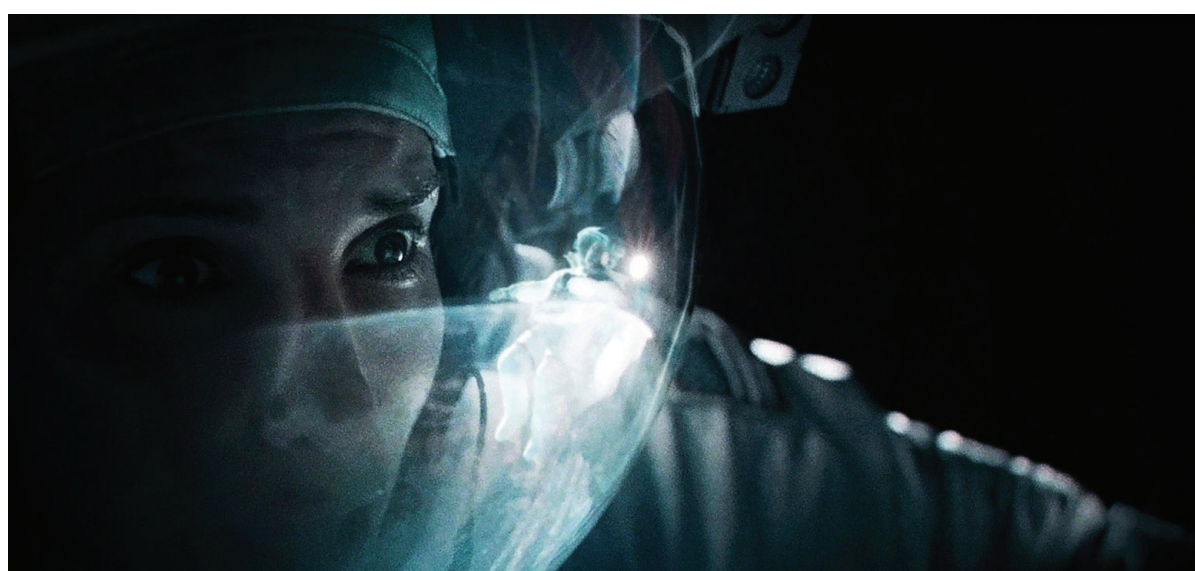
Film camera sales had been going strong, especially with the success of the ARRICAM, 435, 235 and 416 cameras, but in the Fall of 2008, film camera sales dropped off a cliff. Rental managers suddenly did not see a future in film anymore. My guess is this was partly caused by the global financial crisis and partly by the threat of a SAG (Screen Actors Guild) strike. Anyone who wanted to still shoot used AFTRA (American Federation of Television and Radio Artists) actors, but their contract stipulated electronic cameras. That's when the ALEXA project really kicked into high gear. By that point we had enough digital competence and experience in house, but it was still an equally exciting and exhausting time.

**When did the first ALEXA appear?**

We shipped the very first ALEXA in June of 2010. It already had all the qualities that, in my opinion, led to the great popularity of the ALEXA family of cameras: best overall image quality, including super high dynamic range and great skin tones, great reliability, great ease of use and a sensor with the same dimensions as traditional 35mm film. As one cinematographer commented: "It is fast and easy to make good images with ALEXA." Many Oscars for best picture and almost all the Oscars for best cinematography and best VFX have gone to movies shot with some model of ALEXA in the following years, including *Hugo* in 2012, *Life of Pi* in 2013, *Gravity* in 2014, *Birdman* in 2015, *The Revenant* in 2016, *Moonlight* in 2017, *The Shape of Water* and *Blade Runner 2049* in 2018 and *Roma* in 2019. But ALEXAs were and are also popular for TV series. Back in 2010, some of the first ALEXAs went straight to Ireland for the first season of a small, unknown TV series called *Game of Thrones*, and they have been shooting happily ever after with successive generations of ALEXA cameras. For all the many models and features we now have, the original ALEXA started with modest features: it used only the 16:9 area of the sensor, ran up to 60 fps, and recorded only ProRes in-camera; for ARRIRAW you needed an external recorder.

**How did you determine what would be next?**

We always spend a lot of time talking to cinematographers, camera assistants, DITs, rental houses, colorists, post supervisors, VFX supervisors, directors and producers, just about anyone involved in the process. And that is not a shy crowd of people. They will tell you clearly what they want. The trick is to filter all that and at the same time look at trends in the industry and at the available technology. From there we draft a road map. To give us some flexibility, the ALEXA is based on FPGA (Field Programmable Gate Arrays) technology, which is essentially computer chips that can be completely reprogrammed. This has allowed us to release a continuous stream of software updates for the cameras based on customer feedback, providing many new significant features over the years to keep the cameras relevant. One of the first software updates was 120 fps, followed by improvements in image quality, anamorphic de-squeeze, false color, extensive metadata recording, look management, ProRes 2K, ProRes 3.2K and so many others.



**THE ALEXA STUDIO IS ROGER DEAKINS' CBE, ASC, BSC FAVORITE AND WAS USED ON MANY OF HIS PROJECTS, INCLUDING THE JAMES BOND FILM SKYFALL**

Marc Shipman-Mueller, Product Manager Camera Systems, ARRI

**What were other ALEXA models you developed?**

The original ALEXA Classic EV (Electronic Viewfinder) was joined in 2011 by the ALEXA Classic Plus, which featured built in wireless remote control of camera and lenses, and the ALEXA Classic Studio, which was the first digital camera with a 4:3 sensor and to this day is the only digital camera with an optical viewfinder. The ALEXA Studio is Roger Deakins' CBE, ASC, BSC favorite camera, and was used on many of his projects, including the James Bond film *Skyfall*. Then came the ALEXA M in 2012, which had a separate body and (Modular) head. The M was used extensively in 3D; integrating just the lightweight head into the 3D mirror rigs made them much more manageable.

**What were the most popular recording formats?**

The big surprise to all of us was the huge popularity of Apple ProRes in the first years. While originally meant as an offline editing format, once filmmakers realized how good the image quality was and how they got immediate access to the footage on their Macs, it quickly became a mastering format. Our unencrypted and uncompressed ARRIRAW has higher image quality, greater flexibility in post, is better for archiving and was used for all the really big shows, but for many customers the external recorder and higher data rates were not appropriate. In 2012, the ALEXA XT family of cameras (XT EV, XT Plus, XT Studio and XT M) brought in-camera ARRIRAW recording and started our great relationship with CODEX, who co-developed the recording and who have provided super reliable digital capture drives and workflow solutions for our cameras ever since. With the XT cameras, ARRIRAW started to become more and more popular. The XTs also all used the full 4:3 sensor area, which paved the way for an increase in the use of anamorphic lenses.



**How did you then branch out in your camera development?**

In 2014 we introduced the AMIRA, which includes the same sensor but in a new camera form factor, designed with single-user ergonomics in mind for situations where crews are small, time is short, and budgets are tight. On the other end of the spectrum, ARRI Rental introduced the exclusive ALEXA 65 in 2015 with a sensor three times the size of the Super 35 ALEXA sensor, effectively starting a new era of large format cinematography. The same year also saw the introduction of our most popular ALEXA to date, the ALEXA Mini. It shares the same sensor and the best overall image quality with its predecessors, but came with its small size, light weight and great versatility. Originally meant as a camera for drones, gimbals, underwater housings and action photography, the ALEXA Mini soon was also used as an "A" camera on many sets. With the ALEXA Mini our customer base expanded from mostly rentals to a large number of owner/operators. 2016 then brought an update to the larger ALEXA, the ALEXA SXT, followed in 2017 by the ALEXA SXT W, which has an integrated wireless video transmitter.



**When were the first Large Format cameras released?**

In 2018 we released the ALEXA LF, which is based on the ALEXA SXT W electronics but has a sensor twice the size of a Super 35 sensor. This was mainly to account for the growing trend towards large format cinematography but had the pleasant side-effect that the ALEXA LF was Netflix approved. The ALEXA LF was accompanied by the ARRI Signature Prime lenses. That was followed in 2019 by our newest baby, the ALEXA Mini LF, where we squeezed the large sensor and powerful processing from the ALEXA LF into a Mini-sized camera. Early ALEXA Mini LF prototypes were used on *1917* shot by Roger Deakins CBE, ASC, BSC, with ARRI Signature Prime lenses, and on *Dune*, shot by Greig Fraser ACS, ASC.

**What do you see for the future?**

I think we will see large format and Super 35 co-exist, like it was with Super 16 and 35 mm film. We certainly are committed to continuing both our large format and our Super 35 camera lines. And then there are trends: TV series are becoming more important, there are the streaming wars, a interesting need to be more versatile, and certainly metadata and how to handle it downsteam are interesting subjects that are very complex, but gain in importance every year.

# PIX RT

# MAKING THE CONNECTED SET A REALITY



PIX has worked closely with David Fincher and his No. 13 production company since *Panic Room* in 2001, developing tools and services that have fundamentally changed how feature films and television shows are made. One of the first directors to embrace digital cameras with his use of the Thomson Viper on *Zodiac*, Fincher and his team are constantly redefining technology as they seek to blur the line between production and post production and strive to automate the mundane and more clearly communicate their creative vision.



## PRODUCTS DEPLOYED ON MINDHUNTER

PIX, PIX RT

The series also uses the X2X Labs developer program for custom integrations.

On Netflix's *Mindhunter*, Fincher again used the latest digital capture technology – custom RED Xenomorph cameras designed to his specifications, integrating all the usual camera components (wireless video transmitters, focus controls etc.) into the camera for a much more ergonomic design. But Fincher's desire for innovation extended far beyond the camera, so he again turned to PIX.

### CHALLENGE

Working on his current project, the second season of *Mindhunter*, David Fincher was looking for a way to better convey the thoughts and ideas he came up with during production via annotations attached to the image captured by the camera. In the past, a thought about the grading required for a particular shot might have been conveyed via a phone call to the dailies colorist much later in the day after shooting wrapped. David Fincher required a real-time telestration solution, rather than a delayed response later in the evening or next day. And it absolutely could not delay shooting or increase the footprint or complexity of production.



### SOLUTION

PIX has built a proof of concept that makes a Connected Set a reality. PIX RT (Real-Time) creates media that is immediately available to the director so that he or she can make annotations and notes on the image right after it has been captured. This media and metadata are synchronized to PIX to all the approved members of the production who can review them along with image files. Other approved production crew – for example, DP Erik Messerschmidt – can also add their own notes. These notes are securely conveyed through to editorial and post production along with the image files and other metadata.



### RESULT

Real-Time Creative Capture – The thoughts and ideas of the creative team are recorded in real-time immediately after the take. This ensures that their vision and ideas are communicated clearly and without change through the many lines of communication to the rest of the production team, reducing the potential for misunderstanding. For example, the editorial team can easily see any notes the director or DP have made without relying on paper, phone calls or emails sent later in the day. This might be a note that a take needs to be printed down half a stop or a note that something in the frame needs to be removed in post. Having the note linked to the image vastly reduces the opportunity for error and saves valuable time.



**Patented Content Security** – Along with the rest of the industry-leading PIX platform, PIX RT is extremely secure, built on PIX's patented DRM with dynamic and forensic watermarking and meets the exacting standards of the MPAA.

**Minimal Footprint On Set** – Rather than adding to the on-set production infrastructure, PIX RT actually reduces it by providing immediate playback of takes to authorized devices as they are captured by the camera.

**No Production Delays** – As authorized members of the creative team can annotate the file immediately and easily on their own tablet, there is absolutely no slowdown in the pace of production.

# THE LION KING COMBINES HIGHTECH WITH THE HUMAN TOUCH



Robert Legato, ASC and Caleb Deschanel, ASC



After a mere ten days in release, *The Lion King* blew past half a billion dollars at the worldwide box office. The success must be gratifying for director Jon Favreau and his team, led by director of photography Caleb Deschanel, ASC and visual effects supervisor Robert Legato, ASC. The trio pushed virtual filmmaking to new heights with the film, working with VR headsets while providing a comfort zone for Deschanel, a six-time Oscar nominee who brings old-school chops to the undertaking. Legato, who has three Oscars on his mantle, built on his impressive accomplishments with Favreau in 2016's *The Jungle Book*.



## WE SHOT REFERENCE MATERIAL IN AFRICA WITH AN ALEXA 65 TO CAPTURE THE SOUL & SPIRIT

Robert Legato, ASC

What follows are excerpts from conversations with Deschanel and Legato, looking back on the experience of working at the intersection of high technology and the human endeavor of cinematic storytelling.

**Deschanel /** I really liked *The Jungle Book* – I thought it was amazing. What got me excited about *The Lion King* was Jon's idea of bringing my expertise of shooting live-action films over the past 40-some years. They had designed the tools to be very similar to what I've been used to all this time. We had dollies and cameras and lenses – everything you'd expect on a regular movie. The locations only existed in virtual reality. You put on the glasses and you're in Africa. Jon worked with the animals for performance, and got the performances from the voice actors. So in a way it was sort of pre-blocked. Early on, we would have animals walking through rocks and things like that, but as time went on, they perfected it. Eventually you could understand the animals' emotions and really get what was going on.

**Legato /** My background is in cinematography, so the live action approach is what I bring to visual effects anyway. After *The Jungle Book*, we came up with a new way of doing the virtual reality tools that allows you to put on a visor, and have the next best thing to being there. Almost immediately, your instincts kick in and you're crouching behind a bush and looking for the shot. You don't have to think about it. It's not a technical exercise. You're looking at what you're looking at, and you're thinking of how to make the right shot. Once you translate from the brain to what filmmaking actually is, you do a take and you're off to the races. The thing that makes it instantly accessible is the analog nature of it. You start to feel like you're making a movie, and stop thinking about the technology behind it.



**Deschanel /** Honestly, I was worried about having to become a sort of tech nerd or something, in order to do this. But it was so beautifully designed by Rob and his team. They made me feel very comfortable and made it very easy for me to just drop right into this kind of filmmaking – and have a good time doing it. It's tech nerdology to the extreme – and it looks beautiful. It's really remarkable, but you don't realize the incredible amount of mathematics behind it to get to that point. I was always good at math in school, and I loved it. But the stuff these guys are dealing with is beyond anything I could imagine.

**Legato /** On the location scout, you talk with the production designer and the director, but you have more options. What if we put this stream further to the right? Then maybe the production designer adds three trees over here. The director weighs in. We can add a Steadicam – Henry Tirl had a sensor on top of his rig, which was appropriately weighted, and you get instant results that work right in with the movie. So you get a sense that it's a conventionally filmed movie. It's beautifully filmed, but it's conventionally filmed. You feel the soul of the operator because he's always behind the camera making subtle adjustments like you do in real life.

**Deschanel /** The animators would block the animals, and Rob and I would put in our two cents' worth about how to improve it to simplify it or make it better for the story. We'd get the re-animated files on set, and I would light it with my lighting director, Sam Maniscalco. We'd pick one of 350 skies based on the time of day and the particular feeling, and we'd put the sun where we wanted it. We could change the light just as we would on a real location. In the virtual reality, there were various markers indicating a flag or a viewfinder. We had a real dolly, with a real dolly grip who would follow the action.



**Legato /** Instead of making it technically easy, we made it analog easy, and that's different. Others might try to make it perfect, but we don't really want perfection. In the real world, you try to make it perfect, but there are too many factors fighting against you. In the computer world, everything's perfect, but you don't want that. So we mix the two together to create the illusion.

We might re-block something to make it a little more interesting, or to make a more elegant shortcut and tell the story in fewer shots.

## THEY MADE IT VERY EASY FOR ME TO JUST DROP RIGHT INTO THIS KIND OF FILMMAKING. IT'S TECH NERDOLOGY TO THE EXTREME – AND IT LOOKS BEAUTIFUL

Caleb Deschanel, ASC

**Deschanel /** The movie feels real because of two things. One, the animation is just phenomenal, and the sets are phenomenal. The backgrounds and the trees and the vegetation and the rocks – everything is so beautifully done. But another thing that adds reality is the feeling that there is a person observing it behind the camera who you do in a human movie, where the camera's actually being operated by a human being. And that gives it another sense that is really important for people to appreciate it as a live action film. The one thing I missed was the sort of serendipity of what happens when a storm rolls in or an actor comes up with some new idea while he's performing that surprises you. But we were able to make up for that because we could repeat actions any number of times. It was easy to move a hundred Wilderbeests back to one by pressing a button. You didn't have to wait for the wranglers to go track them down at the end of the gorge and drive them back to the beginning position which would take 45 minutes or whatever.

**Legato /** We shot reference material in Africa with an ALEXA 65 to capture the soul & spirit. You do feel some spiritual essence that comes from the land and the animals and the ecosystem, how it's been perfected over the years. I like to root the visual effects with some sense of reality, but I couldn't root it this time because there are no live action elements. I loved working with the A65 because you're shooting large and you're using a larger format. There's a film quality that you get from having so many more granules to resolve an image. That actually helps with the lighting and makes for softer roll-off in the blacks because there's so much more resolution. If you're trying to copy something, that would be the best thing to copy. We mimic the 65 mm film back in the computer, so that the lenses and the depth of field is the same. That's subtle stuff, but I like to think that the audience picks up on that even if they don't exactly know what we do. I always use ARRIRAW. It's easy to work with and I always have the best version of the film. I can get any form I want out of it. I pulled the ARRIRAW footage and looked at a 4K DCP at IMAX in 1.43:1, just to get the gestalt of what it feels like. What's the point of not shooting with that extra resolution? I grew up thinking that the very best movies were 65. You do sense it and feel it. It does something intangible, at least for me. If you're going to go for it, go for the best you can do. The footage is gorgeous – spectacular.

**Deschanel /** No matter how advanced the technology becomes, you're really always telling a story. If you don't tell a story that compels the interest of the audience, then you really haven't done anything more than show off some technology. And that's ultimately boring.



**Camera Type:** ARRI ALEXA 65  
**Camera Rental by:** ARRI Rental  
**Director:** Jon Favreau  
**Director of Photography:** Caleb Deschanel, ASC  
**DIT:** Company 3 – Stefan Sonnenfeld

Behind the scenes images courtesy of American Cinematographer. All other images courtesy of their respective owners.



ERIC DACHS & MARC DANDO

# THE INTERVIEW PART ONE

We took the opportunity to sit down with the founders of PIX and CODEX, Eric Dachs and Marc Dando, to learn more about why PIX acquired CODEX and what the future holds for X2X.



## What made you realize that PIX and CODEX would make a great partnership?

**Eric/** We'd crossed paths in the past few years, but it wasn't until I met with Marc in 2018 that I recognized that we shared an entrepreneurial spirit and a passion for the film industry. I quickly realized he had so many great ideas that were much bigger than CODEX's core business. And CODEX's core business is a good one! Like PIX, he's grown CODEX through building strong partnerships with key customers and partners like ARRI and Marvel, as well as with cinematographers and DITs. I saw that we could be even stronger together.



I'VE ALWAYS HAD IDEAS OUTSIDE OF CODEX'S CORE PRODUCT AREAS. WORKING WITH ERIC AND THE TEAM AT PIX GIVES ME A CHANCE TO PURSUE SOME OF THESE BIG PICTURE CONCEPTS

Marc Dando, CDO, X2X

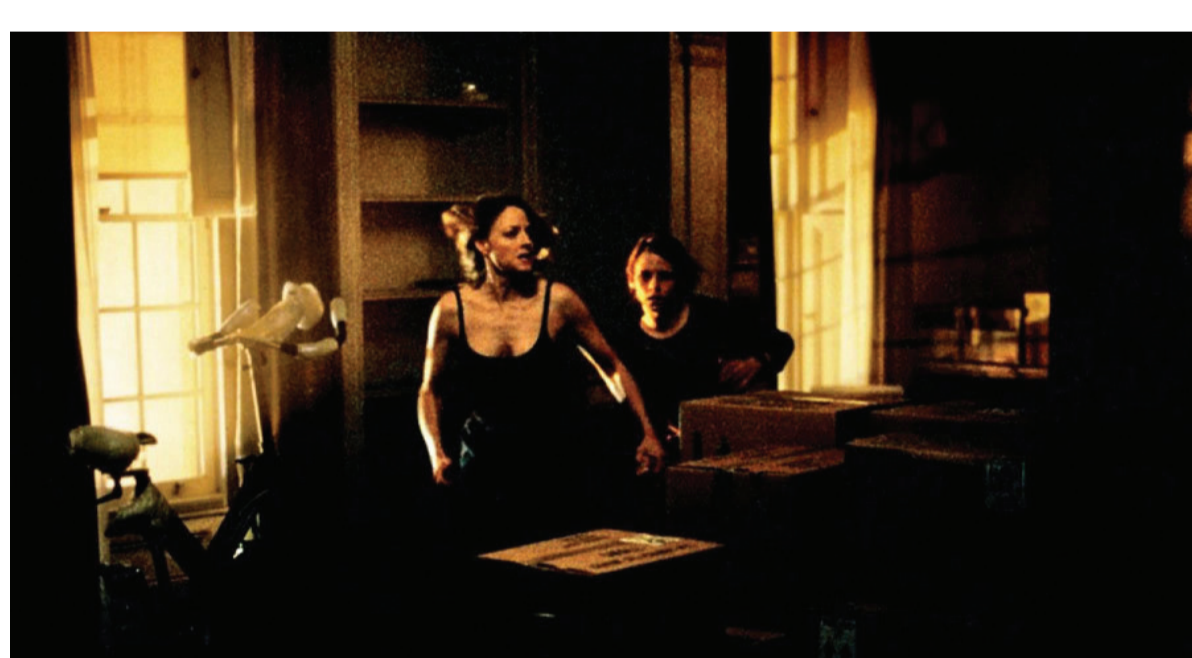
**Marc/** Eric and I are very similar in that we've worked in the trenches – Eric in the sound department and I on-set and picture post-production. We both saw gaps in how productions were traditionally managed and designed products and services to fill them. I think we both aimed to simplify workflows so creative people can create without technology, or the lack of technology, getting in the way. Both companies also appreciate the importance of security and reliability – at CODEX we developed the most secure and reliable media, effectively a digital film negative, and PIX had developed the most secure dailies pipeline connecting filmmakers and the studios. With all the great people at both companies, I knew we'd be able to develop some amazing products together.

## How has working with specific filmmakers – David Fincher, Chivo, Bob Richardson etc. influenced your product strategy and design?

**Eric/** I was fortunate enough to meet David Fincher on *The Panic Room* in 2001 when I was working as a sound editor and the relationship I developed with him and his No. 13 production company has carried through until today with *Mindhunter*. He's someone I can bounce ideas off and he's constantly challenging us.

For the second season of *Mindhunter* he asked to design a real-time telestration solution that would enable him to communicate the

thoughts and ideas he came up with during production via annotations attached to the image captured by the camera. We came up with PIX RT – it immediately creates clips of the take and presents this clip to the director and certain other approved crew members via a tablet, so he or she can make annotations and notes on the image. This media, metadata and the notes are then securely synchronized with the PIX cloud to all the approved members of the production who can review them. And of course, it is completely secure and integrated with all of our other services. And now we're working with the CODEX team on the next evolution of these tools.



**Marc/** Sometimes it takes working with the most demanding and yet most exceptionally talented people to push you to design the best products. That's certainly the case with cinematographers like Bob Richardson and Chivo. On *Gravity* we worked with Chivo and his crew along with our services company to design an efficient, color critical, ARRIRAW workflow that would support this complex, multi-camera shoot which involved "The Cage". The Cage was a lightbox consisting of 196 2'x2' LED panels which simulated the light coming from stars and the sun and reflected light from Earth, but could also project images of Earth, distant stars, or images of Sandra Bullock's child character, as the actor was suspended within. It was groundbreaking. And funnily enough, I recall that Chivo talked to David Fincher before the shoot and he thought that it was a couple of years too early to pull it off. Projects like *Gravity* inspire us to push the boundaries of what is possible.



## What makes PIX and CODEX better together?

**Eric/** PIX and CODEX have both spent the last few years working hard on streamlining production and post-production and helping creative people make amazing films and television shows. Both companies saw that there's no longer a gap between the two areas – post-production really begins in pre-production. With the products and services they already provide spanning pre-production, production and post, they are ideally positioned to develop products and services that can take advantage of new technologies such as 5G and the ubiquitous "Cloud".

**Marc/** I've always had ideas outside of CODEX's core product areas. Working with Eric and the team at PIX gives me a chance to pursue some of these big picture concepts. And our knowledge of cameras and on-set workflows has been a great addition to PIX and slots in nicely alongside their knowledge about dailies delivery. We're really excited about one of our first initiatives, X2X Labs, which will develop specialized services and provide workflow consultancy from pre-production to production and post and will provide feedback and allow us to accelerate the introduction and adoption of new products and services. It's really a continuation of how Eric and I like to develop products – by getting as close as possible to the customer, working next to them and seeing where the gaps and needs are.

The combined team is excited to work together to take movie making to the next level.



# THE MARVEL PLATES LAB

Marvel's innovative approach to VFX with its Burbank centralized facility.



Since its debut in March 2019, Marvel Studios' *Captain Marvel* has brought in more than \$1 billion at the box office. Produced by Marvel Studios and distributed by Disney, the film places a female superhero at the center of the action.

"The story is a very personal and intimate journey," says director of photography Ben Davis, BSC. "It's one woman trying to find out who she was and where she comes from - to discover herself. It's her story, and the camera must connect with her. It's a wider lens-close camera approach, with a handheld camera communicating a human response to her actions. We're trying to tell a story and connect the audience emotionally with the character."



## WE ALWAYS HAVE A LOT OF CONFIDENCE IN THE CODEX VAULT PLATFORM

Michael Maloney  
Manager of Image and Color,  
Marvel Studios

Meanwhile, behind the scenes, Marvel Studios' state-of-the-art visual effects process provided no shortage of astonishing cinematic legerdemain. Over the course of more than 20 films in the Marvel Cinematic Universe, Marvel Studios has fine-tuned its VFX practices, taming a Wild West of formats and tools and streamlining the assembly process to make polished, photo-real miracles an everyday occurrence. CODEX has been an essential partner in this endeavor.

On *Captain Marvel*, visual effects supervisor Chris Townsend oversaw contributions from eleven different companies, including ILM, Framestore, Digital Domain, and Trixter. Steven Shapiro, Director of Production Technology, also played a key role, as did Michael Maloney, who served as Manager of Image and Color for Marvel Studios. Maloney is responsible for the image and color workflow on all Marvel Studios productions.

Marvel Studios is unique among studios in that it coordinates VFX and VFX plate pulls at its own centralized facility, in Burbank, called the Marvel Plates Lab. This arrangement has been in place since *Guardians of the Galaxy Vol. 2*. CODEX VAULT is an essential part of the pipeline. Every frame from the camera is stored in an air-gapped storage pool. When a VFX facility needs a particular piece of the camera to complete its work, they submit an EDL, which is uploaded to the CODEX Backbone, which communicates with the CODEX Vault XL system and generates an OpenEXR files from the RAW camera negative. Shot metadata and CDL information from the set accompany the files, as does a reference QT file.



On *Captain Marvel*, Davis shot with ARRI ALEXA 65 large format cameras and used the CODEX VAULT 65 on-set and near-set media management of the resulting data-rich image files. "Consistency is very important to us, not only within a project, but across multiple shows," says Maloney. "We use ACES color management, which is fully supported in our CODEX VAULTS. We also appreciate that the VAULTS are always faithful—they refer to the camera SDKs, unlike other software, where we sometime run into problems. We always have a lot of confidence in the CODEX Vault. If specific updates are needed for a certain workflow, CODEX is very responsive to our needs. We have a great relationship."

Matt Walters, previous CTO at CODEX, commented, "Pushing the envelope and is always risky, but since we have such a good development relationship with the Marvel team, we are both testing and communicating our findings as soon as we have a new camera or process working. Before we deliver anything to Marvel we make sure it is rock solid at that point, and we know it is going to be ready for everyone else too."

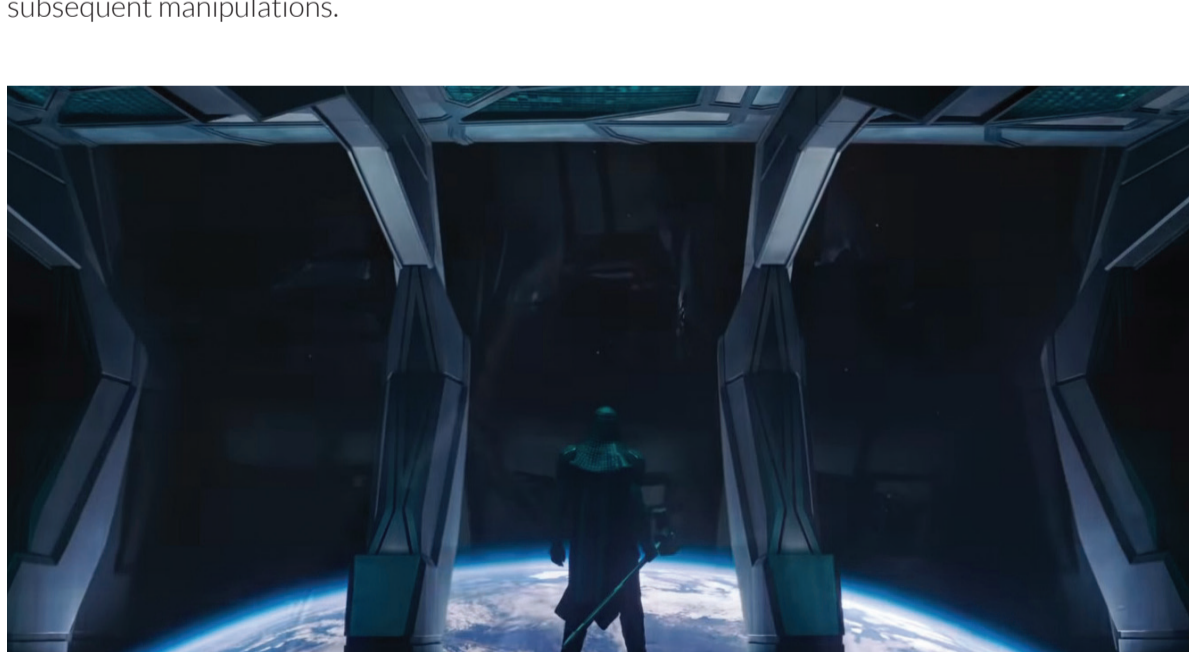
Traditionally, several departments feed into a production workflow. There's software on the set used to control the image, and a dailies facility processes the dailies. VFX does their work, and eventually the digital intermediate brings everything together. Plates need to be delivered to all the various facilities, including effects houses.



"We found that by internalising this process, we are at the centre of the workflow making sure that we've validated the various image and color pipelines end-to-end," says Maloney. "With the VAULT, we de-Bayer all of our plates from all cameras into a common EXR set of imagery, with a common ACES color space. But then we also provide workflow templates that validate the deliveries from onset to dailies before we deliver it to VFX. So we basically do a validation or QC check of the work prior to delivering to VFX. That helps bridge the gap between those two departments, so that we know that the plates that are delivered to VFX and DI truly represent what is viewed onset."

One goal is efficiency. Another is to create dependable standards that translate to future projects. Working against that goal is the accelerating pace of change. "The challenge of creating these standards is keeping up with the latest technology," says Maloney. "Marvel Studios productions always want to use the latest and greatest cameras that are released. One huge benefit of using the CODEX Vaults is that they tend to be among the first to update to the latest SDKs to support the newest cameras. We can very quickly integrate new cameras and workflows into our production pipelines."

In some cases, Maloney is interacting with dailies facilities that use CODEX Production Suite. On *Captain Marvel*, Technicolor provided the dailies using Colorfront. In the near future, HDE (High Definition Encoding) will make the movement of image data much more efficient. On *Captain Marvel*, the data-rich RAW files coming off the ALEXA 65 sensor helped lay the foundation for subsequent manipulations.



"The idea is to get the cleanest image possible, in layman's terms," says Maloney. "We make a lot of adjustments to the camera imagery, in some cases to match different cameras seamlessly. We do a theatrical release and an HDR release. We need to maintain as much of the range and image fidelity that the sensor can capture as possible, so that we have the flexibility and latitude for all the departments downstream. Most of the cameras are capturing more than today's consumer HDR displays can show, and frankly, we require all that latitude in post production in order to make the imagery that we make."

Looking to the future, Maloney says that he and Marvel Studios have been working closely with CODEX on expanding flexibility in grading. "We are constantly trying to get better at quickly balancing some of the differences between multiple cameras and shots," he says. "We're envisioning a grading system that is very flexible for balancing things out but is also non-destructive in terms of delivery to departments downstream. We'd like to streamline that, to become more efficient and to separate that idea from the creative look."

"We're also looking at the ability to view and deliver things in HDR throughout the process," he says. "Right now, a lot of our deliverables are in HDR, but we're working on making it part of the production from the set to final delivery. We're actively testing that now."

No doubt CODEX will be an important part of the solution, as they have been on virtually every Marvel Studios production.



**Camera Type:** ARRI ALEXA 65  
**Camera Rentals by:** ARRI Rental US  
**Lenses:** ARRI DNA  
**VFX Services by:** Marvel Studios, ILM, Framestore, Digital Domain and Trixter

# MANAGING DATA: FAR FROM HOME

Most cinematic superheroes of today were born in the 1950s low-tech medium of comics. Today, the astonishing on-screen derring-do of these spandex-clad characters is made possible by the highest of high technology. And behind the scenes, the success of Marvel and others is driving change at an unprecedented rate. *Spider-Man: Far From Home* is a perfect example.

**CODEX, working closely with DIT extraordinaire Francesco Giardiello, developed and implemented a change in color-pipeline methodology on that project, and while it may seem like a subtle tweak to the process, the adjustment could save thousands of hours of work and many dollars going forward.**



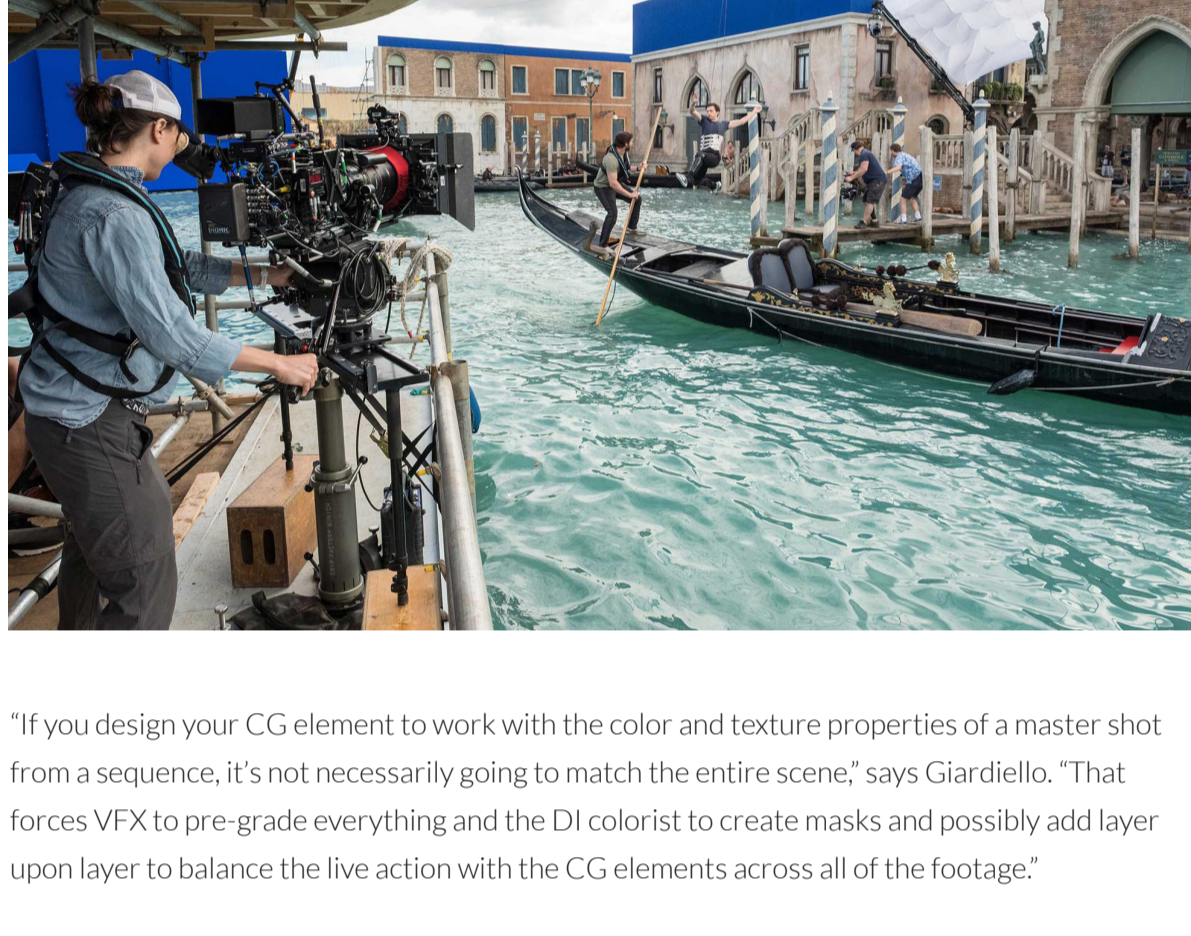
**THE VISUAL EFFECTS VENDORS ARE TELLING ME THAT IT'S GOING TO SAVE THEM HUNDREDS OF HOURS**

Francesco Giardiello, DIT

Essentially, CODEX and Giardiello developed a much more efficient way to match footage across scenes and takes destined for the visual effects pipeline. This new method takes advantage of existing tools developed over the years by CODEX.

In the standard procedure, the director of photography lights and shoots the scenes and the rushes go to the lab, where a dailies colorist makes a one-light grade, usually using ASC-CDL values that are baked into the images used for editorial. When on-set live grading tools are used, the DIT provides the ideal look to post-production, again mostly using ASC-CDLs. Both the DIT and the dailies colorist end up using the same tool for both purposes: to create a CDL designed to be the cinematographer's artistic intent for the picture, and as a sort of matching mechanism used to balance shots.

Problems arise when the footage goes to VFX, where the dailies CDL grade is removed from the equation, and artists work on the raw files to maximize image quality and flexibility for the compositing process and CG integration. Because that CDL grade contains both the look along with the matching grade, removing it sends the footage back to its original state, which therefore won't necessarily match. Perhaps the scene cuts between two shots that were done with different lenses or are otherwise inconsistent and will now require a "technical grade," which will be performed by VFX prior to starting their work. This can cause delays and could generate new inconsistencies. It's also an inefficient workflow.



"If you design your CG element to work with the color and texture properties of a master shot from a sequence, it's not necessarily going to match the entire scene," says Giardiello. "That forces VFX to pre-grade everything and the DI colorist to create masks and possibly add layer upon layer to balance the live action with the CG elements across all of the footage."

Work expands exponentially. Creating a "double CDL" workflow was partly an early attempt to address this issue, but linking footage to a separate CDL file circumvented the problem without actually solving it, says Giardiello, and often came with its own issues. "The real solution was to find a way to provide well-balanced footage to visual effects," he says.

After six years of testing and iterative improvement using CODEX Production Suite and several software and hardware tools developed by CODEX for the purpose, a solution was achieved. The new method takes advantage of the RAW capabilities of the cameras used on complex, effects-intensive projects like *Spider-Man: Far From Home*. Marvel, known for strict guidelines regarding workflow, required extensive testing before agreeing to the new procedure.

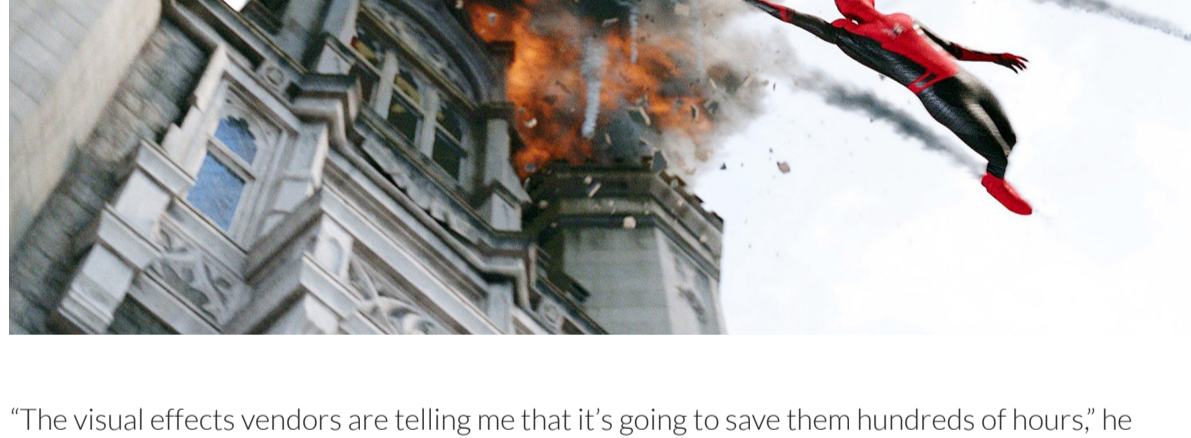


"These cameras offer the ability to modify the way their sensors see the scene," Giardiello explains. "Using 3x3 matrices and transform equations, you can reach a sweet spot. That doesn't necessarily work on the set, because it can take too much time. But by getting into the RAW footage and modifying the RAW metadata, we can interpret the footage so that when it comes out from the de-Bayer, it has balance already baked in. It's much simpler than complex systems like two-layer CDLs, where things could go downhill once you leave the software framework or send it to a different vendor."

The method uses CODEX Production Suite in conjunction with CODEX's Review Module to adjust color temperature, tint and exposure index. Afterwards, a normal CDL can be applied.

"People think of those controls as a representation of an analog world, but we saw those as simply numbers that can be changed to adjust the footage," says Giardiello. "When VFX gets the footage as an OpenEXR file, it's already well balanced, and incorporates a CDL as a single look that's applied to everything in that scene or that environment."

In a way, the method enables a return to first principles for cinematographers, who can think as they did in the days of film emulsion, changing colors using lighting and gels on the set while depending on a dailies reaction in the camera – like that of a film stock. On *Spider-Man: Far From Home*, Giardiello and director of photography Matthew Lloyd, CSC designed the entire film's color using just 48 CDLs – a number that often reaches thousands on complex projects. On the shoot, data managers Will Gardner and Andrea Michelon, working in a purpose-built truck, started balancing the footage almost immediately, guided by a master shot identified early in the work day. Later, Giardiello reviewed the work.



"The visual effects vendors are telling me that it's going to save them hundreds of hours," he says. "That's essentially what it is – a time saver. It's nothing you can't achieve in post production, given enough time. It's like having a dailies colorist on the set, but way more accurate and efficient, and you don't have to time the rushes in three hours overnight. Even the trailer's color is remarkably close to our original on-set color correction."

"This system is genius," says Lloyd. "Francesco and CODEX have cracked the code. I loved how the images looked, additional off-set dailies color correction was not needed. If there was a CDL work was right on the money, you had a lot to do with how smoothly it went. Francesco's tricky shot, we could always go back to the 'neg,' put the LUT on, and look at the CDL from the set. You can see how the image ended up where it is. As far as the on-set work making its way into the DI, this was definitely one of the cleaner experiences I've had. It puts control back in our court. You don't have to throw away all that work and start building the look from scratch in the DI. I really appreciate that there are people thinking about what the intention is, and how to preserve it from capture to finish."



## CODEX HIGH DENSITY ENCODING

*Spider-Man: Far From Home* is a follow-up to *Spider-Man: Homecoming*. As the script revolves around Peter Parker and his friends going on a European vacation, it was clear early on that there would be multiple production locations in Europe and the United States. Principal photography was based at Warner Bros. Leavesden Studios, just outside London with additional locations in and around New York, Prague, and Venice. Like *Spider-Man: Homecoming*, this was a co-production between Marvel Studios and Sony Pictures and was directed by Jon Watts with cinematography by Matthew J. Lloyd (*Daredevil*, *The Defenders*).

Moving files securely from one place to another is a common challenge on many projects, particularly on productions like *Spider-Man: Far From Home* that are international in scope and contain many visual effects. In this case, every single frame captured needed to be sent back to Marvel Studios in Los Angeles, so the volume of data to be transferred was large. A simple workflow was set up by Sony and Marvel, along with CODEX, SHED London and DIT Francesco Luigi Giardiello, to meet this challenge.

CODEX High Density Encoding (HDE), a lossless encoding method, reduced the size of the ARRIRAW files by up to 40%, with no sacrifice to the integrity of the ARRIRAW images. A decoded HDE file is a bit-for-bit perfect match to the original. Given that *Spider-Man* used three ARRI ALEXA Minis shooting ARRIRAW at 3424 x 2202 (plus an additional three on second unit), this reduced file size would be valuable in both the dailies process and in transporting the files from London to Los Angeles.

**Learn more about Codex HDE used on Spider-Man: Far From Home at [x2x.media/codex-hde](https://x2x.media/codex-hde)**

**Camera Type:** ALEXA Mini  
**Camera Rental by:** ARRI Rental UK  
**Final Color/DI:** Jill Bogdanowicz – Supervising Finishing Artist at CO3  
**Director:** Jon Watts  
**Director of Photography:** Matthew Lloyd, CSC  
**DIT:** Francesco Giardiello

# PIX

cinematic whichever way you view it



Smartphone | Tablet | Desktop | Large Screen

# FORD V FERRARI PUTS THE VIEWER IN THE COCKPIT

Phedon Papamichael, ASC, GSC  
and James Mangold Blend Action  
and Character



In many ways, *Ford v Ferrari*, the Fox-Disney feature film set in the world of 1960s auto racing, is a hybrid. The film exemplifies director James Mangold's career-long fascination with reconciling artistic aspirations with the dictates of commercial Hollywood studio production. The action is intense and competitive, but at its heart, the story is about the relationship between Carroll Shelby (Matt Damon) and Ken Miles (Christian Bale). And the movie takes advantage of today's filmmaking tools while avoiding the swooping, fast-and-furious style in favor of the more intense and direct style of 1960s classics like *Le Mans* and *Grand Prix*.



WE'RE TRYING TO COMMUNICATE WHAT IT'S LIKE IN A LITTLE METAL BOX WITH A HUGE ENGINE AND A BUNCH OF FUEL GOING 200 MILES PER HOUR

Phedon Papamichael, ASC, GSC

The result looks like an artistic and box-office success, passing \$100 million in receipts in ten days, while garnering critical praise and awards, including a Golden Frog nomination at the 2019 Camerimage Film Festival in Poland – often a leading indicator for the Oscar race.

Director of photography Phedon Papamichael, ASC, GSC brought a life-long interest in auto racing to the project. His uncle, Nick Papamichael, was a champion rally car driver and winner of the 1953 Rally Acropolis in Greece, driving the Jaguar XK120. On *Ford v Ferrari*, his goal was to deliver a sense of what it's like in the driver's seat.

"Jim and I are not action filmmakers per se," says Papamichael. "We're focused on the drama. Of course, we had elaborate rigs for shooting the racing scenes, which are extensive. But we're always asking ourselves how a given shot communicates a character's thoughts and feelings."

That instinct for character led in part to the choice of format. Papamichael and his team shot mostly with the ARRI ALEXA LF camera, using Panavision lenses specially adapted to fill the larger sensor area. Shooting close with wide lenses brings the viewer into

the driver's world, while simultaneously including the environment – the track conditions, the other cars and drivers, and most importantly, the sense of speed and danger. Hard-mounted cameras, available natural light, and car-to-car shooting were in tune with the overall aesthetic. Russian arms and other remote camera systems generally couldn't handle the G-forces produced at high speeds. Visual effects were surprisingly minimal.

"Jim embraces being physically close to the space of the actors," says Papamichael. "I would have been happy to shoot everything on the 40 mm. With this combination of lenses and sensors, even if you're in tight, you're not isolating your actors. You always feel the environment and are able to compose with all their surroundings."

You feel the proximity of the other cars, which are all precisely choreographed. We exposed Christian to all the movement and all the actual interactive light and reflections. We embraced the vibrations. We're trying to communicate what it's like in a little metal box with a huge engine and a bunch of fuel going 200 miles per hour. We thought that smoothing things out would be a mistake."



On the set, Papamichael is driven to improve every aspect of the frame continually. He considers himself a non-technical filmmaker. The high technology used to dependably capture the shot is not on his mind, and digital imaging technician Lonny Danler to ensure that it stays that way. Papamichael and Danler first worked together on *Nebraska*, a black-and-white film that brought the cinematographer his first Oscar nomination. On *Ford v Ferrari*, the LFs were generally set to capture 4.5K ARRIRAW using a 2.39:1 excerpt of the full OpenGate sensor. The workflow used CODEX SXR 1TB High Speed Capture Drives and CODEX SXR Readers. Monitoring was done via 24fps 1080p Log C with a single LUT applied.



Papamichael's career path has been non-standard. His father was a well-known production designer in Europe who worked with John Cassavetes. The younger Papamichael was born in Athens, educated in Munich, and came to the U.S. before he was 21. Using a 16mm camera borrowed from family friends, he photographed a film that won a prize at the Cork Film Festival and was soon shooting low-budget features for Roger Corman, where his crews included future masters like Janusz Kaminski, Wally Pfister and Mauro Fiore. Since then, he has balanced more intimate work with more significant studio projects, forging relationships with visionary directors like Alexander Payne (*Sideways*, *The Descendants*) and Mangold (*3:10 to Yuma*, *Walk the Line*).

Regarding his affinity with Mangold, Papamichael says, "We have the same influences embedded in us. We love the same filmmakers. We love Ozu, and the Italian neo-realists, and the French New Wave, so we're speaking the same language. But more specifically, we have very similar compositional instincts and aesthetics. We're both still photographers. That really helps when you're making decisions on the fly."



Currently, Papamichael is shooting *The Trial of the Chicago 7* for director Aaron Sorkin. Set in a similar period, the film is being shot on the same combination of ARRI ALEXA LF and Panavision anamorphic lenses.

**Camera Type:** ARRI ALEXA LF  
**Camera Rental by:** ARRI Rental  
**Director:** James Mangold  
**Director of Photography:** Phedon Papamichael, ASC, GSC  
**DIT:** Lonny Danler

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