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Full Frame Cine Future Camera & Lens Mounts Hiroo Edakubo, Canon Hiroto Okawara, Canon Blackmagic URSA Mini 4.6K Dr Michael Kaschke, ZEISS Porto Portugal Leica Portugal Tour **Gods of Focus Speak** Nicol Verheem, Teradek Teradek & Creative Solutions Tour Aaton-Digital Cantar Mini **AbelCine Industry City** 1.3x Anamorphic **Underwater Anamorphic Technovision Anamorphic Cooke Anamorphic SF Angenieux Anamorphic Vintage Lenses**

FILM DIGITAL TIMES

Art, Technique and Technology

Film and Digital Times is the guide to technique and technology, tools and how-tos for Cinematographers, Photographers, Directors, Producers, Studio Executives, Camera Assistants, Camera Operators, Grips, Gaffers, Crews, Rental Houses, and Manufacturers.

It's written, edited, and published by Jon Fauer, ASC, an award-winning Cinematographer and Director. He is the author of 14 bestselling books—over 120,000 in print—famous for their user-friendly way of explaining things. With inside-the-industry "secrets-of the-pros" information, *Film and Digital Times* is delivered to you by subscription or invitation, online or on paper. We don't take ads and are supported by readers and sponsors.

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Contents – Feb 2017 Issue 80

Full Frame Cine	4-6
Updated Sensor and Lens Coverage Comparisons	6
Future Camera & Cine Lens Mounts	7-15
Medium Format	16
FUJIFILM GFX 50S Mirrorless Medium Format Camera System	17
Hiroo Edakubo and Hiroto Okawara discuss Canon C700	18-20
Canon EOS C700 Lens Mount and Sensor Swap	21
Blackmagic URSA Mini 4.6K on "KUHANA!"	22-23
Dr. Michael Kaschke, President and CEO of ZEISS	24-26
ZEISS Camera Lens Distributors Evening at Photokina 2016	27
Porto and Port Wine	28-31
Leica Porto Opening	32
Leica Portugal Factory Tour	33-45
Optical Elements	34
Lens Barrels	35
Anti-Refection Coating and Edge Prep	36
Optical Assembly	37
Finishing Focus and Iris	38
Lens Measurement and QC	39
Electronics	40
Building Leica Cameras	41
Let's Build a Leica M	42
Analog Leicas	43
Leica M Assembly and Adjustment	44
Leica Portugal "Gallery"	45

The Gods of Focus Speak: Preston Light Ranger 2	46-47
Angénieux Anamorphic 44-440 to Spherical 25-250	48
S4/i Uncoated Cooke Look	49
Cooke Anamorphic/i Special Flares	49
Cantar Mini from Aaton-Digital	50
StarliteRF-A for Alexa Mini and Amira	51
Lighting Tabletop with DMG Lumière	51
Nicol Verheem, Teradek CEO & Creative Solutions SVP	52-55
Teradek Tour	56-59
Vittorio Storaro's Digital Cinematography on "Café Society	60-69
AbelCine in Industry City	70-71
AbelCine's new Development Center	72-73
Christian Abomnes on "L'Origine du Mal"	74-76
Bright Tangerine Misfit Atom & Titan Arm	77
PhotoCineRent, VR, Fashion, Multi-Cam	78-79
Jakob Ihre, FSF on "Thelma"	80-82
Yo, Adrian, where's my Steadicam Volt?	83
"Magpie" Kickstarter Indie Period Piece	84-87
André Chemetoff on "Io" via RVZ	88-89
Zero Optik Rehoused Baltars	90
RVZ Rehoused Mamiya Mediums	90
BC 2016	91
BC and Cinec 2016	92
Cinec 2016	93



Full Frame Cine 4-6



Future Camera & Cine Lens Mounts 7-15





Cover Photo: Cover: Leica Portugal Camera Assembly

The Gods of Focus Speak: Preston Light Ranger 2 46-47

Nicol Verheem Teradek Tour 53-59

AbelCine in Industry City and new Development Center 70-73



Hiroo Edakubo and Hiroto Okawara discuss Canon C700 18-20



Dr. Michael Kaschke, President and CEO of ZEISS 24-26



Full Frame Cine

What do lens makers know that we don't? They introduced a flock—a flurry—of Full Frame cine lenses lately. But why haven't we seen many, if any, actual Full Frame cine cameras yet?

Quick review: Full Frame (FF) has also been known as the Leica Format ever since Oskar Barnack turned 35mm motion picture film sideways to expose 24×36 mm 8-perf frames in 1913. It is also called FX (Nikon), but mostly Full Frame. 24×36 mm.

RED introduced their Weapon camera with Dragon 8K VV sensor at NAB in April 2015. The sensor is 21.60×40.96 mm. Many of us started calling it "VistaVision," thinking that's what "VV" stood for. But hang on a second, primordial VistaVision is 25.0×37.7 mm, slightly taller and wider than Full Frame. And wasn't VistaVision a registered trademark of Paramount Pictures since 1954, renewed in 2015?

Panavision launched their 8K Millenium DXL camera at Cine Gear in June 2016. It uses the same RED 8K VV 21.60×40.96 mm sensor.

You can use Full Frame cine lenses on the RED 8K VV and Panavision DXL cameras. Many will cover without vignetting. If the edges do go dark in the native 40.96 mm width, you can crop to 36 mm wide. Then it's essentially a Full Frame camera with a native 1.66:1 aspect ratio, 21.60×36 mm.

ARRI announced Alexa 65 at Cinec in September 2014. Its Large Format sensor is 25.58×54.12 mm, which is actually a couple of millimeters bigger than the film gate on an Arriflex 765 65mm film camera (23.0×52.5 mm). It's interesting that the cine world calls it Large Format. Large Format for stills is 4×5 inches (102×127 mm), 5×7 , 8×10 and more. The closest cousins to Alexa 65 sensor size are called Medium Format in the still world and Alexa 65 cameras often use modified and rehoused Medium Format lenses. Of course, Full Frame lenses also fit. Some vignette, others don't. Those that do can be cropped in post.

Sony mirrorless a7S II and a7R II cameras can record QFHD 3840 x 2160 16:9 video internally in XAVC S 4:2:0, using a sensor area of 20.25 mm high \times 36 mm wide. Stills are Full Frame. These are essentially still cameras, but they capture nice video.

Meanwhile, lens manufacturers have been churning out Full Frame cine lenses at a prodigious rate: ZEISS, Sigma, Canon, Schneider, Leica, Sony, IB/E Optics, Tokina and Angenieux. So why is the cart before the horse? Is it technology or economics? This could be the year when orbits align and Moore's Law, processing power, data rates, heat issues and ROI are resolved. Somehow I think the dreaded question of ROI (Return on Investment) has been weighing heavily on Full Frame cine camera development. Users must convince product managers and engineers must answer to economists.

Who needs Full Frame? Everyone.

I like Full Frame, with its 24 mm sensor height, because it offers greater flexibility of formats and aspect ratios and is more futureproof. Yes, there are a lot of 16:9 TVs out there, but letterbox 2.4:1 looks great, tablets and smartphones are often viewed vertically, and it's not going to be a 16:9 world forever. With 2x anamorphic lenses, a 24×36 sensor offers the equivalent of large format 24×57.6 . FF might revive classic aspect ratios like 1.33:1 and 1.5:1 and 1.6:1 and we'll be aspect-ratio independent. Although FF may be a bigger sensor with more read-out and data rate challenges, historically Updated Full Frame Cine Lens Overview



Sony FE PZ 28-135 f/4 G OSS E-mount FF zoom



Angénieux Type EZ FF 45-135 T3 and FF 22-60 T3



Sigma FF Cine 24-35 T2.2; 20, 24, 35, 50 and 85 T1.5



Schneider Xenon FF 18, 25, 35, 50, 75, 100, 135 T2.1



Leica M 0.8 21 f/1.4, f/1.4, 28 f/1.4, 35 f/1.4, 50 f/0.95



IB/E Optics Raptor Cine Macros 100, 150, 180 mm T2.9



Canon EF Cinema CN-E 14, 24, 35, 50, 85, 135 mm



ZEISS FF w/ ZEISS Lens Gears Loxia 21, 35, 50mm; Otus 28, 55, 85; Milvus 15, 18, 21, 35, 50, 50M, 85, 100M, 135



ZEISS CP.2 15, 18, 21, 25, 28, 35, 50, 50M, 85, 100, 135



ZEISS CZ.2 15-30, 28-80, 70-200

Full Frame Cine, cont'd

we have worked with A-cameras that don't do slow motion—slow motion can be handled by other, specialized cameras. And in case anyone is worried about workflow: VistaVision film and 65mm film have been scanned and managed readily in post. Finally, a larger sensor will have additional advantages in post-production such as cropping and image stabilization.

Dan Sasaki, Panavision VP of Optical Engineering has commented on FF to FDTimes, and it's worth repeating, "Full Frame offers magnification benefits about 1.5 times greater than traditional 35mm capture. For example, if we use a 27 mm lens in Super 35, we would choose a 40 mm lens in Full Frame in order to get a similar field of view. As a result, the image produced by the Full Frame combination would provide a much more natural perspective and magnification than the Super 35mm counterpart. This is because the imaging characteristics produced by the greater magnification and perspective characteristics of the larger imager more closely relate to how we see naturally.

"The larger format gives us a more natural perspective, meaning fewer distortions and a more natural depth of field. Objects appear to look sharper even though we may not be using a sharper lens. As an example, we are not really worried about how many leaves are on a tree; we're more interested in whether it's an oak tree and that our actor is under it. The higher magnification associated with large format photography, be it 65mm or Full Frame, emphasizes the imaging cues that convey reality more accurately than with traditional Super 35mm photography.

"A convenient feature of Full Frame is that it shares many of the characteristics of the 65mm format yet the lenses don't get really large and there's an existing infrastructure for it. Because of this, Full Frame has a future that will serve both the television and feature segments. On the other hand, the formats offered by imagers greater than Full Frame create magnification and natural perspective cues that are unique in the art of cinematography.

"There are millions of Full Frame still photo lenses that people are familiar with. You can get high speed lenses in a manageable size. We're finding out the hard way with 65mm large format sensors that the lenses can get a bit cumbersome and costly, especially ones with large apertures. With the Full Frame format you can easily meet the 4K to 8K requirements without making a pixel insanely small. An added benefit to the Full Frame format can be revealed when we add all of the combinations possible with anamorphic compression. It gets really interesting."

Otto Nemenz once said, "Most cinematographers never saw a larger sensor or larger format that they did not want to fill up."

Jeff Allen, Managing Director Of Panavision Europe said, "It's generally our view at Panavision, as a rental company with operations around the world and thinking about cameras for the future, that standard 35mm as we currently know it in the movie industry, with an 18×24 mm image area, will be used like the current 16mm format. And, Full Frame, with a 24×36 mm image area, will become the standard for what used to be 35mm cinematography. In fact, we had this conversation with ARRI engineers when they came around to us last year. Of course, above that, you'll have larger format cameras like the Alexa 65. But I think that Full Frame 24×36 mm will become the de facto format for feature filmmakers, and Super 35 format will predominantly remain the domain of TV."



actual sizes





Masaya Maeda, President and Chief Operating Officer of Canon told FDTimes in 2015, "It is a challenge how far we can go with dynamic range and sensitivity using current APS-C or Super 35 size sensors. A larger sensor size is actually more advantageous because a larger pixel pitch will be more sensitive."

Jarred Land, President of RED, said in April 2016, "Full Frame has the aesthetic advantages of having a larger format and retains the ability to still use faster glass without hitting the limited availability of lenses that 65mm has to deal with—especially on the wide end. I believe there actually might have been more larger format cinema lenses released in the last year than normal cinema Super 35 lenses."

For the last 100 years, we pretty much worked in the format that allegedly was established by Kodak and Edison, 18 mm high \times 24 mm wide, the standard Academy format. ARRI Alexa is pretty much the only digital cine camera with a standard 18 mm height. Most of the other digital cameras have sensors that are shorter in height—often 13 to 14 mm—and a 16:9 TV-inspired aspect ratio. This is probably derived from the APS-C still camera sensor size, which these manufacturers fabricate in the millions. The machinery, SMT lithography and infrastructure is readily available.

Camera manufacturers usually call this format "Super35," but that's vague and sizes vary. Sony F55 is 12.7×24 mm. F65 is 13.1×24.7. Canon C300 is 13.8×24.6 mm and C700 is 13.8×26.2 in 4K. Super35 is an ambiguous term that provokes an immediate phone call from Denny Clairmont any time he sees me print it. He asks, "Is it Super 35 3-perf or 4-perf, Big TV with common 1.85 headroom or

Full Frame Cine, cont'd

what?" Good point. But for the purpose of this essay, let's stay with Super35 or S35. I've heard rental house owners berate manufacturers every time yet another 16:9, sub-18mm height sensor camera comes along. "If you want to shoot anamorphic, anything less than 18 mm results in a crop factor, the equivalent of a tighter lens, using a smaller sensor area," they explain.

Now, if you were a manufacturer faced with introducing another camera in the near future, you could come up with a new 18×24 sensor. Or you could leapfrog to the next common size, 24×36 mm. It's a familiar size. Full Frame digital still cameras number in the hundreds of millions. The manufacturing infrastructure is already there. It would be future-proof.

Some rental houses might still complain, "But why do we need cameras with this Full Frame format that will make our huge inventory of Super35 PL-mount lenses obsolete?" Hardly obsolete. All those S35 18×24 cine lenses in inventory will still work on a Full Frame camera—windowed or cropped in post. A 50 mm S35 lens on a Full Frame camera is always a 50 mm lens.

And what about a Full Frame lens on all those S35 cameras? Better still. FF lenses are future-proof—fitting S35 and ready for the inevitable next wave of FF cameras. Which is probably why the lens manufacturers are building more and more of them. The recent abundance of Full Frame lenses come with standard cine lens gearing (0.8 M). They join hundreds of millions of Full Frame still lenses delivered over the past century, ripe for rebarreling and cinematizing. For anyone craving vintage lenses for cinema, this is the mother lode.

ZEISS came out with the first FF Compact Primes in April 2009, and CP.2 lenses with interchangeable mounts in April 2010. The first ZEISS FF CZ.2 zoom arrived April 2012. Canon Cinema EOS FF primes came in mid 2013. In 2014, Sony had a 28-135 FF zoom for a7 and E-mount cameras. Recently, there were new FF Zooms from Angenieux, FF Zooms and Primes from Sigma, FF Leica M 0.8 lenses, additional Schneider Xenon FF primes, and ZEISS Milvus FF primes with ZEISS Lens Gears.

With cinematographers constantly in search of new styles and new forms of expression, the possibilities offered by Full Frame cine cameras and lenses are very exciting. The larger format entices with shallower depth of field, new aspect ratios, vertical formats for fashion shows and architectural presentations, native 1.5:1 and anamorphic FF formats, and spherical FF widescreen. For the past hundred years, large format was reserved for very rarified budgets because of the high cost of the film. The digital age continues to democratize—now in Full Frame.

With all these choices, will future lens mounts become agnostic or annoying? Read on to find out more.



Updated Sensor and Lens Coverage Comparisons

	Width (mm)	Height (mm)	Diagonal (mm)	Horiz Rez	Vertical Rez	Aspect Ratio
ALEXA 65 camera	54.12	25.58	59.87	6560	3100	2.11:1
ALEXA 65 Lenses			62			
ARRI Vintage 765 Lenses			79			
Arriflex 765 motion picture film camera	52.5	23.0	57			2.28:1
Hasselblad H5D, X1D, Fujifilm GFX cameras	43.8	32.9	55	8272	6200	1.33:1
Leica S camera (native)	45	30	54	7500	5000	1.50:1
Leica S lenses (widescreen coverage)	49.8	20.8	54			
Panavision Primo 70 lenses	48.1	20.1	52.1			
VistaVision format	37.7	25.0	45			1.50:1
Full Frame Stills format	36	24	43.27			1.50:1
RED W8K VV camera	40.96	21.60	46.31	8192	4320	1.89:1
ALEXA SXT camera	28.17	18.13	33	3414	2198	1.54:1
SONY F65	24.7	13.1	27.96	8182	2160	1.88:1

Port Wine



Barcos rabelos once transported Port Wine from the vineyards upriver in the Douro Valley to the wine merchants' cellars in Porto.



It's an uphill walk along narrow, cobblestone streets of Vila Nova de Gaia for a tour and tasting at one of the venerable Port wine houses.



Taylor, Fladgate & Yeatman, established 1692, a family business. John Fladgate, Baron da Roêda of Portugal, 1809 - 1901.





Port wine is made from grapes upriver in the Douro Valley, picked by hand in September and crushed by foot. Taylor's research recently concluded that, "Although expensive and laborious, treading is still the best way of achieving gentle but complete extraction, producing wines with structure, depth of flavour and balance." The fermenting wine is poured into vats, and then "fortified" with a clear, neutral, young brandy (77% alcohol) at a ratio of about 1:4. As the wine ages, the brandy and wine combine flavors that are subtle and complex. Port matures and ages far longer than most wines. That's the reason Port wine traveled well to England and the world, and why Vintage Port wine can be enjoyed decades later. Sort of like cine lenses: artisanal, artistic, described like fine wines, commanding attention for fine vintages.



Leica Portugal Factory Tour



Leica Camera's new Portuguese plant in Vila Nova de Famalicão is a pleasant half-hour drive north of Porto, made especially easy since CW Sonderoptic Managing Director Gerhard Baier was at the wheel. A whimsical Leica M-like gate house greets the visitor. Beyond is the modern factory of Leica Aparelhos Opticos de Precisão SA. It is the size of several football fields. Many Leica cameras, lenses and sport optics are made here. It's one of the most high-tech, impeccable places in the industry, with a highly skilled, enthusiastic workforce. Carlos Mira and Pedro Oliveira are the Managing Directors.

More than 720 people work in the new factory which is about 30% larger than the original one. Inside, the layout and the machines themselves are almost identical to the ones in Wetzlar. State of the art tools and manufacturing techniques ensure quality and productivity. Leica's investment of more than \notin 23 million was not insignificant and the benefits are already apparent.

Leica COO Markus Limberger shuttles frequently between the two production facilities in Wetzlar and Famalicão. He expained, "Our new, ultra-modern plant in Famalicão shares a crucial and equal role with Wetzlar in Leica's success in the coming decades and will ensure economic stability and continuity in the long term."

Optical manufacturing is not only a science but also an art. As we toured the Famalicão factory, it soon became clear that Leica's investment is ensured by the presence of a very large, highly educated, technically skilled workforce. Labor costs in Portugal are among the lowest in Western Europe and membership in the EU means exchange rates are uniform.







L-R: Gerhard Baier, Carlos Mira, Miguel Reis, Nuno Barros





Aaton Cantar Mini



Aaton Cantar Mini, the little sister of Cantar X3, made her debut on January 27 at Micro Salon in Paris.

The Cantar Mini is a high-end audio recorder that is half the weight, half the size and half the price of the famous Aaton Cantar X3.

Cantar Mini records up to 16 tracks of audio. She uses the same batteries but uses only but 2/3 the power consumption as Cantar X3. The design is similar: sculptural, milled from a solid block of aluminum, rugged, water-resistant, dust-proof, modular and a pleasure to work with.

The Aaton Cantar Mini's monitor display folds nicely over the mixing pad's sliders.

Aaton Cantar X3 continues as the top-of-the-line model, recording up to 24 tracks. It can also play back and record at the same time—an attractive quality not only for cinema audio but also for a large, new market among musicians, orchestras, and singers. aaton.com

or cart selecto antar X3, made her debut on and se der that is half the weight, half aton Cantar X3.

Specs Dimensions: 259 X 234 X 90 mm – 10.2 x 9.2 x 3.5 inches

Analog and digital Inputs: 4 low noise mic inputs, preamps, 48V phantom power, limiters, filters and EQ, 2 balanced line inputs.

AES digital inputs include 2 AES42 (mode 2) / AES3 pairs (4 mono channels) Built-In slate mic with external slate mic input.

Outputs: 8 analog line level outputs; 4 AES3 digital outputs on SubD HD 15

4 Recording Media: Simultaneous recording to internal mSATA 256 GB SSD drive, two SD cards and USB external drive

Metering and Controls: Ultra-bright large swiveling display panel, visibility optimized for shoulder work or cart, auto adjust brightness. One large rotary selector. 10 onboard sliders with magnetic linear assignable channels. Direct access to monitoring and set-up functions through dedicated buttons.

Power: Two identical onboard quick-release lithium smart batteries ensure seamless switchover during recording. Up to 11 hours operation in standby mode. XLR4 13-17 V DC input.

Features: All inputs can be routed to any of the 16 tracks, linear control sliders addressable to any input and output.

All tracks and inputs can be routed to 8 analog auxiliary outputs and/or 4 digital outputs.

Automatic PDF, CSV and ALE Sound Reports embedded with deliverable media. Variable Delays on all analogue Inputs. -30 Second Pre-Record Buffer.

Independent analog, digital and display modules for easy maintenance and upgrades. Housing made of machined avionic aluminium. Water and dust resistant.





Nicol Verheem, Teradek Founder/CEO & Creative Solutions GM



Nicol Verheem (above) is the Founder and CEO of Teradek and General Manager of Creative Solutions. He has a degree in Electronic Engineering, worked in communications, defense and at GE prior to starting Teradek in 2008. In 2013, the Vitec Group acquired Teradek. When I first visited them a couple of years ago, it was a beehive of 85 brilliant people in a 9000 square foot place that seemed ripe to be cited by any occupancy ordinance inspector who happened to read FDTimes. "You have to see our new place," Nicol said recently, as excited as an 8-year-old that he likes to compare to the company because neither can sit still. "We're about 500 yards away on the same street in a new, 40,000 sq ft building." Here's an interview with Nicol and a tour of Teradek.

JON FAUER: Your new home for Teradek and Creative Solutions is huge.

NICOL VERHEEM: [Laughs] Yes, when Vitec visited us to see their new acquisition three years ago, our facility was so cramped that the only room big enough for us meet in was the kitchen. All the execs—Stephen Bird, Martin Green, Martin Vann, Marco Pezzana, and many others—were sitting around a small kitchen table. There was an unfortunate event with a coffee cup in someone's lap...That's when I realized we should move.

Tell us how the company is structured.

The Vitec Group is a public company on the London Stock Exchange. Our CEO is Stephen Bird. We have around 1,800 employees in 10 countries supporting 20 brands under two overall categories: Photography and Broadcast.

The Photography division is managed by Marco Pezzana, and anchored by the well known Manfrotto brand, which is focused on the consumer and prosumer photographic and video applications. Other brands include Gitzo, Avenir, Lastolite, etc, focused on tripods, camera bags, and other affordable accessories.

The Broadcast division is divided into 3 business units, each reporting directly to Stephen Bird. In time, each will likely grow into a division by itself, but we are not big enough yet to report results separately. The biggest business unit is Production Equipment under Alan Hollis, with well-known brands such as Anton/Bauer, OConnor, Sachtler, Vinten, etc. Then comes the Production Services Business Unit, managed by Halid Hattic, and comprised of Bexel, Auto Script, Camera Corps, and others—a combination of broadcast rental companies and also a lot of engineering services backing them up. They can provide anything from a couple of flight packs to an entire setup for really big projects like the Olympics, the US Open, and the NFL.

How is Creative Solutions different?

The youngest and smallest part is Creative Solutions, which consists of 5 recent Vitec acquisitions. All young companies, with young employees. And like you would expect from youngsters, growing fast. This makes sense because we are addressing a market with an equally younger demographic that is equally fastgrowing: the independent content creators. The companies in our group are Teradek, Paralinx, Wooden Camera, SmallHD and Offhollywood.

Creative Solutions focuses on the Independent Content Creator (ICC), a relatively new phenomenon. If you go back and look at the historic "Hollywood" production model, most of the equipment used on set was out of reach of the individuals using them. It was either far too expensive, or only available for rental, not even for sale to begin with. But then RED and Canon started building cinema-capable tools that were within reach of many individuals, leading to a landmark change that we call the democratization of video.

History repeats itself. Wasn't there a similar cycle in the 1970s when independent rental houses were established to compete with the big studio camera departments?

Exactly, and it touches on the nature of how films and shows are produced now. Instead of just having a few studios owning all the gear to create content, now independent people are doing it. They buy a camera or a Steadicam. Maybe they pool their resources: a DP buys the camera, camera assistants buy lenses, a DIT buys the cart. Many or all of them are independent contractors. If they purchase their own equipment and rent it back to the production, they gain more revenue than simply charging for their labor. Therefore, the industry's purchasing power is shifting from a few big studios and rental houses to a much larger group of individuals.

The individuals' purchasing behavior resembles that of a consumer more than a big business. Make no mistake they're all professionals, they're in the business of making content for money. But when choosing gear they act like consumers and small businesses, not a corporation. They're looking for a greater selection of equipment that is more affordable, and for an easy way to transact with the manufacturer. This results in a lot more choices for everyone.

In this new purchasing paradigm, the independent contractors often pay with a credit card. As soon as they figure that something's going to bring in more business, they can make a decision. It's not like a big organization that takes six or nine months to qualify a product, fill out forms in triplicate including yellow and pink copies, and then give the vendor 120-day terms, and only approve the purchase if the product has an ROI (Return on Investment) of 200 days.

Is the cost of equipment going down as well?

Previously, most production equipment was priced too high for the independents to afford. Camera packages sometimes were **Sponsors and Educational Partners**



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