

Innovation Research Paper

**Sony Mirrorless Cameras: Changing the perspective of
digital photography**

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1 Introduction

A camera is one of the best examples of where a technology has become globally adopted and utilised in all walks of life across the globe; comparable to the vacuum cleaner, refrigeration systems and cars (as three examples), **everyone has used a camera and often carries one around everyday..** It is an invention so popular that a simple drawing of 2 circles inside a landscape rectangle would nearly always be recognised as a camera.

Cameras were first developed dating back to the early 11th Century, when Arab physicist Ibn al-Haytham invented the camera obscura, a simple invention that involved a completely darkened room with a small hole & lens used to project a mirrored image onto the background wall (Silverman, 1993). Whilst the Obscura would be used from the 11th – 18th centuries for the use of tracing skylines, there was no method to ‘photographically’ capture an image. This led to the breakthrough innovation of the first photograph taken by Joseph Nicéphore Niépce in 1827 (Figure 1). Niépce used a silver pewter plate coated in bitumen which in turn when exposed to the view out of his laboratory window, exposed the image permanently. Subsequent innovations led to the innovation of dry-plate (using gelatin as a faster activating agent to speed up exposure, this subsequently led to the first uses of handheld cameras.



Figure 1 The first ever photograph taken by Joseph Nicéphore Niépce in 1827 (Wikipedia Creative Commons).

Despite this, cameras were still large, clunky and largely inaccessible to the layperson. It stepped George Eastman who first developed paper film, before migrating over to a flexible celluloid material (Curme & Rand, 1997; Swanson, 2003). This would later be further developed into the 35mm film we know and love(d) today, pioneered by companies such as Kodak and Leica (Silverman, 1993).

This followed by the later innovation of the single-reflex lens in the 1930/40s by companies such as Zeiss and Recaflex, with the current style of cameras being descendants of those earlier pioneering designs (Spira et al., 2001).

Today, nearly everybody carries a camera. Whether it be a Leica 35mm rangefinder, disposable camera, or the **smartphone** in our pockets, nearly everybody carries a camera day to day (usually in the latter forms). With this, there is a clear blurring of the lines of where camera innovations have occurred. The early photographic film cameras and obscura cameras are clear breakthrough innovations, early pioneers for a new and intriguing device. Later innovations such as the single-reflex-lens allowing for the same field of view observed as captured could be classified as sustaining, whilst later so auto-focus and light systems classed as disruptive. However, what about the last 10-15 years of photography. This report intends to examine the innovation that has taken place in the camera industry in the past 10-

15 years, specifically focusing on Sony's development of mirrorless cameras and subsequent industry adoption.

1.1 Aims Report

This research paper will examine the modern-day innovation that the camera industry has seen, from Sony with the development of the Mirrorless camera system. Sony's innovation will be related to Satell's Matrix of Innovation – See Figure 2 (Satell, 2017), with the innovation process they followed evaluated for success, risks and barriers.

The key questions posed are:

1. What were the key drivers for the innovation of the mirrorless camera?
2. Risks faced by Sony in developing the mirrorless camera system?
3. What processes or technologies did Sony use to carry out the innovation? (were they internal or acquired?!)
4. Where Sony's development of mirrorless cameras lies in Satell's matrix (Figure 2) and whether it represents best practice?
5. How successful was Sony in developing the mirrorless camera?
 - What impact did the innovation have on other manufacturers?
 - What is the future?

Innovation Matrix

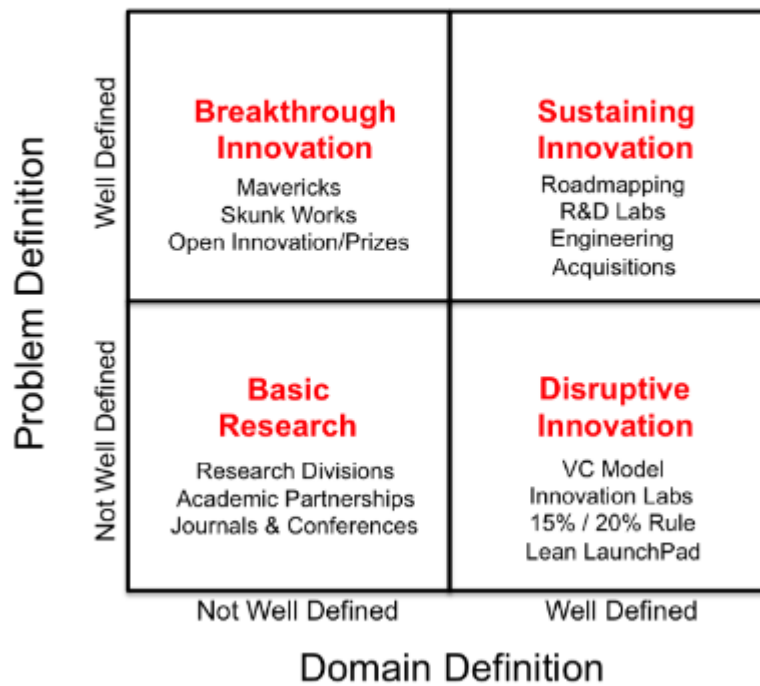


Figure 2 Satell's Innovation Matrix, with examples of innovators/innovation processes (Satell, 2017).

2 DSLR/Digital 'Innovation'

The first digital image sensors were developed in in the 1950s by Russel Kirsch and his team at the National Bureau of Standards (Kirsch et al., 1957). The first digital image was a scanned photograph of his son Walden, which was stored on a magnetic tape cassette.

This followed by the first self-contained digital camera developed by Eastman Kodak, where Steven Sasson and his team used a Fairchild semiconductor to digitally develop images captured by a CCD image sensor (Figure 3). This innovation was an internal innovation and purely a demonstration of what digital technology could offer for Kodak (Vitton et al., 2014). Despite developing this, Kodak would not release their first digital camera until the 1990s and despite having a commanding 78% of market share at the time in film photography (Vitton et al., 2014), they are a brand almost confined to smaller niche products and batteries.



Figure 3 First Kodak digital camera, which could store 30 digital images on a tape cassette. (Image Source: NY Times)

There have been countless papers of note describing the fall from grace that Kodak have had, and their inability (specifically in the boardroom) to keep up with disruptive innovation. The case of Kodak is simple, their Board of Directors

dismissed the innovation of digital as a fad, their refusal to innovate left them behind to competitors and led to their eventual collapse. Further reading on the subject and a case study of failing to respond to disruptive innovation in an industry sector can be found in: Lucas Jr & Goh, 2009; Munir, 2012; Stanwick & Stanwick, 2020.; Vitton et al., 2014.

Despite this, Kodak's failure to capitalise on a new market opened the industry for new market leaders. Sony shocked the world in 1981 with the demo of its new prototype analog-digital camera, the Sony Mavica. The Mavica was an innovative design that could record both still photography and videos.

Today digital cameras are available in a variety of form factors, notably as compact-digital, bridge, D-SLRs and more recently mirrorless systems.

3 The Disruptive Game Changer: Sony Mirrorless

3.1.1 History

Sony was founded in 1946, first specialising in radios and early television & video recording technologies. Since then the company has diversified into many different markets and is the oldest Japanese company to have been listed on the American Stock Exchange. In 2021, they were ranked 88th on the 2021 list of the global Fortune 500 (Source: Fortune 500) that ranks companies by revenue.

Despite having a clear foot in early video recording, it wasn't until 1981 that Sony entered the camera market, with its early digital-analog still camera; the Sony Mavica (Mindel, 2019). The Mavica was a revolutionary game changer, the first digital camera prototype to be displayed to the mass market, and its introduction garnered attention from both individual and corporate sales alike – particularly news stations seeing the potential benefits of a semi-digital camera that could be used to quickly get breaking news stories to mass audiences. The camera operated with a digital CCD sensor that produced digital negatives that were processed in the camera body. This was a disruptive innovation that caught competitors like Kodak and Fujifilm stunned, how had Sony, a **company with zero market** share pipped them to the first digital camera?! – The answer: innovation. Sony has long fostered

innovation and the companies growth is partly down to carefully planned acquisitions, as well as robust internal development. This freedom allowed for the development of the Sony Mavica. Whilst Sony wanted to disrupt the market by releasing the world's first digital camera prototype, Kodak and Fujifilm simply did not. And any internal development of such were quickly squashed by senior board members (Munir, 2012; Stanwick & Stanwick, 2020; Vitton et al., 2014). After the Mavica debuted in 1981, it wouldn't be until 1987 when Sony would follow up with the successor, the finalised consumer Mavica that would save images to internal storage. The period of the 1990s followed with Sony releasing the Sony Memory Stick, one of the first flash memory sticks to be used in cameras (in a period when most digital cameras utilised internal storage. The Cybershot was one of the first digital cameras to utilise such technology, which allowed for users to carry multiple memory cards and carrying on shooting. Despite these advances, Sony lagged behind many of its competitors and early cameras were confined to the consumer market. Despite this Sony lagged behind in the professional markets and had no SLR lines, nor did they have any film-based cameras. But they didn't need to..... As discussed by Yohn (2019) in a recent Havard Business Review Article, **GREAT INNOVATIONS NEED GOOD MARKETING**. Whilst Yohn was discussing recent failures around the failure of Sony e-readers, Sony's early camera division knew exactly what they were doing and being the disruptive innovators they were sowing the seed of digital into mass consumers. Whilst this strategy hasn't worked in certain areas, Sony has seen similar success with the Walkman and it was no different here... Sony's market withered from 9-20% with its entry level Sony Cybershot cameras only attracting entry level and amateur photographers with no clear line or technologies to draw in a larger market share.

Enter Minolta Cameras. Minolta had been a small Japanese camera company that were best known for developing the first auto-focus systems on cameras, using small microcomputers to computer high areas of contrast difference which meant the image was likely to be in focus. Sony had what it wanted, a professional camera line with a loyal following. They couldn't develop an D-SLR internally, but instead acquired external expertise in the form of Minolta. Minolta had given Sony their

own camera division overnight, with a full line of professional cameras dubbed as the Sony-Alpha series. Whilst Sony had little experience in the optical production and manufacturing of camera technologies, the acquisition of Minolta's camera division represented a crude and thought-out logic – that they could focus on what they knew best – the electronics.

Sony had recognised that one of the main strengths they had as a company was developing robust consumer and professional electronics. By acquiring Minolta, they had acquired a set of experts in both optical and camera electronics, this has built the strong foundations that future innovations could be built on. Minolta themselves were by no means unaware of innovation, and where in that sense well aligned to Sony – having been the first camera company to develop a consumer autofocus system (long before digital cameras) they were a company that embraced innovation and at times threatened companies like Canon and Nikon that were way above their market share in foreign markets (Jarvie et al., 2017; Windrum, 2005).

Innovation is no stranger to Japanese companies. It could be posed that the Japanese culture lends itself well to innovative minds and company collectives. Imai et al. (1984) discusses this in more detail the innovation processes that Japanese companies tend to employ by engaging all parts of the innovation chain (from top management to consumers) with the innovation process.

The acquisition of Minolta led Sony to the development of professional cameras, with their first innovation being the semi-translucent mirror. Sony had realised that the D-SLR was using a technology (although reliable) that was based on older mechanical technologies, that didn't align to a digital era. The solution was to alter the mirror to a semi-translucent mirror that allowed light through to the sensor, but also reflected a portion of the light to the viewfinder.

However, this led to the innovation in question. Mirrorless cameras. The mirrorless camera was first commercially developed by Panasonic for the Four-Thirds camera system (Sheerin, 2008; Yoon & Anderson, 2014).

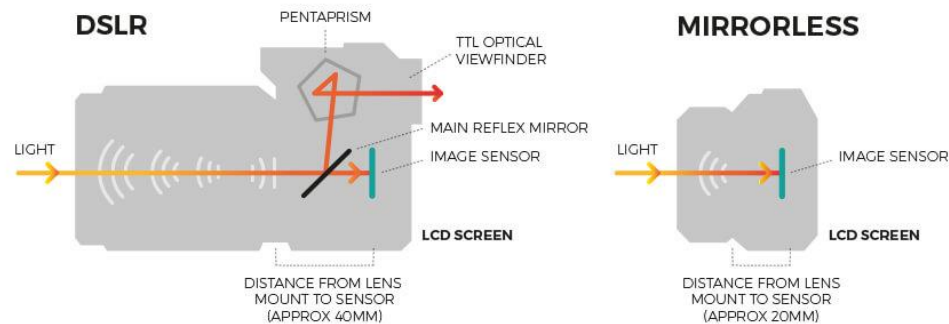


Figure 4 A simplified cross section of a DSLR (left) and mirrorless (right) camera systems and their relative size. (Source: Fujifilm.com)

As shown in Figure 4, mirrorless cameras remove the need for the reflex mirror and subsequent pentaprism, greatly reducing the size of the camera and distance from the lens to the image sensor (greatly improving image quality and decreasing noise). This design allowed for further optical improvements by allowing for larger lenses on smaller camera bodies, without the size increasing exponentially.

3.2 Sony's Mirrorless Innovation

To start, mirrorless cameras in themselves are not a new innovation. They have been present in compact cameras since the late 1990s, with many early digital cameras operating with just a simple LCD screen and very basic contrast detection. Whilst for beginner and traveller point and shoots these were more often enough adequate, for professionals and intermediate shooters the reliability was often poor and would lead to images being out of focus unless in perfect lighting conditions.

Whilst Sony's first ventures into the mirrorless market with the Nex-3 and Nex-5 sparked some interest, the market was stunned when Sony were first to market with a full-frame mirrorless camera priced at <£1500. For context, the nearest competitors had D-SLRs with full frame image sensors priced at more than double. This shocked the market and forced Canon and Nikon to react to produce a competitor to the Sony whilst having to also please their existing customers which

has lead to both significantly losing ground in terms of market share in both markets. Whilst their traditionally strong autofocus advantage over competitors, Sony's ability to not only match but significantly exceed autofocusing times of their competitors have lead to competitors trailing behind.

Whilst it took Canon/Nikon more than 3 years since the release of the Sony Full Frame Mirrorless to develop and release their own bodies, other competitors such as Panasonic and Olympus decided to discontinue their D-SLR lines in focusing only on mirrorless. Internally Sony made this change in direction in 2015, with the release of their last traditional D-SLR, in favour of pursuing further mirrorless developments.

Although the technology had existed for some time, the application of their mirrorless technology to cameras meant that Sony's innovation and development can be classified as a disruptive innovation on Satell's innovation matrix (Figure 2). Whilst competitors had the market well defined (i.e. consumers wanted to take photographs), other brands such as Nikon/Canon could not see mirrorless development being taken seriously as D-SLRs could do exactly the same and more than any mirrorless previously designed. That and their stubbornness developed gave Sony the perfect opportunity to disrupt the market which has undoubtedly changed the camera industry forever & given Sony a step ahead of all of its competitors.

3.2.1 Drivers

Although mirrorless itself was not an innovation in itself with other competitors bringing a product to market prior to Sony's mirrorless developments, the success of such cameras were limited. With professional photographers put off by the low-resolution viewfinders and poor autofocusing performance.

Sony's key drivers were:

- To create one lens mount across all of their cameras
- Improve the autofocusing performance of mirrorless cameras
- Open licensing of their lens mount to encourage third-party lens development
- Gain market share in the photography industry against giants

3.2.2 Risks

The main risks behind Sony's step into mirrorless cameras, is not only did they have little experience with image sensors or a native knowledge, Sony had only previously entered the professional camera market 3 years prior to their mirrorless camera innovation. Although that had expertise in the manufacturing of digital image sensors their share of market stood at only 4% of the time of release of their first mirrorless camera.

3.2.3 Sony's innovation process

3.2.3.1 Seed Acceleration Program

Since 2014, Sony has sought to follow other companies with open innovation to involve consumers with its 'Seed Acceleration Program (SAP)' (Rion-Davies & Evans, 2017). In the SAP Sony would encourage fledgling and early start-ups to approach Sony with innovative ideas where Sony can provide assistance and professional resources to develop ideas into products to be brought to market. However, as well as this Sony engages with users in online platforms and observes members of the influencer community to gather feedback on future product development/improvement. Although not an innovation and more along the lines of continuous improvement, it was noted that when developing their latest edition of their A7 line, the A7IV, that the previous lines suffered from noisy straps (see YouTube clip here: <https://youtu.be/0Ztx-RqpWZM>). This caused issues with videographers, as the noisy straps would bang against the camera body, causing excessive noise on recordings. To solve this Sony improved the strap connectors on their latest model, with feedback taken directly from members of the community. This example of open innovation has been conducted by both Sony and competitors such as Canon since the late 1990s (Harryson, 1997).

3.2.4 Success?

Sony's venture into mirrorless cameras and specifically full-frame mirrorless has been a lasting success. In the past 15 years Sony have gone from having essentially no share in either consumer or professional photography to being the main choice for many videographers and photographers looking for a light setup. Popular

photography discussion site Petapixel have argued that Sony's success could be seen to be hampering the photographic industry, with other manufacturers such as Canon and Nikon forced to release products early simply to stay close to Sony (Cade, 2019). In 2010, Sony held just 4% of international production of digital image sensors to 49.1% of TOTAL image sensor market share in 2022 (source <https://www.t-s-r.co.jp/en/>).

Sony have continued to progress their mirrorless brand and product line with the release of the Sony A9: the fastest focusing camera in the world with just 0.07 seconds to acquire a focus. This has changed the game, with faster autofocus times previously the domain of ultra high-end D-SLR camera bodies.

4 A second disruptor?!

Apple have long since challenged consumer views on how tasks can be performed alternatively with mobile devices, and the camera is no exception (Palmer, 2012). Since the release of the iPhone and other smartphones in the past decade, the camera capabilities have often been marketed as a key selling point. It should be interesting to note that whilst Sony haven't attempted to prevent the use of smartphone photography, they have sought to make it easier for their camera bodies to interface with smartphones via WiFi or Bluetooth, being the first major camera manufacturer to do such. Whilst Sony cannot compete with Apple for scale of adoption, such features and integration with smartphones is one of the main reasons Sony cameras are more popular with the vlogging industry and younger generations than other cameras.

5 Conclusions

- Sony's development of mirrorless cameras was a disruptive innovation in a stagnant market that was susceptible to sudden changes.
- Sony's desire to enter an industry with limited knowledge could only be achieved with the acquisition of a company with experience in producing and developing camera technologies. From this perspective they were in the right place at the right time for the acquisition of Minolta's camera division.
- Competitors in the market had failed to see the advantages that mirrorless cameras may have and the appeal outside of existing consumers which gave Sony a head start.
- With the development of the mirrorless line, Sony has not only managed to dominate the camera industry but have also used this to leverage into the camera sensor market.
- By listening to consumers, Sony has also embraced open-innovation. Causing not only continuous improvement in each iteration since the release of the camera lines, but genuine consumer interest and buy-in to where future products go to.
- Without a doubt, Sony has changed the face of photography and are now the industry leaders in innovation in the sector.

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7 Notification of competing interests

The author notes that there is no funding from competing interests for the purposes of this research.