

Inside IMAX: What Makes It “The World’s Most Innovative Movie-Going Experience”

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Abstract

The innovative technology of IMAX, which includes sound systems, projection systems, cameras, and uniquely designed theaters offers audiences an immersive viewing experience (IMAX 2021c). This paper analyzes the history of IMAX to understand IMAX's transition from museums to movie theaters. An examination of IMAX technology illustrates IMAX's involvement in the filmmaking process from production to exhibition. The global expansion of IMAX screens and the box office success of IMAX films are also described. Even as the number of streaming services increases, IMAX continues to possess the ability to attract audiences with its innovative technology.

Keywords: IMAX, technology, movie theaters, streaming services, box office

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IMAX has become a name synonymous with blockbuster films, massive screens, and immersive viewing experiences. But aside from the larger-than-life screens, how does IMAX differ from other movie-going experiences? What drives the success of this innovative technology, even as the prevalence of streaming services increases? Figure 1 shows that in 2006, IMAX held .4% market share of the worldwide box office. In 2021, IMAX is predicted to hold 3.9% market share of the worldwide box office, representing an 875% increase in 15 years (Statista, 2017). As Figure 1 illustrates, IMAX’s market share typically increases each year, with only three instances of decrease in the past 15 years. In all three instances, IMAX’s market share increased the next year. This impressive growth serves as a testament of IMAX’s continued ability to appeal to audiences. Specifically, IMAX’s ability to draw audiences away from the streaming services in their homes to the immersive experience of IMAX screens.

The questions and statistics mentioned above warrant an in depth analysis of the IMAX Corporation and its technology. The purpose of this research paper is to examine how IMAX offers audiences a different viewing experience. In order to adequately discuss this topic, multiple aspects of IMAX will be explored. Beginning by breaking down the history of IMAX by decades, this paper will explain the creation and evolution of IMAX. This section will provide background information relevant to understanding how IMAX transitioned from museums to movie theaters. The next section will provide descriptions of IMAX technology, such as cameras and projectors. Technical aspects of the IMAX production and exhibition process, such as resolution and aspect ratio, will be explained. This paper will also include a section examining the economics of IMAX. Specifically, the global expansion of IMAX screens, the price of IMAX

tickets compared to standard screen tickets, and the success of IMAX films in spite of streaming services.

The History of IMAX

The 1960s - The Inspiration for IMAX

The origins of IMAX trace back to Expo 67, a world's fair in Montreal, Québec, Canada. Expo 67's theme was "Man and His World" with five divisions of that theme: Man the Creator, Man the Explorer, Man the Producer, Man the Provider, and Man the Community (Lambert, 2015). Two Canadian documentarians, Graeme Ferguson and Roman Kroitor, each directed and exhibited a film fitting the theme.

Ferguson's film, *Polar Life*, shown in the Man the Explorer Pavilion, presented audiences with footage from the Arctic and Antarctic in an immersive experience (*Polar Life*, 2021). For 18 minutes, audiences sat on a rotating turntable while *Polar Life* played on 11 screens surrounding them. While immersive, the rotation limited the number of screens audiences could view at one time to three (*Polar Life*, 2021).

In the Labyrinth Pavilion, Kroitor exhibited *In the Labyrinth*, a film "intended as a modern interpretation of the myth of Theseus and the Minotaur" (St-Pierre, 2017). Using five screens arranged in the shape of a cross, *In the Labyrinth* showed audiences footage from around the world for 21 minutes (*Labyrinth*, 2021). Inspired, the filmmakers set out to create a new film format for a large format projector to display on a large screen. During this time, Ferguson and Kroitor approached successful businessman Robert Kerr and engineer William Shaw to join their team and help create IMAX (Vadukul, 2021).

The 1970s - The First IMAX Film and Theater

The next major moment in IMAX's history came at another world's fair: Expo 70 in Suita, Osaka Prefecture, Japan. Here, audiences experienced the first-ever IMAX film: *Tiger Child*. Viewers were immersed in the film for 17 minutes as they moved through the theater on a rotating platform (Tiger Child, 2021). Shortly following Expo 70, IMAX experienced another exciting first, securing a venue for its first permanent theater. Ontario Place, an amusement park in Toronto, agreed to purchase an IMAX projector for a large-screen theater they were building. This theater, called Cinesphere, showed *North of Superior*, an IMAX documentary directed by Ferguson (Vadukul, 2021). Lasting 20 minutes, the film immersed audiences in Ontario's northland nature (North of Superior, 2021). Both *Tiger Child* and *North of Superior* were shot in the IMAX 15/70 format (North of Superior, 2021; Tiger Child, 2021). For many years IMAX films centered on nature, producing documentaries commonly viewed by audiences in museum theaters.

The 1980s - The Expansion of IMAX into Museums

The 1980s marked the start of IMAX and NASA's collaboration to send astronauts to space with IMAX cameras. However, before astronauts could start capturing beautiful visuals of their lives in space, they had to learn how to use IMAX cameras. Astronauts learned how to film using the approximately 80 pound cameras, which were "minimally altered for flight, with bumpers added to the sharp corners to prevent injuries" (Stromberg, 2012). While able to take in expansive visuals, the cameras did present some obstacles as "the film had to be re-loaded after every three minutes of filming and extra lighting was required to produce attractive footage" (Stromberg, 2012).

Footage from NASA missions produced six movies, including a 1985 film, *The Dream is Alive*, directed by Ferguson. The 37-minute film originally premiered on a 50-by-70 foot screen at the Samuel P. Langley Theater of The Smithsonian Institution's National Air and Space Museum (Clarity & Weaver, 1985). The film followed multiple astronauts' journeys, from their training on land to their lives in space (Koren, 2013). According to Valerie Neal, the space shuttle curator at the Smithsonian National Air and Space Museum, "astronauts have said it's the next best thing to being there" (Koren, 2013). She went on to further praise the film saying, "the theater kind of dissolves and you feel like a part of the film. I had this sense that I was in space with them" (Koren, 2013). These audience reactions to *The Dream is Alive* illustrate the ability of IMAX technology to immerse audiences in the viewing experience, transporting them to incredible places.

The 1990s - Altering IMAX Technology for Hollywood

The next defining phase of IMAX's history occurred in 1994. It was during this year that the founders sold the company to Richard Gelfond and Bradley Wechsler (Vadukul, 2021). Gelfond and Wechsler acquired the IMAX company with a vision of transitioning the IMAX experience from museum theaters to mainstream theaters. However, Hollywood industry members such as studios and exhibitors were hesitant to adapt to the IMAX model (Gelfond, 2013). Gelfond explains, "studios didn't want to film a movie in our format (which required bulky, expensive cameras and lots of film) unless thousands of theaters were equipped to show IMAX films. Theater owners wouldn't convert to IMAX until many more IMAX films were available" (Geldond, 2013).

In order to increase IMAX's appeal in Hollywood, Gelfond and Wechsler began changing aspects of the technology. The initial step involved reducing the cost of IMAX technology from

\$2 million to \$1.2 million and figuring out “how to retrofit existing multiplexes for IMAX, to eliminate the expense of building from scratch” (Gelfond, 2013). Before the digital era, studios provided movie theaters with physical prints of films to show. Although Gelfond successfully reduced the upfront costs, the cost of the physical print remained staggering. A typical film reel cost around \$1,000. An IMAX print cost \$30,000 (Gelfond, 2013).

The 2000s - The Transition from Museums to Movies

In 2001, IMAX began using “computer algorithms to convert existing movies into the IMAX format” (Gelfond, 2013). This technology, called digital remastering (DMR), was first used in *Apollo 13*. This film, directed by Ron Howard and originally released in 1995, is based on the true events of the Apollo 13 lunar mission. Gelfond explains: “this was huge. Instead of persuading studios and directors to film with IMAX cameras, we could come in after the fact and turn a movie into IMAX. We paid for the conversions ourselves, and in return the studios agreed to give us 12.5% of the gross box office receipts on the IMAX versions” (Gelfond, 2013). In 2006, IMAX further reduced theaters' cost of adopting IMAX by installing IMAX at no upfront cost. In return, IMAX received “about 20% of the box office receipts for IMAX films shown on that screen” (Gelfond, 2013). In 2008, IMAX began installing digital systems, using \$150 hard drives to show IMAX films, effectively eliminating the staggering cost of IMAX prints (Gelfond, 2013).

Another defining moment in IMAX's history occurred in 2009 with the release of *Avatar*. Gelfond states, “the IMAX version was a global phenomenon” (Gelfond, 2013). With a runtime of nearly three hours, this film transported audiences into the new imaginative and vibrant world of Pandora. Director James Cameron explained the vital role IMAX played in audiences' experiences: “The larger field of view and powerful surround sound of an Imax [*sic*] theater will

immerse the audience in a way that cannot be experienced anywhere else” (Pierce, 2009). Cameron’s influential endorsement of IMAX, combined with the overwhelming financial success of *Avatar*, cemented IMAX’s place in mainstream theaters.

IMAX Technology

IMAX Cameras

By creating technology for multiple steps along the filmmaking process - from production, to post production, to exhibition - IMAX creates “more than a movie” (IMAX 2021c). The collaboration of multiple pieces of IMAX technology creates the immersive experiences audiences associate with IMAX. IMAX’s dedication to showing breathtakingly large images begins with its cameras, available in both film and digital formats, which capture “up to 40% more image” (IMAX 2021c). The film format of IMAX cameras, IMAX 70 millimeter, runs film through the camera (and later on IMAX projectors) sideways (Murphy, 2012). Running the film sideways places 15 sprocket holes (perforations in the film used for transporting and steadying) per frame at the top of bottom as opposed to the sides of the frame. This explains why IMAX film format is sometimes referred to as 15/70. For comparison, 35 millimeter film has four sprocket holes per frame on the sides. IMAX cameras also offer the “highest resolution” with “standard setting clarity” (IMAX 2021c). Using IMAX 70 millimeter film cameras again as an example, 70 millimeter IMAX film provides about 10 times more image and resolution than 35 millimeter film (Murphy, 2012).

Christopher Nolan, a critically acclaimed director, notably uses IMAX cameras in several of his films including *The Dark Knight Rises*, *Interstellar*, and *Dunkirk*. *The Dark Knight Rises*, the third and final installment in Nolan’s Batman series, featured 72 minutes of IMAX footage, the most of any studio film at that time (Murphy, 2012). As the rest of the film was shot in 35

millimeter, the format and aspect ratio changes from scene to scene depending on the camera Nolan used. Additionally, audiences watching *The Dark Knight Rises* will see different shot compositions depending on whether they are viewing the film on IMAX screens or standard screens. For example, in one shot, Batman stands in the center of the frame surrounded by smoke. Standard screens crop out the bottom part of Batman's hand along with some of the smoke. Although the standard screen shot composition does not negatively impact the audience's understanding of the scene, it provides an example of how standard screens offer a less visually immersive experience for audiences. Nolan explained the benefits of IMAX, saying that "the sharpness and the depth of the image, projected onto those enormous screens, is simply the best quality image that has ever been invented" (Murphy, 2012).

A recent development regarding IMAX cameras occurred in September of 2020 when IMAX launched its "Filmed in IMAX" program: "IMAX will certify high-end, best-in-class digital cameras with leading brands including ARRI, Panavision, RED Digital Cinema and Sony to work in the IMAX® format when paired with its proprietary post-production process" (IMAX, 2020). By partnering with leading brands in the industry, IMAX increased filmmakers' access to IMAX products and experiences, thereby also increasing the audience's ability to see IMAX movies. As mentioned previously, IMAX films are not strictly restricted to films shot with IMAX cameras. The digital remastering (DMR) process "takes films shot digitally or using 35mm film and enhances their resolution so that they can be projected onto IMAX's huge screens, reducing graininess" (Dodes, 2012). All of these technological advancements increase the accessibility of the IMAX experience.

IMAX Aspect Ratio

IMAX scenes are also recognizable for their expanded 1.9:1 or 1.43:1 aspect ratio (IMAX, 2021a). Aspect ratio refers to the ratio of an image's width to its height (Masterclass, 2021). IMAX 1.43:1 aspect ratio means that the width of an IMAX image is 1.43 times the size of its height. These aspect ratios benefit both filmmakers and audiences alike. Filmmakers utilize IMAX aspect ratios to include more information in their shots, ultimately creating immersive scenes. Audiences experience the benefits of IMAX aspect ratios when they view them on massive IMAX screens. For comparison, the 2.39:1 aspect ratio, known as anamorphic widescreen format, displays an image with a width that is 2.39 times the size of its height. (Masterclass, 2021). Although as wide as IMAX aspect ratios, the 2.39:1 aspect ratio has a significantly shorter height, resulting in less visually immersive shots.

IMAX Projectors

As mentioned briefly above, IMAX projectors play an important role in the exhibition process of a movie. Using dual projection (two projectors running simultaneously), IMAX projectors provide “unparalleled brightness and brilliant clarity” (IMAX 2021c). IMAX's 4K laser projection system, “IMAX with Laser,” provides “increased resolution, sharper and brighter images, deeper contrast as well as the most distinct, exotic colors ever available on-screen” (IMAX, 2015). These special projectors provide another example of how IMAX enhances filmmakers' visions and audiences' viewing experiences.

IMAX Screens and Sound System

Up until this point, much of the IMAX technology discussed is typically only used and seen by professionals throughout the filmmaking process. The general public can experience IMAX technology by traveling to see a film on IMAX screens. IMAX designs theaters to

showcase the high quality of its technology and to “create the most intense experience” (IMAX 2021c). Massive curved floor-to-ceiling screens, a hallmark of the IMAX viewing experience, reach up to 118 feet wide and 82 feet tall. These screens display the high-quality images captured by IMAX cameras and projected by IMAX projectors (Blum, 2013). IMAX attempts to further enhance audience’s immersion in a film by using a “12-channel sound technology” with “side and overhead channels to deliver greater dynamic range and precision for ultimate audio immersion and sound you can feel” (IMAX, 2018).

The Economics of IMAX

The days of struggling to convince Hollywood distributors and exhibitors to adopt IMAX technology are long gone. IMAX currently has 1,580 commercial screens in 85 countries and territories (IMAX, 2021b). The benefits (both creatively and economically) of IMAX technology are now well understood in the film industry. In 2019, all 15 of the top grossing films were released in IMAX. In 2020, 13 out of the 15 top grossing films were released in IMAX (IMAX, 2021b).

IMAX Ticket Price

IMAX films typically play for one to two weeks in theaters, effectively creating excitement around new releases (IMAX, 2021b). However, IMAX tickets cost audiences significantly more than standard tickets. At the time of writing this paper in November of 2021, *Eternals* was playing in IMAX theaters. At AMC Lincoln Square 13, New York City, the cost of one ticket for *Eternals* on a standard screen was as follows: \$17.99 for an adult, \$14.99 for a child, and \$16.49 for a senior. The cost of one ticket for *Eternals* on an IMAX screen was as follows: \$26.99 for an adult, \$23.99 for a child, \$25.49 for a senior. AMC defines children as ages 2-12 and seniors as ages 60 and above. The showtimes were both on Sunday November 7,

2021 (the standard screening was at 7 p.m. and the IMAX screening was at 6 p.m.) These showtimes were during the opening weekend of *Eternals*, two days after the opening night on November 5, 2021. Across all age groups, IMAX tickets cost \$9 more. The price difference between standard tickets and IMAX tickets represents a price increase of 50% for an adult, 60% for a child, and almost 55% for a senior. Although the more expensive option, “IMAX admissions account for a significant portion of opening weekend tickets sold, as new Hollywood content returns” according to IMAX (IMAX, 2021b).

IMAX Box Office Split

When audiences buy tickets to see a movie on an IMAX screen, the revenue is split between the distributor (for instance a major studio like Paramount Pictures), the exhibitor (movie theaters like AMC), and IMAX (Gelfond, 2013). Even though the revenue is split three ways, the studio and movie theater receive more revenue when audiences purchase an IMAX ticket as opposed to a standard ticket. The increased revenue is due to the higher price of IMAX tickets as compared to standard tickets explained above. Additionally, “theater owners see that simply having an IMAX theater installed tends to increase overall attendance at their multiplexes” (Gelfond, 2013). Ultimately, the revenue sharing concept IMAX uses benefits IMAX, the distributor, and the exhibitor.

The Rise of Streaming Services

The rise of subscription video on demand (SVOD) services such as Netflix, Disney+, and HBO Max present a threat to traditional theater screenings. These services allow audiences to stream films and television shows from the comfort of their own homes. This convenience has the potential to reduce the appeal of theaters for some audiences. Figure 2 shows that in 2016, only 13% of SVOD users in the United States subscribed to three or more services. In 2021, that

number increased dramatically to 65% (Statista, 2021a). This statistic illustrates consumers' willingness to pay for content, specifically content with the added bonus of being able to be watched at any time while at home.

Figure 3 shows that over 50% of individuals aged 18 to 34 would pay \$30 for a premium video on demand (PVOD) service (Statista, 2021b). PVOD services allow consumers to stream films at an early date for an increased price. While these statistics present potential problems for theaters, “IMAX box office is driven by blockbusters that benefit from theatrical releases, helping to insulate from the rise of streaming and premium video-on-demand releases” (IMAX, 2021b). Blockbuster films, typically characterized by large budgets and famous actors, consistently draw audiences to theaters. IMAX further entices fans of blockbuster films by providing audiences a way to watch their favorite actors or franchises on larger-than-life screens with immersive sound.

IMAX Box Office Success

Dune, a film directed by Denis Villeneuve and filmed with IMAX certified digital cameras, was released simultaneously in IMAX theaters and on HBO Max in October of 2021. This film demonstrated audiences' continued interest in viewing films on IMAX screens. Although released simultaneously in IMAX theaters and on HBO Max, *Dune* “brought in IMAX’s highest domestic opening since 2019’s *Star Wars: Rise of Skywalker*, with \$9 million in domestic box office” (IMAX 2021b).

Other Hollywood blockbusters such as *Venom: Let There Be Carnage* and *No Time to Die* both impressed at the 2021 box office with their respective releases on IMAX screens (Wall Street Journal, 2021). *Venom: Let There Be Carnage* made \$9.6 million at IMAX screens in North America and Russia, accounting for 9.5% of the film's overall initial weekend box office

results. *No Time to Die*, the first James Bond film shot with IMAX cameras, impressed internationally, “earning \$6.8 million across 284 IMAX screens in 50 international markets” (Wall Street Journal, 2021).

It is important to note that not only films built on tentpole franchises such as James Bond perform well in IMAX. *Dunkirk*, the Christopher Nolan film mentioned previously, tells the story of the evacuation of Allied troops during World War II from the beaches of Dunkirk in France. During its opening weekend, this film “took in about \$50.5 million at North American theaters, or about 20 percent more than analysts had expected before release” (Brooks, 2017). As discussed previously, Nolan frequently endorses IMAX technology, encouraging audiences to see his movies on IMAX screens as opposed to standard screens. Nolan’s endorsement could be one explanation for why “turnout was very strong at Imax [*sic*] locations” for the opening weekend of *Dunkirk*. (Brooks, 2017).

Conclusion

The innovation and teamwork of four men, Canadian documentarians Graeme Ferguson and Roman Kroitor, businessman Robert Kerr, and engineer William Shaw, created IMAX. The imaginative ideas of these men sparked a business and filmmaking format that continues to entertain audiences around the world over half a century later. Since the days of the first-ever IMAX film, *Tiger Child*, IMAX has evolved and grown, effectively creating a name for itself in the film industry.

However, as outlined above, the notoriety IMAX enjoys today was not easily or quickly achieved. After buying IMAX in 1994, Richard Gelfond and Bradley Wehlser experienced challenges in multiple areas of the IMAX business. For many years in its early history, IMAX films focused on nature or science. This subject matter subsequently relegated IMAX films and

technology to science museums. Although primarily shown in science museums, these films were high-quality and received positive reviews from audiences. Examples include films shot in space, such as *The Dream is Alive*, an IMAX film shot in collaboration with NASA. However, Gelfond envisioned a different future for IMAX. Specifically, a future involving the bright lights of Hollywood.

Reducing the cost of IMAX technology and adopting the emerging digital format proved instrumental in transitioning IMAX into the Hollywood film industry. Another influential event regarding the acceptance of IMAX by mainstream audiences and industry professionals occurred with the release of *Avatar* in 2009. The global popularity of *Avatar*, combined with director James Cameron's glowing endorsement of IMAX, helped cement IMAX in the minds of directors, studios, exhibitors, and audiences alike.

While the history of IMAX provides useful insight into how IMAX achieved its current status, technological innovation remains the heart of the format. IMAX successfully combines past innovations (updated to stay compatible with today's technology) with exciting new creations. The combination of multiple decades of work and technology creates a unique array of products. The range of available IMAX products illustrates how IMAX creates technology for multiple steps of the filmmaking process. Instead of focusing on one specific filmmaking aspect, for instance production or exhibition, IMAX creates technology with a bigger picture in mind. By making technology ranging from cameras, to projectors, to sound systems, IMAX becomes involved in the entire filmmaking process. This involvement allows IMAX to create visually breathtaking scenes and immersive experiences.

Additionally, IMAX collaborates with leading brands in the filmmaking industry to increase the accessibility of IMAX products and experiences. These collaborations benefit not

only IMAX, but also filmmakers and audiences. The increased accessibility of IMAX products allows more filmmakers to achieve their visions by creating visually impressive IMAX films. This subsequently increases the number of filmmakers who publicly endorse IMAX technology and the IMAX viewing experience. For example, director Christopher Nolan frequently uses IMAX cameras to create visually beautiful films. After completing his films, he often encourages audiences to see his newest film on IMAX screens as opposed to traditional screens. Additionally, the more filmmakers capable of creating films with IMAX technology, the higher number of IMAX films available for audiences to experience. Finally, the increased number of IMAX films benefits IMAX financially as this presents more opportunities for ticket sales and the expansion of IMAX screens.

The financial success of IMAX further demonstrates the audience's interest in this format and movie-going experience. As the numbers discussed above illustrate, IMAX films produce impressive results at the box office, both domestically and globally. Additionally, the global expansion of IMAX screens provides an opportunity for continued growth in multiple markets. The box office numbers for IMAX also showcase how audiences not only accept the IMAX format, but actively choose it. The relatively high cost of tickets for IMAX screens, as compared to tickets for standard screens, exemplifies this. Although costing more, the price of IMAX tickets does not wholly dissuade audiences from seeing a movie in IMAX. Directors' endorsements, innovative IMAX technology, and immersive viewing experiences all provide compelling reasons for audiences to choose to pay the extra money to watch a movie on IMAX screens.

Although not impervious to outside threats such as streaming services, IMAX possesses multiple assets that help increase its appeal in comparison to streaming services. Discussed at

length throughout this paper, innovative technology and immersive viewing experiences provide the most obvious benefits of seeing a movie in IMAX. Through the use of its technology, IMAX offers audiences an experience that they cannot easily replicate in their homes. What audiences lose in convenience (by leaving their homes and traveling to IMAX screens), they gain in breathtaking images and sound. However, IMAX is in an increasingly competitive and changing industry. In order to remain successful in the coming years, IMAX will need to have a deep understanding of the audiences' viewing preferences. Additionally, IMAX movies are offered in a limited window of one to two weeks. The limited viewing window directly contrasts the on demand viewing option provided by streaming services. However, this limited time frame adds a special sense of excitement to IMAX movies. Audiences are incentivized to view movies on IMAX screens before the experience is no longer available.

In labeling itself as “the world’s most innovative movie-going experience,” IMAX makes a large claim. However, by staying to the foundation of its format (immersive viewing experiences) and constantly innovating, IMAX differentiates itself from other production and exhibition companies. IMAX effectively creates an environment filmmakers want to explore and audiences want to experience.

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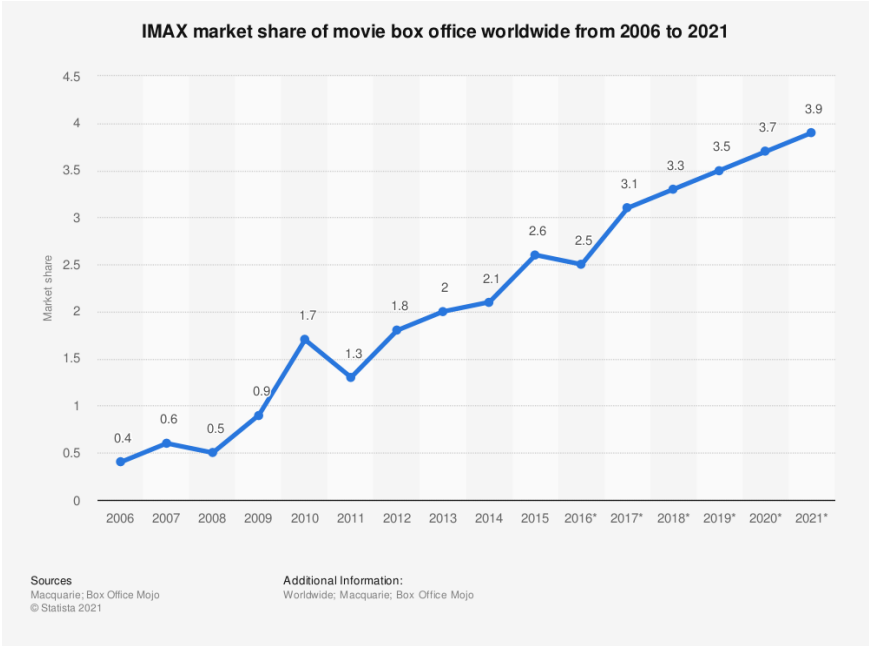
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Figure 1

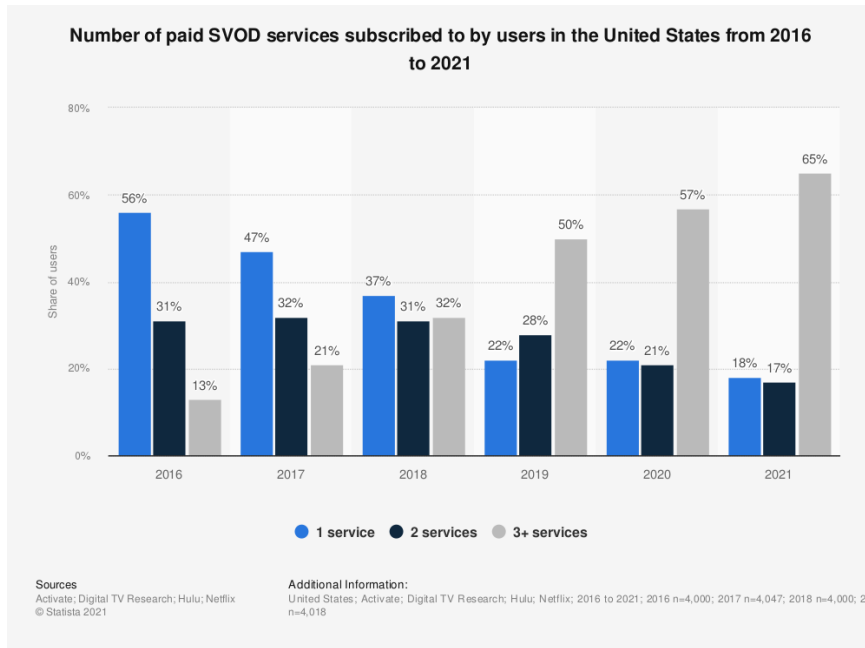
IMAX Market Share of Movie Box Office Worldwide from 2006 to 2021



Statista. (2017, February). IMAX market share of movie box office worldwide from 2006 to 2021. <https://www.statista.com/statistics/717498/imax-box-office-share/>

Figure 2

Number of Paid SVOD Services Subscribed to by Users in the United States from 2016 to 2021

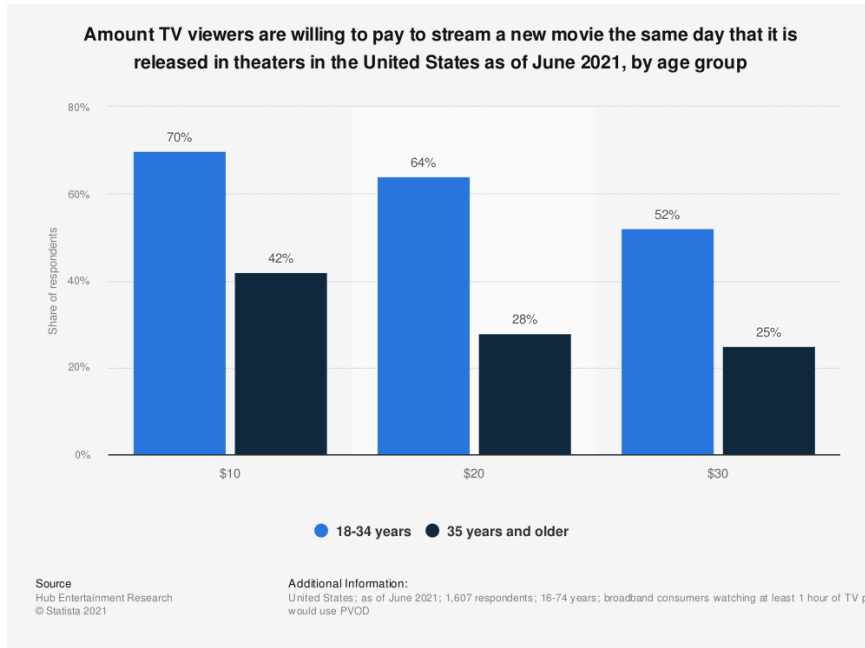


Statista. (2021a, October). Number of Paid SVOD Services Subscribed to by Users in the United States from 2016 to 2021.

<https://www.statista.com/statistics/786665/number-paid-svod-service-subscriptions-us/>

Figure 3

Amount TV Viewers are Willing to Pay to Stream a New Movie the Same Day that it is Released in Theaters in the United States as of June 2021, by Age Group



Statista. (2021b, June). Amount TV Viewers are Willing to Pay to Stream a New Movie the Same Day that it is Released in Theaters in the United States as of June 2021, by Age Group. <https://www.statista.com/statistics/1258264/price-pay-stream-pvod-us/>