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A Study on the Predictive Analytics Powered by the Artificial Intelligence in the Movie Industry

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Abstract

The use of the predictive analytics (PA) powered by the artificial intelligence (AI) is more important in the movie sector during the COVID-19 pandemic, because Hollywood witnessed the impact of the 'Netflix Effect' and began to invest in data and AI. Our purpose is to discover a few cases of the AI centered PA in the movie industry value chain based on five objectives of PA: Compete, grow, enforce, improve, and satisfy. Even if movie companies' interest is to predict future success for competing with over-the-tops (OTTs) at a first glance, it is observed, once they start to use the PA with the AI, they try to utilize the enhanced PA platforms for remaining four objectives. As a result, ScriptBook, Vault, Pilot, Cinelytic and Merlin Video (Merlin) are use cases for the objective 'compete.' Movio of Vista Group International and Datorama of Salesforce are use cases for the objective 'grow.' Industrial Light & Magic (ILM) and Geena Davis Institute on Gender in Media (GDI) with Disney are use cases for the objective 'enforce.' Watson, Benjamin, and Greenlight Essential are use cases for the objective 'improve.' Disney Research (DR) with Simon Fraser University and California Institute of Technology is the use case for the objective 'satisfy.'

Keywords: *Predictive Analytics (PA), Artificial Intelligence (AI), Movie Industry, AI Centered PA Platform.*

1. Introduction

Before artificial intelligence (AI) is a common method to predict the future in most industries, the concept of conventional predictive analytics (PA) refers only to the analytics using historical data. However, as uncertainty increases especially during the Covid-19 pandemic, PA uses statistical algorithms combined with internal and external data to forecast future trends which enables businesses to optimize inventory, improve delivery times, increase sales and ultimately, reduce operational costs. When paired with AI, the insights gleaned from these advanced systems are the key to more accurate and timely forecasting going forward.

PA improved processes using historical data, but it is questioned what happens when this data is no longer predictive of the future during the pandemic. For instance, companies producing toilet paper had no way of predicting how much the demand for those products would increase during the pandemic. Most businesses are struggling with forecasting due to anomalies in consumer behavior during the pandemic. So, PA with AI is crucial in improving forecast accuracy post-pandemic. Even before the pandemic, inventory over- and understock contributed to millions of lost dollars every year. When the value chain leaders sync real-time data with AI, they can optimize their inventory management beyond simple reordering. Monitoring technologies

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like Internet-of-things (IoT) devices in the warehouse provide real-time alerts for low inventory, so they can restock products before they go out of stock.

Over time, an AI-based solution can gather data and recognize patterns, enabling companies to plan inventory more effectively [1]. According to IBM, PA refers to a branch of advanced analytics making predictions about future outcomes using historical data combined with statistical modeling, data mining techniques and machine learning (ML) as well. Companies employ PA to find patterns in the data to identify risks and opportunities. To gain insights from data residing across transactional databases, equipment log files, images, video, sensors or other big data sources, data scientists also use ML and deep learning (DL) algorithms to find patterns and make predictions about future events. These include linear and nonlinear regression, neural networks, support vector machines and decision trees [2].

PA is the use of statistical methods like AI including ML and DL to predict the value of something of interest. AI centered PA embedded in the business processes can drive significant improvement such as reduced cost, increased margin and profitability, better safety and reliability, and lower environmental impact [3]. The use of PA with AI is evolving in every sector of industry value chain. During the COVID-19 pandemic, Hollywood witnessed the impact of the 'Netflix Effect' and began to invest and develop competing data and AI innovations in order to keep pace. This paper is interested in the application of PA powered by AI in movie industry sector which has been undergoing a digital transformation for competing with over-the-top (OTT) companies. So, the aim of this paper is to investigate use cases of PA with AI in the movie industry value chain based on objectives of company's PA.

2. Previous Literature and Theoretical Logic

2.1 Literature Review

In data analysis level, profitability of a movie is predicted to support investment decisions at early stages of film production. By leveraging data from various data sources, the proposed system extracts several types of features including "who" is in the cast, "what" a movie is about, "when" a movie will be released, and "hybrid" features. It is illustrated how it can be used to recommend a set of profit-maximizing cast members. The power of predictive and prescriptive data analytics in information systems is important to aid business decisions [4]. It is analyzed what variables affect average minute rating (AMR) and share rating (SHR) of Korean drama, "My love from the star." The analysis has been conducted by looking at the buzzword frequency of drama properties which was mentioned in Twitter messages and Naver news articles [5]. It is also found that the entertainment companies use data to analyze consumers' behaviors and gain insights of content creation like identifying specific elements of enjoyments and conditions to share the content with others [6]. Lastly, domestic and foreign data analysis are compared in art field and it reflects information of art consumers and professional opinions of art experts using Delphi method [7].

More recently, AI based business models of media firms are developed. For it, 'AI activity model' has been discussed. The practices of the efficiency model are home equipment-based personalization and media content recommendation. The practices of the expert model are media content commissioning, content rights negotiation, copyright infringement, and promotion. The practices of the effectiveness model are photo & video auto-tagging and auto subtitling & simultaneous translation. The practices of the innovation model are content script creation and metadata management. The use cases are introduced along four activity models of AI and it is proposed to utilize the AI for transforming from traditional to successful digital media firms [8].

The use of big data is investigated in the cultural arts industry, focusing on video content. By benchmarking Netflix's AI centered PA of 'House of Cards', the state of OTT business in Korea is compared. In addition, focus group interview (FGI) has been held. In this way, the future prospect of big data in the domestic culture

and arts industry are divided into technical, creative, and ethical aspect [9].

Utilities of AI in the media industry are examined and AI's role is explained in the context of value chain of media industry. As media are interwoven into consumers' daily lives and technology bundles, media companies should deliver engaging individual experiences to every consumer in context, in the moment, and all the time. The fields of how AI is being used is categorized: Audience content recommendations, audience engagement, augmented audience experience, message optimization, content management, content creation, audience insights, and operational automation [10]. Table 1 shows the summary of previous research. From 2016 to 2018, studies relied mainly on primitive forms of data analysis using statistical tools, while from 2019, efforts to develop AI based business models and categorize AI adoptions are starting in media industry sector.

Table 1. Summary of previous research

Year	Authors	Key points
2016	**M. T. Lash and K. Zhao**	Predicting profitability of movie success for supporting investment decisions
2016	**D. Y. Kim**	Predicting TV viewing of a drama, "My love from the star" with social analysis
2016	**H. W. Kim and M. Lee M.**	Investigating how big data are utilized in media & entertainment sector
2018	**K. Song and C. H. Ahn**	Emphasizing big data analysis such as social analysis in video content sector
2019	**M. Z. Song**	Developing four AI based business models of media firms
2019	**H. Y. Kim and J. W. Kim**	Emphasizing the utilization of big data analysis powered by AI (ML & DL)
2019	**S. Chan-Olmsted**	Categorizing eight AI adoptions in media and entertainment industry sector

2.2 Theoretical Background

Companies have seven objectives to utilize PA: Compete, grow, enforce, improve, satisfy, learn and act. First, 'compete' is to secure the most powerful competitive stronghold. Since the data includes companies' sales to customers exposed not only to their products, but also to those of their competitors, the modeling process learns to distinguish the microsegments of customers choosing companies from those deferring to a competitor. In this way, they can identify where their competitor falls short within the customer behavior trends.

Second, 'grow' is to increase sales and retain customers. Marketing applications of PA are companies' value propositions providing value uniformly across industry. Each customer is predictively scored for sales-related behavior like purchases, responses, churn and clicks and the scores drive operations across marketing, sales, customer care and website behavior. Marketing applications of PA also include scoring leading to target sales resources, product recommendations, behavior-based targeting, market research survey, scoring sales channels and other B2B applications.

Third, 'enforce' is to maintain business integrity by managing fraud. As transactions become increasingly automated, criminal opportunities abound. Across industry verticals, fraudulent transactions involving invoices, credit card purchases, tax returns, insurance claims, mobile phone calls, online advertising clicks and consumer banking checks incur great cost. Scoring transactions with a predictive model can leverage companies' recorded experience with fraud to dramatically boost fraud detection. PA extends to information security with the detection of online intrusions by hackers and viruses, as well as to the identification of criminals by law enforcement.

Fourth, 'improve' is to advance companies' core business capacity. Whether products or service offerings, the companies' central function is to produce and deliver with increasing effectiveness. PA improves product manufacturing, testing and repair in many ways. During production, faulty items are detected on the assembly line. Once products are in the field, reliability modeling determines which components are likely to fail or, in response to customer calls, which are likely to require repair, so they may be loaded onto a dispatched vehicle.

New innovations expand the range of PA applications, improving core capacity and advancing central functions across classes of business. It includes supply chain optimization with inventory demand prediction, application processing by predicting approvals and denials, human resource performance and attrition modeling to support decisions in recruitment, hiring and human capital retention, proactive marketing, algorithmic trading by predicting markets, and political constituent scoring such as predicting likely or swing voters for political campaign optimization.

Fifth, 'satisfy' is to meet consumers' expectations. They demand a greater degree of relevancy. Product recommendations become increasingly visible, valued and even expected. Improvements delivered by analytical quality control, reliability modeling, streamlined services and expedited application processing meet the escalating consumer demands. The choice of vendors, products and service options grows, and customers are empowered with complete knowledge, as delivered online. While fraud levels increase, consumers remain expectant of protection, yet become sensitive to the inconvenience of "false alarm" fraud warnings that interrupt payment transaction processing. With a competitive stronghold secured, success breeds success.

Sixth 'learn' is to employ most advanced analytics. Standard business intelligence (BI) and reporting methods provide value in their capacity to summarize the past. Business reporting techniques, including scorecards, dashboards, key performance indicator (KPI) metrics, online analytical processing (OLAP), ad hoc queries and standard marketing segmentation, deliver a retrospective analysis. The capacity for PA to learn from experience is what renders this technology predictive, distinguishing it from other BI and analytics techniques. PA integrates and leverages powerful sources of data like social and unstructured data.

The last 'act' is to render BI and analytics truly actionable. The insights delivered by standard BI and reporting are not readily actionable. PA is designed to generate conclusive action imperatives. PA delivers a powerful aggregate win by driving millions of operational decisions, such as whether to mail, call, offer a discount, recommend a product, show an ad or expend sales resources on a lead. For fraud management, the predictive model drives decisions to audit, investigate or block for fraud. In core business applications, PA-driven decisions include whether to inspect an item or system for failure, load a component on a repair truck, dispatch assistance, provide a loan, fast-track an application or buy a stock [11, 12].

3. Research Questions and Methods

3.1 Research Questions

Price Waterhouse Coopers (PwC) categorizes media and entertainment industries into TV subscriptions and licenses, TV advertisements, movies, music, games, Internet advertisements, outdoor advertisements, radio, consumer magazines, newspapers, general books and educational books, B2B publishing [13]. Figure 1 shows the research framework: AI based business models [8] and categories of AI adoption [10] are linked to the value chain of the media industry and PA objectives, and the research scope is the movie industry sector.

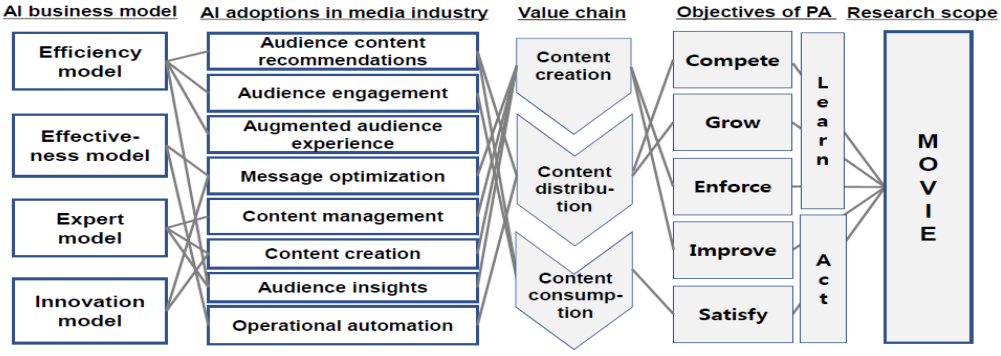


Figure 1. Research framework with goals of AI powered PA in movie industry value chain

Among seven objectives of PA, last two, 'learn' and 'act' are about the tools and activation of other five. The reason why the scope is limited to movies is because movie makers think about the target audience and right decision during pandemic. Their current competitor, OTT's innovation is well underway accelerated by consumer needs. OTT is changing game rule by using AI centered PA and research questions are as follows:

1) What are PA use cases to achieve 'compete' objective in the movie industry?
2) What are PA use cases to achieve 'grow' objective in the movie industry?
3) What are PA use cases to achieve 'enforce' objective in the movie industry?
4) What are PA use cases to achieve 'improve' objective in the movie industry?
5) What are PA use cases to achieve 'satisfy' objective in the movie industry?

3.2 Research Methods

The research scope is limited to movie industry sector which competes with OTT especially during lockdown in COVID-19 pandemic. So, the research period is recent which found previous researches about PA. The research method of this paper is a secondary literature analysis. Movie makers' PA platforms based on AI and partner companies are searched. Some output analysis is also investigated in parallel.

4. Results

4.1 AI Centered PA for Movie Company's Objective 'Compete'

For planning releases in systemic way, PA is considered by the producer, director, and actor who make a blockbuster [14]. Once, "Gigli" took in USD7.2mn. at box office from a budget of USD76mn., and the movie scored 6% on Rotten Tomatoes. ScriptBook is developed to assess the inherent predictive value of screenplays. Its users upload their screenplay to be analyzed by its patented software, 'Script2Screen' which generates an AI-based assessment indicating the project success, along with insight on the storyline, target demographics, market positioning, distribution parameters. It trains algorithms to detect patterns compelling storylines have in common based on a dataset of scripts which have a theatrical release from 1970 to 2016. Its value is in improving human decision-making process throughout the spectrum from script to screen, limiting false decision-making while maximizing the potential [15]. AI analyzes screenplays to assist in decision making by analyzing Hindsight, Foresight, and Insight. Hindsight is composed of data mining tools utilizing the textual data of previous film scripts to extract and exploit useful patterns and form training data to form foresight including a series of ML tools trained on this hindsight data to build models to make predictions on new sample data which ultimately forms the final insight capable of predicting the success of new movie scripts [16].

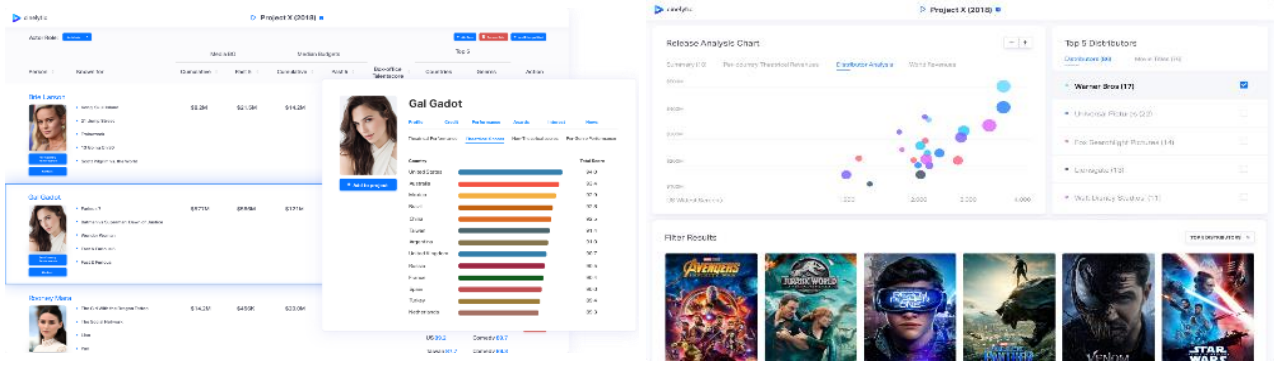
There were 62 films released by Hollywood in 2014 and 2015. 32 films were a failure and among them, 22 had received a negative report from ScriptBook. Conversely, all films that performed well at the American box office had received a greenlight from it. The company thus has started attracting international attention. In 2014, it entered in Telenet accelerator, Idealabs top 10 best start-ups. In 2016, it announced a one million euros seed round, led by PMV and Pamica, an investment company [17, 18].

For improving the productivity of creators, Israeli start-up, Vault provides a service that predicts the box office success by looking at scenarios. It learned about 300,000 to 400,000 scenarios and analyzed patterns on box office success and showed 65 to 70% accuracy on whether the new scenario was successful. Its 'Deep Audience' analyzes thousands of key story elements of a script, outline, finished cut, or trailer to visualize the audience. It is conducted in a matter of hours and produces results that can shape the creative development and on-set production. The platform is developed to affect each stage of the pre-production and development process from title and talent selection through to marketing strategy [19, 20].

Boston-based startup, Pilot can forecast box office revenues up to 18 months before a movie's launch with

unrivaled accuracy. Hollywood's movie production companies need to be sure that their movies will sell a lot of tickets at the box office before investing millions of dollars in them. A lot of modeling, data analysis, and financial planning started to come before launching a film into production. Pilot takes in data about a proposed movie, inputs like cast, director, writer, composer, budget, release date, genre, and many more and spits out a prediction for how much the film will gross domestically, in the first weekend and over the film's lifetime. Through ML and data gathering, every iteration of its model gets better and better. It is browser-based, so subscribers can access the database from anywhere and generate models to content. It has one of the most comprehensive databases in terms of US theatrical release movies, producers, composers, and writers. Production companies with budding stars can benefit from its data. Pilot expands its model to predict box office revenue on a country-by-country and weekly basis [21].

Cinelytic is software-as-a-service (SaaS) offering cloud-based AI to enable media industry to make right decisions about packaging, financing, producing, distributing and marketing of content. It provides PA and project management tools in an online system. In 2020, it had a partnership with Warner Brothers (Bros). An AI-driven movie management system uses 'AI-powered predictive forecasting intelligence' to achieve up to 85% accuracy before a movie has been made. It partnered with Sony Pictures and 19 multiple other Hollywood studios and its platforms are powered by ML and DL algorithms analyzing thousands of data to generate insight assisting the decisions of studio executives in the greenlighting of new titles [20, 22, 23]. As Figure 2 shows, 'TalentScores™' ranks talent by their economic impact across the film industry including by media type, genre, and key territories. 'Film Analytics' tools release scenarios and per-territory and per-distributor analysis in a matter of minutes. Pre-calculated key metrics, intuitive and dynamic data visualizations, and PDF and Excel export functionality saves valuable time and effort [24].



[TalentScores™] **[Film Analytics]**

Figure 2. Cinelytic's talent analysis sample

The 20th Century Fox (now 20th Century Studio) data science team partnered with Google's 'Advanced Solutions Lab (ASL)' to create 'Merlin Video (Merlin),' a computer vision that learned dense representations of movie trailers to help predict a specific trailer's future moviegoers. It is powered by 'Cloud ML Engine' in conjunction with the TensorFlow DL framework. 'Cloud ML Engine' automates all resource provisioning and monitoring, so the team focuses on building DL model for Merlin. Its integration with 'Cloud Dataflow' enables seamless report generation in 'Data Studio,' which gives the team a deeper understanding of how the process works. With this infrastructure, the team could start its analysis on 'YouTube-8M,' a publicly available dataset of YouTube videos. It includes a pre-trained model from Google that can analyze specific video features like color, illumination, many types of faces, thousands of objects, and several landscapes. The first step in Merlin is to parse out these predefined characteristics, as a precursor to determining which elements of the trailer are most predictive of moviegoers' preferences.

Merlin is a way for Fox to create precise segmented results as opposed to broad inaccurate success

predictions and the method is to build a tool learning and interpreting dense representations of movie trailers to help predict a specific trailer's future movie-going audience. By using an existing model capable of analyzing video features like color, faces, and objects, it highlights and labels the characteristics of each image in each frame throughout an entire movie trailer. Once these labels have been collected, they are compared with similar labels from other trailers to identify trends and similarities within existing titles that can assist in the marketing and distribution of the new film. It allows for Merlin to analyze and collect data on plot, themes, and even cinematographic choices. The combination of content and consumer data leads to accurate predictions of future behavior which gives it an edge over the other methods and techniques seen in similar platforms [25].

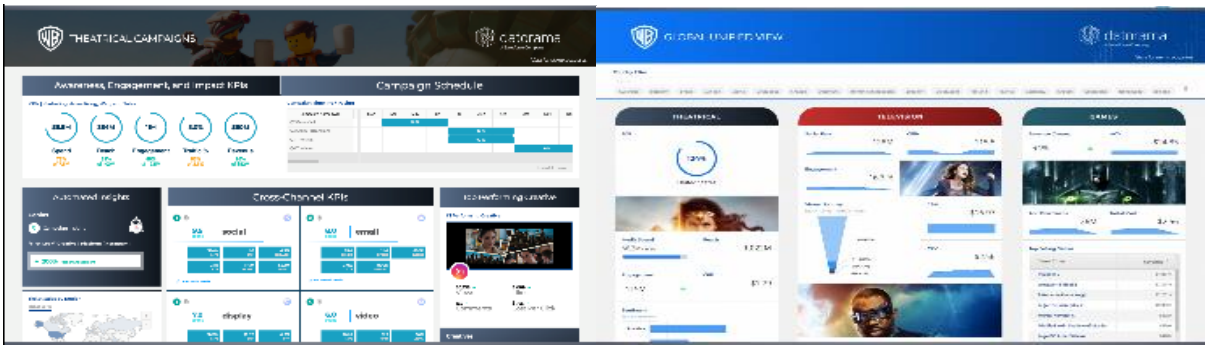
4.2 AI Centered PA for Movie Company's Objective 'Grow'

Movio is a company of Vista Group International, a global leader in data analytics and marketing solutions for the film industry. It is revolutionizing the way the film industry interacts with moviegoers and supporting the world's most comprehensive source of moviegoer data and the company's investment in data science and ML has produced market-leading technologies redefining the possibilities of movie marketing. It empowers movie marketers to connect moviegoers with their ideal movie via online and offline channels, and link campaign data with actual ticket purchases to close the loop and measure campaign effectiveness.

Paramount Pictures' "A Quiet Place" found a top spot among the blockbusters thanks to unique marketing. It transcends the age 13-34 female-skewing horror audience. In order to put its box office returns, Movio compared it to the audience profiles of five recent modern horror movies like "The First Purge," "The Purge: Election Year," "Don't Breathe," "The Conjuring 2," "The Strangers: Prey at Night" and psychological horror movies like "Get Out, Split," "10 Cloverfield Lane," "Hereditary," "Alien: Covenant," as well as "It." In results, its average age of the audience was 34.8, younger than psychological horror and much older than blockbuster horror and modern horror audiences. The noticeable difference was in 50+ age group. 20% of the movie's total audience was over age 50 and the age group's attendance increased by 37% from opening weekend through its final week which is the most significant growth rate in this demographic group of all the movies Movio considered. Its success was due to attracting female moviegoers. By the end of the film's run, the audience was 49% female, a growth of 20% since opening night. Another success was due to attracting moviegoers going to the movies occasionally a year. Movio categorizes them into infrequent (1 to 4 movies per year) and occasional (4 to 12 movies per year) moviegoers. It appealed mostly to frequent moviegoers [26].

Movio has revealed the effects of targeted marketing to moviegoers using its tools. Results showed increases in admissions and revenue and it is confirmed that cinema exhibitors using Movio collectively experienced a USD227mn. incremental box office revenue uplift in 2018. Moviegoers receiving direct communication via Movio increased visitation by 0.89 visits per moviegoer. As moviegoers attend with family and friends, this resulted in 1.96 extra admissions leading to an increase of USD16.61 in box office revenue per moviegoer. The average cinema exhibitor using Movio has 730,000 moviegoers in their database, equating to a total annual box office revenue uplift of USD12.1mn. for each exhibitor. Global box office uplift in 2018 across exhibitors utilizing Movio was USD227mn. and an additional USD97mn. in concessions [27].

Salesforce's Datorama, cloud-based and AI-powered marketing PA platform is from 2018 and Warner Bros. started to use it to measure awareness, consideration, and conversion across the customer journey. The real-time data are used to optimize marketing campaigns more than 20 markets, making return on investment (ROI)-based decisions at the executive level down to campaign, creative, and audience levels for every new release. Figure 3 shows four samples dashboards showcasing Warner Bros. uses it to help optimize KPI, global performance, creative performance & audience engagement, and AI centered insight for campaigns [28].



[KPIs for movie releases] **[Unified view of global performance]**

[Creative performance & audience engagement] **[AI powered insight for campaigns]**

Figure 3. Sample dashboards showcasing different ways Warner Bros. uses Datorama

Warner Bros. releasing 20 movies annually had difficulty tracking ROI for marketing campaigns and this system checking data generated in the marketing sector in real time was introduced. Warner Bros. working with Salesforce makes ROI-based decisions prior to planning a new campaign. The probability of success of the campaign increased through data integration and visualization of current status and result data.

4.3 AI Centered PA for Movie Company's Objective 'Enforce'

Industrial Light & Magic (ILM), American visual effects (VFX) company that was founded in 1975 and it is a division of the film production company, Lucasfilm. With 'Disney Research,' ILM works on using AI to de-noise the images produced by ray tracing and it cut down on CPU and render time. In VFX, AI helps to recognize and replace human faces in a semi-automated way. Many media companies turn to AI to improve the VFX process. 5G, the fifth-generation wireless system creates 100 times faster than 4G and it takes down latency to below human perception. Noting that with cloud-computing, real-time and improved GPUs, frames taking two hours to render can take two seconds. So, ILM, a studio specializing in VFX, manages render farm, a large-scale computing field necessary for producing realistic 3D images on schedule, with AI [29].

'Geena Davis Institute on Gender in Media (GDI)' has partnered with 'Walt Disney Studios' to deploy a new digital tool using AI to assess movie and TV scripts for gender bias. GDI's mantra is "If girls see it, they can be it" and GDI has commissioned studies showing how screen representations influence real-world behavior of women and men. One of the examples is the way the number of girls taking up competitive archery more than doubled shortly after the simultaneous release of "The Hunger Games" and Pixar's "Brave".

GDI and Disney developed "GD-IQ: Spellcheck for Bias (GD-IQ)," a review tool powered by AI. It leverages patented ML developed at the University of Southern California, Viterbi School of Engineering to rapidly analyze the text of a script to determine its number of male and female characters and whether they are representative of the real population. It can also discern the numbers of characters who are people of color,

'Lesbian, Gay, Bisexual, Transgender, Queer, & Intersex (LGBTQI),' belong to other groups failed by Hollywood storytelling. They use this tool to help their decision-making, identify opportunities to increase diversity and inclusion in the manuscripts that they receive. Along with rapidly tallying the genders and ethnicities of characters, GD-IQ can assess the number of speaking lines which the various groups have, the level of sophistication of the vocabulary which they use and the relative social status of power assigned to the characters by group. The goal is to reveal the unconscious bias that commonly manifests in the most well-meaning screenwriter's work [30].

4.4 AI Centered PA for Movie Company's Objective 'Improve'

AI algorithms can suggest script ideas, write a summary, and movie characters. Movie trailers are the gateway bringing audiences to the theaters. Studios must create trailers compelling audiences to watch the movie in a box office. AI can be leveraged to assist editors in creating trailers. IBM's Watson was used to cut a trailer for the movie 'Morgan,' which is the first AI-made movie trailer. The AI algorithm can understand areas of high action or emotions and highlights them for a human editor to create the final trailer [31].

The movie "Sunspring" has been created by 'Benjamin' which was fed the scripts of dozens of science fiction movies including "Highlander Endgame," "Ghostbusters," "Interstellar" and "The Fifth Element." It was asked to create a screenplay including actor directions, using a set of prompts required by the science fiction (Sci-Fi) London film festival's 48-hour challenge. The resulting screenplay and pop song were given to the cast, including Thomas Middleditch, Elisabeth Gray and Humphrey Ker to interpret and make into a film [32]. This Sci-Fi movie is about love triangle of three characters who are played by "H," "H2" and "C". It was authored by recurrent neural network (RNN), long short-term memory (LSTM) algorithm. Benjamin learned dozens of Sci-Fi screenplays. Most of them are from the 1980s and 1990s. Feeding on data, Benjamin pull down letters from speech, dissects the words to learn to predict. It understands which letters tended to follow which, and what phrases and words tended to occur together and recognize text by having the ability to sample much longer strings of letters. So, it predicts a whole paragraph and generates original sentences. With these, it learns to imitate the structure of a screenplay and produce stage directions and character lines [33].

After "Sunspring," a new movie "Zone out" has been produced. This movie is entirely the work of AI [34]. Unlike "Sunspring" in which real actors are used, Benjamin has entire films from the public domain, "The Last Man on Earth" and "The Brain That Wouldn't Die" to which the programs added faces of the human actors from "Sunspring," using face-swapping technology and dialogue using voice-generation technologies. The programs also wrote the screenplay, put together the footage, and created the melancholic piano score [35].

"Impossible Things" funded by Kickstarter was the first film where AI is being used to help develop the storyboard and plot twists. Its AI software was developed by Greenlight Essential (GE). It can suggest plot twists and deviations, appeal type of actors and actresses, specific plot and cast combinations and help find the target market for the movie. This startup developed the patent pending data analytic process to begin the production of "Impossible Things," a horror movie which was engineered with AI which can understand the relationship between movie plots and audience taste [36].

4.5 AI Centered PA for Movie Company's Objective 'Satisfy'

Disney Research (DR)'s factorized variational autoencoders (FVAEs) measures complex audience reactions by assessing facial expressions in cooperation with Simon Fraser University and California Institute of Technology. This DL has been trained to watch an audience of hundreds of faces in a darkened box office and to track their reactions. In the tests, they generated 16 million data points derived from 3,179 viewers. Figure 4 shows 'face landmarks' which are detected on audience in the box office.

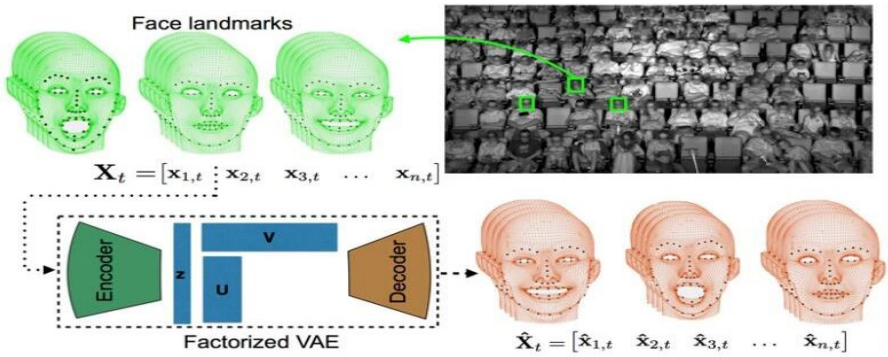


Figure 4. FVAEs' 'Face landmarks'

After observing audience reactions for a few minutes, the AI system can predict their facial expressions for the rest of the movie using a pattern-recognition functioning similarly to a recommendation engine. It can generalize the reactions of an entire audience and measure those reactions against an input that states how viewers should be reacting. Furthermore, DR can measure the audience's facial gestures. So, they can match those reactions to specific scenes, even frames of a film. Based on how AI can provide real time feedback about how an audience is reacting, DR reshapes a movie, as audiences are watching it. It means, there could be multiple endings to a movie, allowing the screening to change dynamically depending on a viewer's response to it. DR helps the company quantitatively gauge an audience's reaction to one of its movies and it is used creatively such as to change a movie's ending, based on a viewer's response to certain scenes [37, 38].

5. Conclusion

Table 2 shows the results. ScriptBook, Vault, Pilot, Cinelytic and Merlin are use cases for the goal 'compete.' Movio and Datorama are use cases for the goal 'grow.' ILM and GDI are use cases for the goal 'enforce.' Watson, Benjamin and GE are use cases for the goal 'improve.' Lastly, DR is the use case for the goal 'satisfy.'

Table 2. Summary of the results

Goals	Types	Representative use cases of PA with AI
Compete	**Success prediction**	ScriptBook, Vault, Pilot, Cinelytic, Merlin (Google's ASL)
Grow	**Marketing promotion**	Movio (Vista Group international), Datorama (Salesforce)
Enforce	**Content management**	ILM, Collaboration of Geena Davis Institute with Disney
Improve	**Automated creating**	Watson (IBM), Benjamin, Greenlight Essential
Satisfy	**Content recommendation**	Disney with Simon Fraser University & California Institute of Tech.

Moviegoer's behavior patterns during the pandemic were not predictive and there are outlying factors skewing data. But OTTs like Netflix which has diverse data sources, whether internal or external paired with AI, can optimize their industry value chain efficiencies. So, pairing PA models with AI are crucial in improving forecast accuracy post-pandemic. The recent pandemic shined a light on the power of PA paired with AI. For movie companies, data collection is crucial, but it is useless if it does not lead to action. They started to gather more data than ever, but they need AI to transform it into actionable insights. They need to have a good technology partner to capture the right data and the appropriate data technology on their journey towards fully implementing PA utilizing AI. Nonetheless, they should not believe 100% in algorithms which are unable to account for cultural changes in taste that will happen in culture industry. Even if ScriptBook uses AI centered PA, it suggests a new collaborative method between human and machine. The blend of human and AI creativity is one of many uses in helping to develop the traditional process of script writing. In conclusion, PA powered

by AI provides abundant opportunities for media and entertainment companies' business innovation.

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