

DEPAUL UNIVERSITY



Strategic Ad Spend Optimization using Predictive Modeling for Skyline Design Company

Presented by

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1. Abstract

This paper explores the enhancement of digital advertising strategies for Skyline Design, a leader in innovative and sustainable architectural glass products. Despite significant investments in advertising, the current strategies have not effectively targeted or engaged key customer demographics, resulting in suboptimal ad performance. Using a comprehensive dataset comprised of past ad campaign data, customer interaction analytics, and market trends, we employed a combination of data cleaning and descriptive statistics in Excel, predictive modeling and simulation in R, and advanced data visualization in Tableau. The objectives were to optimize advertising spend, improve ad content relevance, and increase customer engagement through more targeted marketing approaches. Our analysis identified critical gaps in current advertising practices and provided data-driven recommendations to increase engagement by at least 25% over the next six months. This study not only offers a framework for enhancing ad efficacy through analytical tools but also contributes to the broader discourse on integrating sustainability with aesthetic appeal in marketing practices. The implications of this research are valuable for businesses looking to refine their marketing strategies in highly competitive sectors.

2. Introduction

In the competitive landscape of architectural glass manufacturing, Skyline Design has distinguished itself through its commitment to sustainability and aesthetic excellence. However, despite these strengths, the company faces significant challenges in its digital advertising strategies. Current efforts have not sufficiently capitalized on the opportunities presented by evolving market dynamics and consumer behaviors, particularly in effectively targeting and engaging key customer demographics. This misalignment has led to suboptimal utilization of advertising budgets and diminished returns on investment, which are particularly concerning given the intense competition and rapid technological advancements in the industry.

The core issue at hand involves the inefficient allocation of advertising resources and a lack of precise targeting, which has prevented Skyline Design from fully leveraging its unique market position and product offerings. This inefficiency manifests through lower-than-expected engagement rates and a weak conversion from impressions to actionable customer interactions. Financially, this not only inflates customer acquisition costs but also impacts overall revenue growth, undermining the company's ability to invest in further innovation and sustainability initiatives—key components of its brand identity.

Strategically, the urgency to address these advertising shortfalls is critical. As the market increasingly favors companies that can effectively combine eco-conscious practices with high consumer engagement, failing to optimize advertising strategies could lead to a significant loss in market share. Moreover, the opportunity cost of not maximizing the ROI from advertising spends could stifle the company's ability to expand into new markets and demographics, essential for long-term growth.

In response to these challenges, this project aims to systematically analyze and revamp Skyline Design's advertising approach. The specific and measurable goals set for this initiative include:

- i. Increase Ad Engagement: Boost the click-through rate on digital ads by at least 25% within the next six months, thereby improving direct engagement with potential customers.

- ii. Optimize Advertising Spend Efficiency: Enhance the cost-effectiveness of ad expenditures by reallocating budgets based on performance data, aiming to decrease the overall cost per acquisition by 20%.
- iii. Enhance Customer Targeting: Utilize advanced data analytics to refine customer segmentation and targeting, ensuring that advertising efforts are precisely tailored to the demographics most likely to convert, thus expanding the customer base in targeted sectors.

By achieving these goals, Skyline Design intends not only to improve its immediate financial performance and market positioning but also to set a scalable foundation for future marketing strategies that align closely with its mission and market demands. This project, therefore, is both a strategic imperative and a tactical necessity to ensure the company remains at the forefront of the architectural glass industry.

3. Academic Implications

The refinement of digital advertising strategies within Skyline Design is not only a practical endeavor but also a significant academic exercise, aligning closely with the company's strategic objectives of sustainability and innovation. This project underpins the integration of cutting-edge data analytics into marketing strategies, a move that resonates with current academic discourse on digital transformation in marketing. By leveraging predictive analytics and data-driven decision-making, the initiative challenges traditional advertising models and aligns with contemporary trends in the marketing academic community that advocate for the use of sophisticated tools to enhance customer engagement and efficiency.

Furthermore, the project tests and potentially expands existing academic and industry frameworks on digital marketing effectiveness. Traditional models often emphasize broad metrics such as reach and general engagement without sufficiently integrating the nuances of eco-conscious consumer behavior and the specific demands of niche markets such as architectural design. By focusing on targeted customer segments and aligning the advertising content with the company's core values of sustainability and artistic excellence, this project offers a unique case study on the effectiveness of values-driven advertising strategies.

Moreover, the project's emphasis on measurable outcomes provides a valuable benchmark for academic studies exploring the ROI of tailored advertising strategies in specialized industries. It challenges existing frameworks by demonstrating how detailed analytics can lead to more informed and strategic resource allocation, offering insights that could be significant for both academic research and practical applications in marketing strategy.

4. Technology Merit and Work Plan

4.1 User Demographic Analysis

Upon reviewing the dynamics of user acquisition and engagement through various demographic lenses, our analysis fueled by Tableau visualizations, unveils significant regional variations that influence user interactions. The Americas have consistently shown the highest levels of user activity, with engagement intensifying annually from 2021 to 2023. Although Asia records lower activity levels compared to the Americas, it exhibits notable growth, suggesting untapped potential. The heat maps tracing active users highlight the Americas as a hotbed of user activity, with an

upward trend in engagement. In contrast, regions like Africa and Oceania, despite their lower engagement levels, represent key strategic opportunities for market penetration and user engagement enhancement. Strategically, our focus is on bolstering geographic penetration in these lesser-engaged regions. By tailoring marketing efforts to align with observed user engagement peaks (evidenced by our heat maps) we can potentially enhance engagement effectiveness. Specifically, real-time data suggest that optimizing marketing campaigns during peak periods could elevate engagement significantly.

Resource allocation strategies are also pivotal. By adjusting resources dynamically based on user activity trends, we can not only optimize costs but also improve user engagement efficacy. Our approach includes adapting product offerings to coincide with peak interaction times, aiming to foster a deeper connection with the user base. Predictive analytics plays a critical role in this strategic framework. By continuously analyzing user behavior, we can anticipate trends and adjust strategies proactively, ensuring that our marketing efforts are both responsive and efficient.

In summary, this analysis underscores the necessity of tailored marketing strategies and judicious resource management to align with proven user behavior patterns. By implementing these data-driven strategies, we aim to not only boost user acquisition and retention but also significantly enhance user experience and satisfaction, thereby securing sustained business growth and solidifying our market presence. This refined approach to user interaction management is geared towards effectively expanding our platform's user base and ensuring its long-term success.

4.2 Skyline Design Website Page Analysis

For Skyline Design's website, a detailed analysis of user trends and behaviors across its top-performing pages reveals key insights and strategic areas for improvement to optimize overall performance. While the website saw a remarkable increase in user numbers in 2022, there has been a noticeable decline in 2023, which suggests the need for an enhanced SEO strategy and perhaps more frequent content updates. This decline in user acquisition might also be mitigated by investigating changes in user preferences or external market conditions that could be impacting web traffic.

Moreover, the average session duration, which saw improvement in 2023, indicates that recent enhancements to content or user interface design are engaging users more effectively than in previous years. To build on this momentum, it would be beneficial to continuously analyze user interaction data to pinpoint exactly which changes have had the most positive impact and why. This could involve A/B testing different content formats or design layouts to refine the user experience further.

Additionally, the conversion data from 2023, especially from high-performing pages like "thanks for reaching out to Skyline Design," provides a promising outlook. These pages have evidently succeeded in converting visits to actions, a trend worth delving into to identify the most compelling elements—be it persuasive call-to-action buttons, the clarity of information, special offers, or the overall ease of navigation.

To maintain and amplify this success, it would be wise to replicate effective strategies across other sections of the website. This might include optimizing other key conversion pages, enhancing the mobile user experience, or employing targeted marketing campaigns to drive traffic specifically to

these high-conversion areas.

In summary, Skyline Design's website analytics point towards a need for continuous improvement and adaptation to user behaviors and market trends. By focusing on strategic SEO enhancements, regular content revitalization, meticulous analysis of engagement data, and scaling up successful conversion tactics, the website can aim to not only regain its declining user base but also enhance user satisfaction and conversion rates moving forward.

4.3 Skyline Design Analysis of Engagement and Conversion Trends Over Four Years

The extensive analysis of the dataset reveals intricate details of digital engagement and conversion metrics spanning over four years of various marketing campaigns. The key attributes include metrics around user acquisition—active users, new users, and total users—as well as detailed engagement metrics such as event counts (e.g., page views, clicks) and event types.

A noticeable trend is the escalation in engagement activities like page views and interactions such as file downloads, which indicates a rising interest and consumption of content over time. Particularly noteworthy are the spikes in new user acquisition that align with specific marketing initiatives, pinpointing the effectiveness of targeted campaigns. Despite robust engagement, the variance in conversion activities, such as form submissions for quotes or contact requests, suggests that there is room for optimizing these processes to boost conversion rates. The data also reveals seasonal patterns and periodic peaks in user activities, likely reflecting strategic marketing efforts or market-driven demand.

The analysis highlights actionable strategies that could optimize the effectiveness of digital marketing campaigns. By focusing resources on campaigns that have historically performed well, refining the mechanisms through which conversions are obtained, and aligning marketing initiatives with periods of peak user engagement, strategies can be better tailored to observed user behaviors. This holistic approach emphasizes the importance of leveraging detailed engagement data to enhance overall campaign success, ensuring marketing strategies are more aligned and responsive to the dynamics of user interactions.

4.4 Analysis of Skyline Design's Subscriber Engagement and Retention

In this analysis, key attributes from the email marketing dataset were assessed: Open Rate, Click Rate, Click Through Rate, and Unsubscribed numbers. These metrics are crucial for evaluating the effectiveness of email campaigns, gauging audience engagement, and understanding the impact of content. The Open Rate indicates the percentage of recipients who opened the email, providing insights into the initial appeal of the email's subject line. The Click Rate reflects the proportion of recipients who clicked on a link within the email, revealing the effectiveness of the email content in prompting action. The Click Through Rate (CTR) further refines this by showing the percentage of openers who clicked, offering a direct measure of engagement among interested recipients. Finally, the Unsubscribe rate highlights the number of recipients who opted out of future communications, an essential metric for assessing content relevance and audience satisfaction.

Our analysis revealed that certain campaigns, such as "Jill Malek | Save the Date" and the "Glassboards Lookbook," performed exceptionally well in terms of Open and Click Rates, suggesting that their content was highly engaging and relevant to the audience. On the contrary, the observed higher unsubscribe rates in certain campaigns suggest a need for refinement in areas such as content targeting or email frequency. This metric is particularly useful for identifying which aspects of a campaign may be leading to subscriber discontent, be it the relevancy of the content or the volume of emails sent.

By analyzing these trends, marketers can tailor their strategies to better match the preferences and behaviors of their audience, thus reducing unsubscribe rates and enhancing the effectiveness of the campaigns.

Adjusting email frequency, personalizing content, and segmenting the audience more precisely are proactive steps that can be implemented to foster a more engaged and satisfied audience. This strategic refinement is vital for improving the retention of subscribers and optimizing the overall impact of email marketing efforts.

4.5 Analysis of Marketing Channel Effectiveness and Growth Trends

In assessing the effectiveness and growth trends of marketing channels within the digital landscape from 2021 to 2024, several key metrics were evaluated: new user acquisition, user engagement (sessions and event counts), and conversions. This analysis helps in understanding which channels not only attract new users but also engage and convert them effectively.

Direct, Organic Search, and Email emerged as the leading channels for acquiring new users. Specifically, the Direct channel was responsible for acquiring a total of 80,674 users, making it the most successful in terms of raw numbers. Organic Search followed with 53,880 new users, and Email facilitated the acquisition of 12,669 new users. The growth rate for new user acquisition from 2021 to 2022 can be calculated using the formula:

$$\text{Growth Rate} = \left(\frac{\text{Users}_{\text{Year } 2} - \text{Users}_{\text{Year } 1}}{\text{Users}_{\text{Year } 1}} \right) \times 100\%$$

Applying this formula, the Direct channel exhibited a growth of approximately 109.49%, Organic Search showed a 31.32% increase, and Email demonstrated a significant surge of 1,062.14%.

Engagement metrics were led by Organic Search, which recorded the highest number of sessions (88,532) and event counts (957,369) over the four-year period. This suggests that users sourced from Organic Search are not only plentiful but also highly interactive with the content. Direct and Display channels also showed robust engagement, with Direct accruing 91,274 sessions and 569,891 event counts, and Display gathering 52,171 sessions and 169,145 event counts.

In terms of conversions, Organic Search proved most effective with a total of 1,736 conversions. The Unassigned channel unexpectedly ranked second with 1,561 conversions, suggesting unidentified elements in the marketing strategy contributing significantly to conversion outcomes. Paid Search also demonstrated effectiveness with 246 conversions.

The average session duration (ASD) is a vital indicator of user engagement quality. A significant increase was observed in the ASD from 2021 to 2022 for the Direct channel, rising from 16,741.94 seconds to 44,542.28 seconds. Similarly, Organic Search saw an increase from 29,562.89 seconds to 85,905.30 seconds, indicating enhanced user retention and engagement through content optimization and SEO effectiveness.

This comprehensive analysis highlights the pivotal role of Organic Search in engaging and converting users, underlining its effectiveness as a channel. The phenomenal growth in new user acquisition through Email also suggests its rising importance as a strategic tool for targeted marketing campaigns. These insights can guide future marketing strategies, focusing on optimizing channels that show high engagement and conversion rates while exploring potential under-utilized channels that demonstrate significant growth potential.

4.6 Ad-group and Ad-Campaign Analysis with Optimization Model

This dataset provides a comprehensive overview of digital marketing campaigns conducted by Skyline Design over several years, utilizing platforms like ADWORD and LINKEDIN. It encompasses detailed metrics designed to evaluate the effectiveness and financial efficiency of various advertising strategies

executed across different segments and markets.

The dataset captures a broad spectrum of data points including financial expenditures, engagement metrics, and conversion outcomes. Key attributes include Amount Spent, Clicks, Impressions, and conversions, among others, enabling an in-depth analysis of campaign performance. Each entry in the dataset represents a specific campaign entity, detailed with expenditure, engagement, and effectiveness metrics for a given year.

The overarching goal of this dataset is to provide actionable insights into the performance of each campaign, helping to drive strategic decisions regarding marketing budget allocation, campaign optimization, and targeting strategies to maximize return on investment and campaign effectiveness. For the predictive analysis of digital advertising outcomes—specifically, the number of clicks—an analytical model needs to accurately reflect the underlying dynamics of online user engagement and ad performance. The choice of a linear regression model was driven by several considerations detailed below, aligning with the objectives and data characteristics of our digital marketing strategy.

To ensure the model's robustness and estimate its performance on unseen data, 10-fold cross-validation was employed. This method involved dividing the dataset into ten equal parts, where each part was alternately used as a test set against a training set formed from the remaining nine parts. This technique is critical in mitigating overfitting and provides a more reliable estimate of the model's performance, enhancing confidence in its predictive capabilities.

Model Performance (Performance Metrics)

- **RMSE (Root Mean Square Error):** The model achieved an RMSE of 277.587, indicating the typical deviation of the predicted values from the actual values. This metric suggests the average error magnitude in the predictions, providing insights into the precision of the model.
- **R-Squared:** With a value of 0.813, the model explains approximately 81.3% of the variability in the number of clicks. This high R-squared value underscores a strong relationship between the predictors and the response variable, affirming the model's effectiveness.
- **MAE (Mean Absolute Error):** The model recorded an MAE of 94.470, highlighting the average absolute error in its predictions. This metric sheds light on the actual error magnitude, reinforcing the model's accuracy in practical scenarios.

The linear regression model effectively captures the key factors influencing the number of clicks in digital advertising campaigns. Employing 10-fold cross-validation has guaranteed that the model's predictions are robust across multiple random subdivisions of the data, not merely overfitted to a single dataset split. With strong performance metrics such as an R-squared value of 0.813 and reasonable error metrics (RMSE and MAE), the model is well-poised to perform effectively in predicting clicks in future campaigns, assuming conditions like those under which it was trained. This model serves as a valuable tool in digital marketing, aiding in the optimization and strategic planning of advertising campaigns.

Strategic Enhancements in Digital Marketing: Analyzing Adjustments and Outcomes

This section details the strategic adjustments made to our digital marketing campaigns, focusing on budget reallocation and targeted shifts intended to amplify our reach and engagement with our audience. We assess the impact of these changes by examining budget utilization, click metrics, and cost efficiency.

Financial and Engagement Metrics

- Initial Budget Allocation: \$37,767.59
- Initial Predicted Clicks: 69,078.82
- Revised Budget Allocation: \$52,186.28
- Revised Predicted Clicks: 105,177.98

Detailed Analysis

Budget Modifications:

- The marketing budget was increased by \$14,418.69, a 38.18% rise from the original funds. This adjustment aimed to exploit emerging market opportunities and expand campaign reach.

Engagement and Reach:

- The modifications resulted in a significant 52.24% increase in predicted clicks, totaling 105,178, indicating improved user engagement and expanded audience reach.

Efficiency of Cost Management:

- Cost per Click Before Adjustment: Approximately \$0.546 per click
- Cost per Click After Adjustment: Approximately \$0.496 per click
- The strategic refinement of campaign tactics not only boosted engagement but also enhanced cost efficiency per click, ensuring more effective budget utilization.

The recent strategic enhancements in our digital marketing initiatives have led to considerable improvements in campaign performance, highlighted by increased engagement metrics and more efficient use of budget resources. These outcomes affirm the effectiveness of our budget reallocation in securing a superior return on investment.

5. Project Management (Implementation)

Phase	Dates	Deliverables	Budgeting & Resources	Roles and Responsibilities
Project Preparation	April 04, 2024 - April 09, 2024	<ul style="list-style-type: none"> Project charter Initial stakeholder meeting Team assembly 	<ul style="list-style-type: none"> Initial resource allocation including software tools and access to marketing databases Defined budget for project lifecycle with justifications 	Anasuya Sikdar: Coordinate kickoff, distribute resources
Define Project Scope	April 04, 2024 - April 09, 2024	<ul style="list-style-type: none"> Project Scope Document 		Deep Parikh: oversee budget allocation, ensure financial compliance
Data Collection and Planning	April 08, 2024 - May 05, 2024	<ul style="list-style-type: none"> Collected data Analysis plan 	<ul style="list-style-type: none"> Investment in data collection tools and analytics platforms 	Tsungyen Chen: Lead data collection and validation
Data Processing and Analysis	May 06, 2024 - May 12, 2024	<ul style="list-style-type: none"> Processed datasets Preliminary Insights report 	<ul style="list-style-type: none"> Analytical software licenses 	Manu Johnson Varghese: Execute data processing, initiate descriptive analytics
Model Development and Testing	May 13, 2024 - May 26, 2024	<ul style="list-style-type: none"> Predictive models Testing reports 	<ul style="list-style-type: none"> Advanced analytical tools, expert consultations 	Anasuya Sikdar & Tsungyen Chen: Refine models, align with business objectives
Implementation and Monitoring	May 27, 2024 - June 4, 2024	<ul style="list-style-type: none"> Implemented strategies Monitoring protocols 	<ul style="list-style-type: none"> Implementation support and monitoring tools 	Entire Team: Ensure smooth strategy rollout, adjustments based on real-time data
Project Closure	June 04, 2024 - June 05, 2024	<ul style="list-style-type: none"> Final report Impact analysis Lessons learned Handoff 	<ul style="list-style-type: none"> Resources for documentation and dissemination 	Anasuya Sikdar: Lead project closure, documentation, stakeholder briefing

Schedule Adherence Strategies:

- Regular progress meetings to ensure alignment with the timeline.
- Use of project management software to track progress against key milestones.

- Risk management strategies to identify and mitigate potential delays early in the process.

Cost Justification:

The budget allocated towards advanced analytical tools and expert consultations is justified by the expected increase in ROI through optimized marketing strategies. Improved conversion rates and reduced acquisition costs will offset initial expenditures, providing significant financial benefits in the long term.

By adhering to this detailed project management plan, Skyline Design aims to not only enhance its digital marketing effectiveness but also establish a framework for ongoing optimization based on data-driven insights.

6. Team and Workforce Development

No	Teammate	Role	Skills	Major	No of hours/week
1	Anasuya Sikdar	Project Manager	Project management, Leadership, Data Analytics, Strategy Implementation	Master of Science in Business Analytics	12 hrs/week
2	Deep Parikh	Finance Analyst	Financial Analysis, Budget Management, Forecasting	Master of Science in Business Analytics	8 hrs/week
3	Tsungyen Chen	Data Analyst	Data Collection, Statistical Analysis, Predictive Modeling	Master of Science in Business Analytics	10 hrs/week
4	Manu Johnson Varghese	Business Intelligence Analyst	Data Processing, Business Intelligence, Reporting	Master of Science in Business Analytics	8 hrs/week

7. Conclusion

This comprehensive analysis of Skyline Design's digital marketing strategy has identified key opportunities and challenges within its current approach. By integrating advanced analytics and data-driven insights, the company has the potential to significantly enhance its market reach and customer engagement. The strategic adjustments made to the marketing budgets and campaigns have demonstrated a clear improvement in efficiency and effectiveness, evident from the increased click-through rates and reduced cost per click.

Future Implications: The insights gained from this project are not only immediately beneficial for Skyline Design but also contribute to the broader marketing landscape. They demonstrate the critical role of data in crafting marketing strategies that are not only effective but also economically efficient. As Skyline Design continues to refine its strategies, the methodologies and findings from this analysis could serve as benchmarks for similar industries aiming to optimize their digital marketing efforts.

Further Research and Development:

Demographics and Customer Engagement

1. The data shows that the United States dominates in terms of both active and new users, suggesting that marketing efforts in the Americas are particularly effective. This can be contrasted with Europe and Asia, where engagement is more evenly distributed among top countries like Germany, the UK, Poland, India, and China. It's advisable to continue robust marketing initiatives in the Americas while increasing targeted efforts in high-potential European and Asian markets to balance the engagement levels.
2. Products and Customer Preferences:
 - The engagement data indicates high activity in page views and first visits, which are critical indicators of initial interest. However, conversions from these interactions (like form submissions and product inquiries) are not proportionate, suggesting potential issues in the conversion funnel.
 - Based on the event types that correlate with higher conversions—such as page views, newsletter subscriptions, and phone calls—recommend maintaining products that align closely with these interactions. For products not aligning or contributing to high engagement or conversion, a review or discontinuation should be considered unless they serve a strategic brand purpose.

Sales and Revenue Generation

1. Ad group data shows that while LinkedIn contributes a lesser volume of total clicks compared to AdWords, its conversion rate is significantly higher. This implies that LinkedIn, though smaller in scale, might be reaching more relevant or engaged segments of the market.
2. Campaign analysis shows that certain campaigns like the “LCG Smart Glass Campaign” and “Glassboards Traffic” have high spend but low ROI. These might either need optimization or scaling down to allocate budget more efficiently towards higher ROI campaigns.

personalization of marketing campaigns, potentially increasing conversion rates and customer loyalty.

Recommendations for Continuous Improvement:

- 1. Regular Data Review:** Maintain an ongoing analysis of campaign data to swiftly identify and respond to trends or shifts in market dynamics.
- 2. Dynamic Budget Allocation:** Continue to refine budget allocations based on real-time performance data to ensure optimal use of marketing funds.
- 3. Enhanced Targeting Strategies:** Utilize advanced segmentation and targeting to improve the precision of marketing efforts, ensuring that the right messages reach the most receptive audiences.
- 4. Innovation in Engagement Techniques:** Experiment with new and emerging digital marketing technologies and platforms to stay ahead of market trends and attract new customer segments.

By following these recommendations, Skyline Design can ensure sustained growth and a competitive edge in the dynamic market of architectural glass manufacturing, leveraging the power of digital marketing to fulfill both business objectives and customer needs effectively.

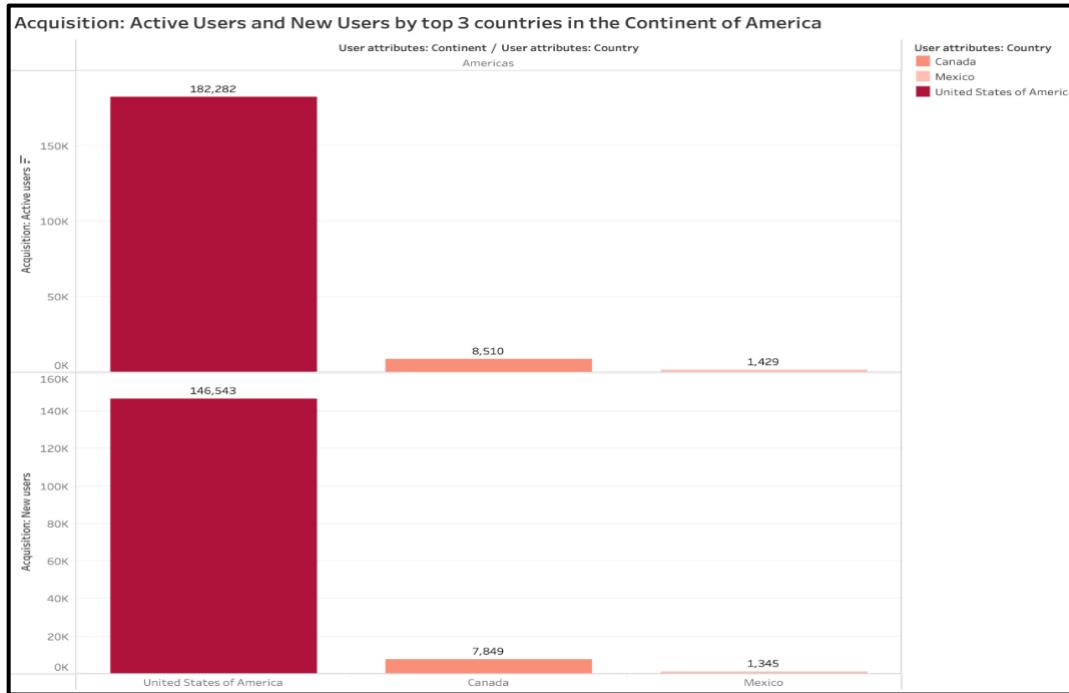
8. References

- Data Science Team at AltheonAI. *Internal Campaign Performance Reports*

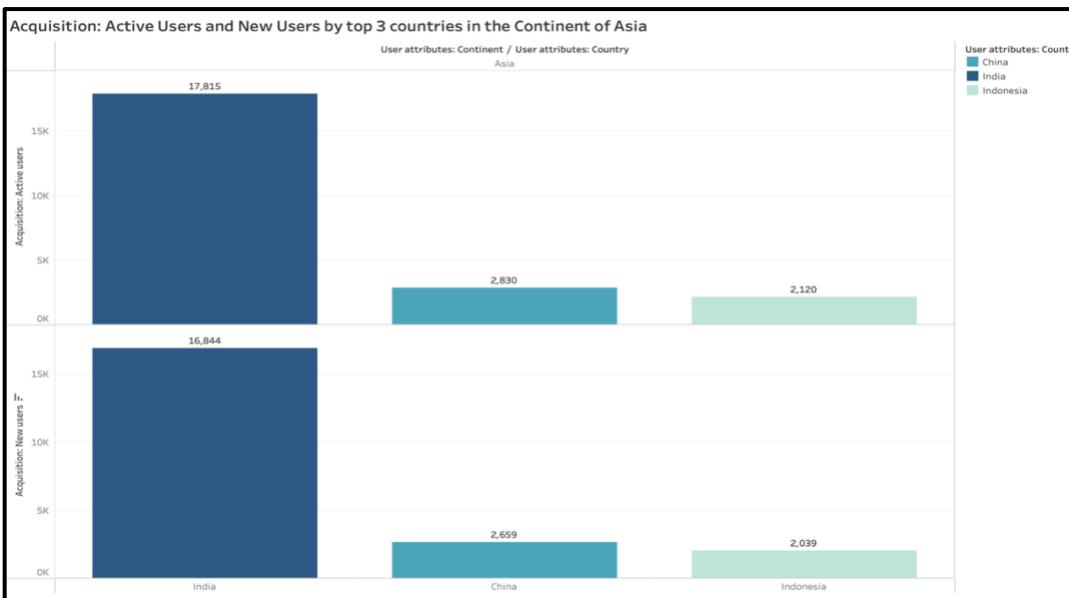
- Skyline Design product data retrieved from <https://skydesign.com/>
- Operations Research: An Introduction by Hamdy A. Taha
- Tuten, T. L., & Solomon, M. R. (2017). Social Media Marketing. 3rd ed. Sage Publications.

Appendices

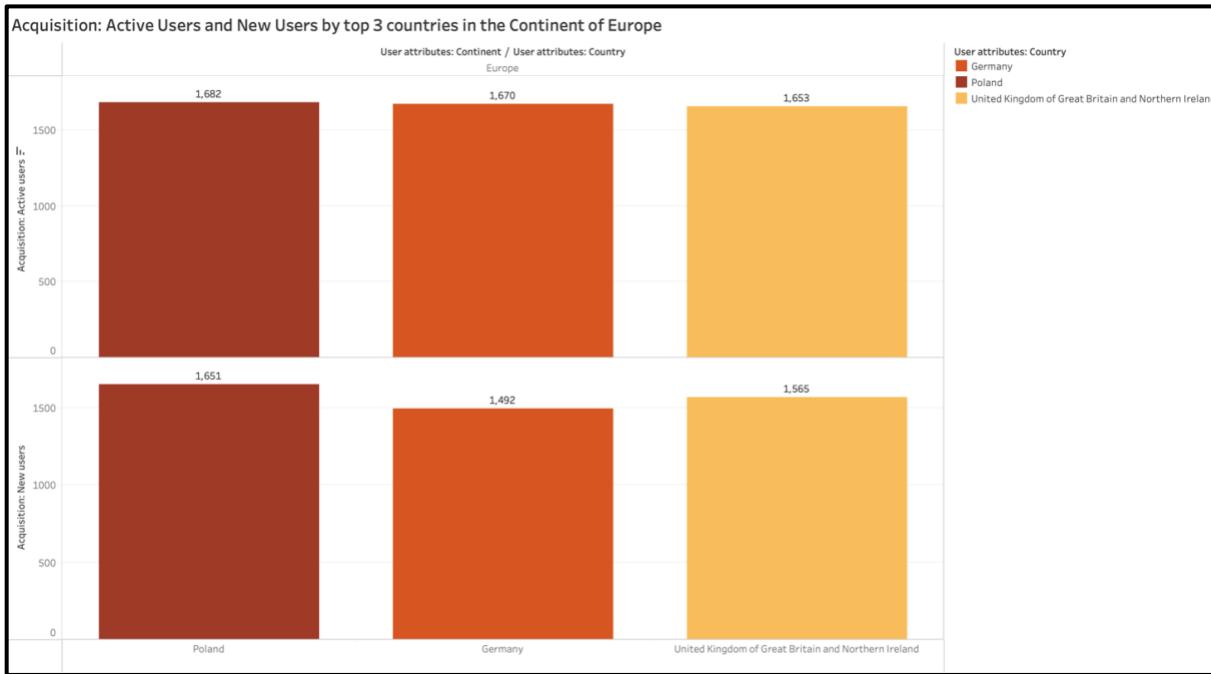
- 4.1.a: Demographics Visualization



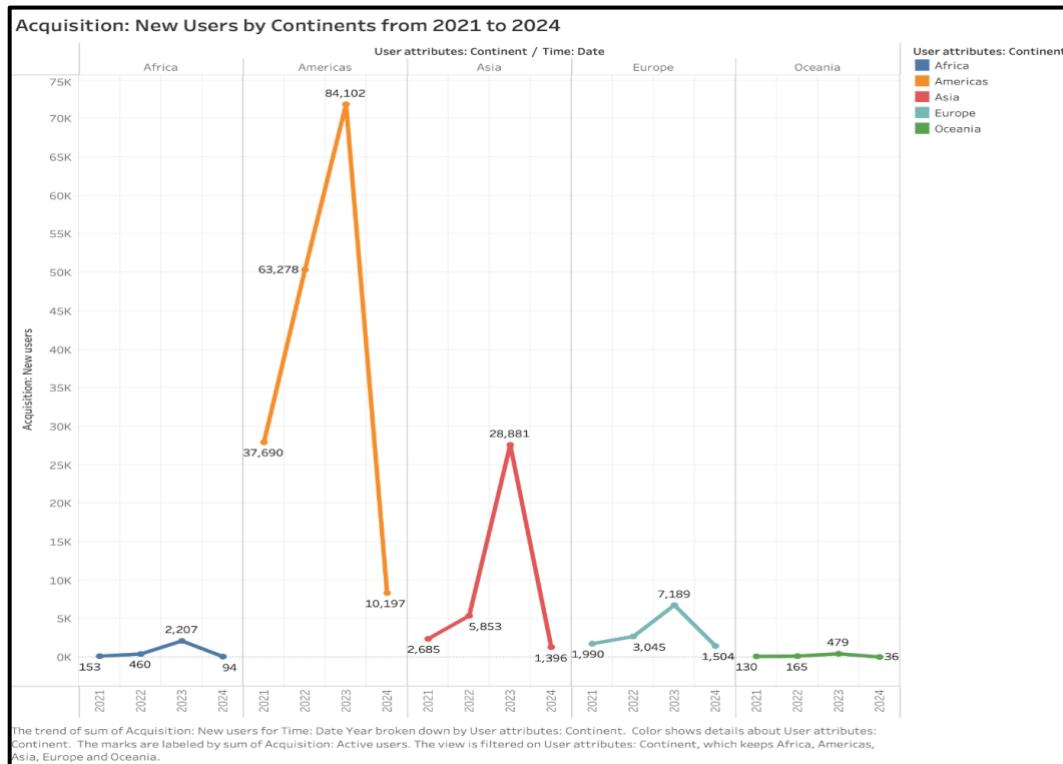
- 4.1.b: Active and New Users by top 3 Countries in the Continent of Asia



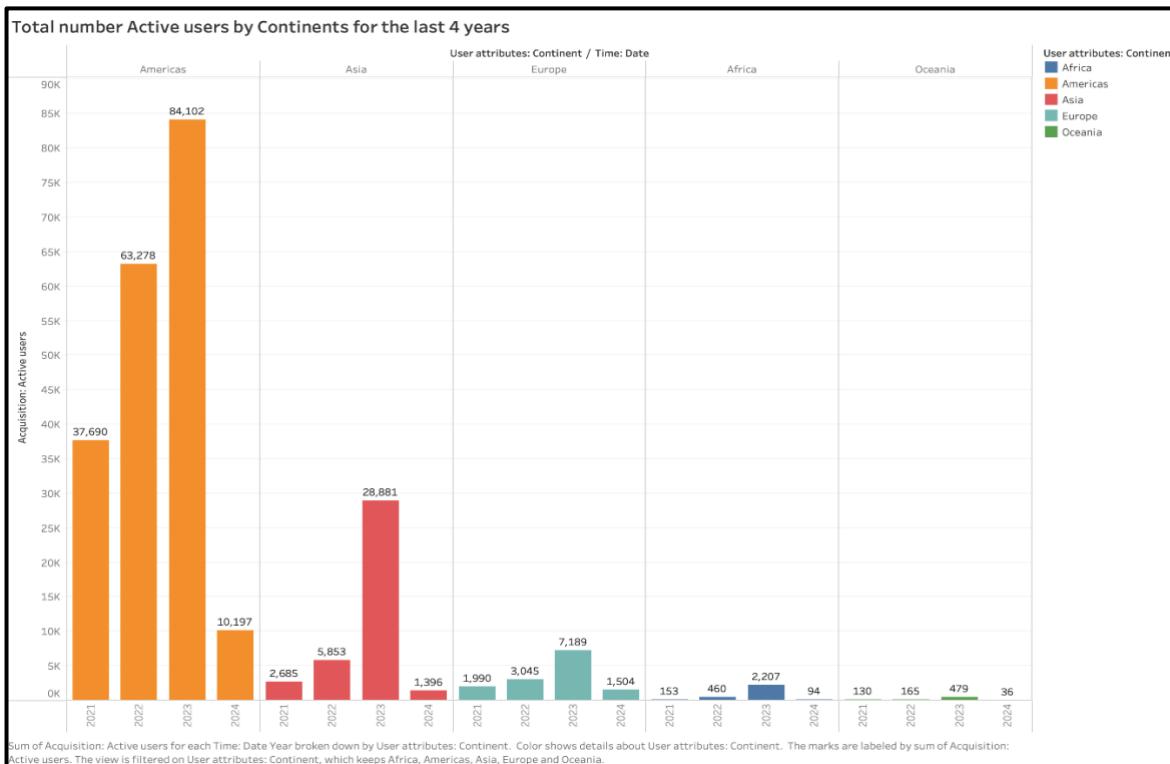
- 4.1.c: Active and New Users by top 3 Countries in the Continent of Europe



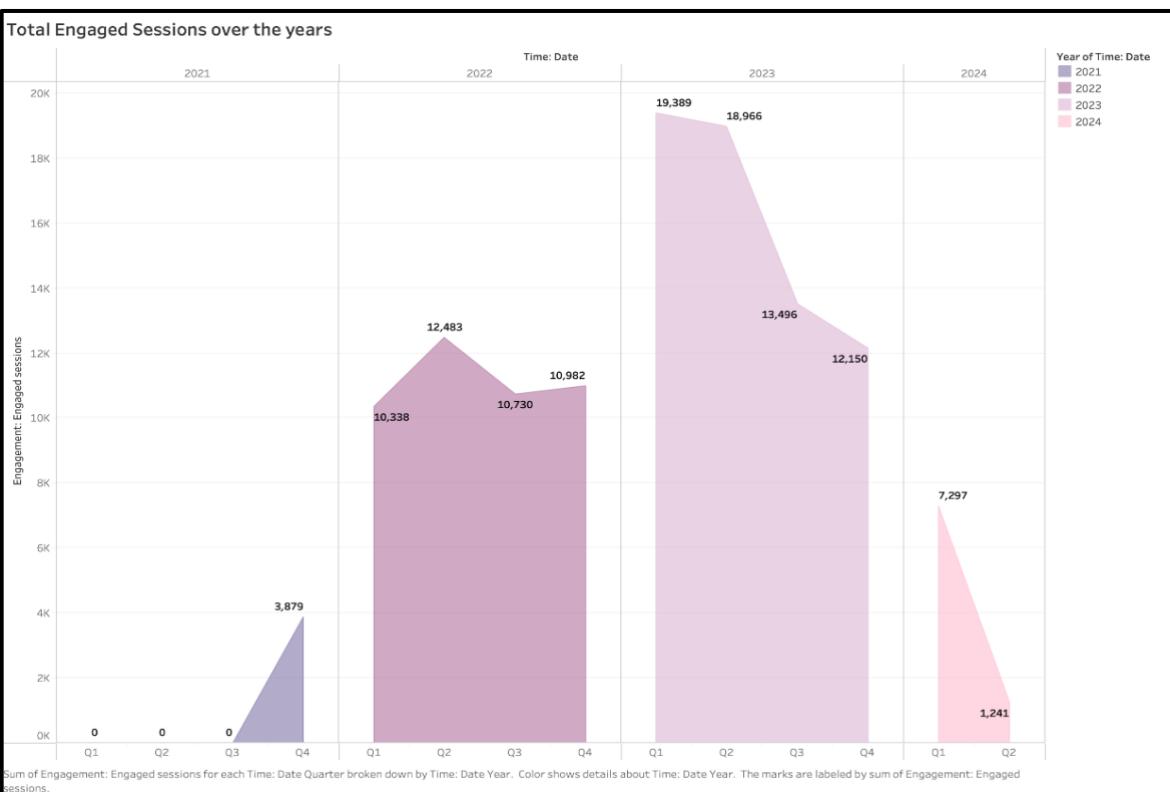
- 4.1.d: New User Acquisition by Continents from 2021 to 2024



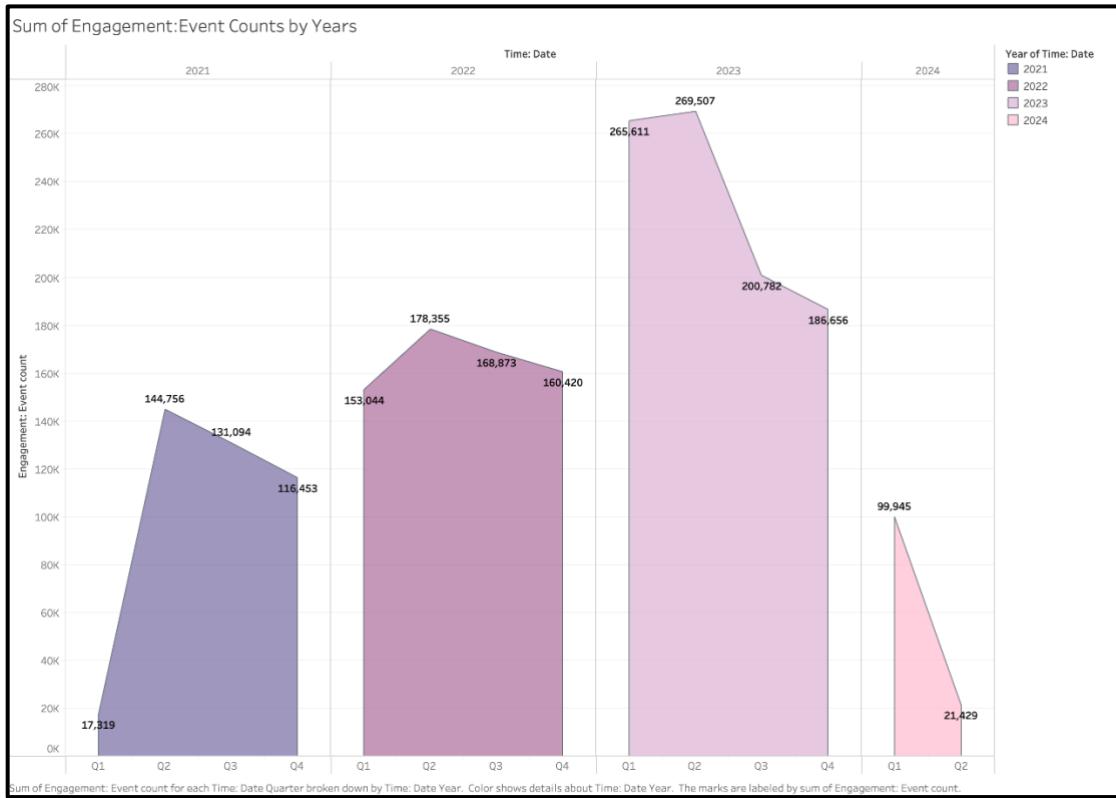
- 4.1.e: Total Active Users by Continents yearly



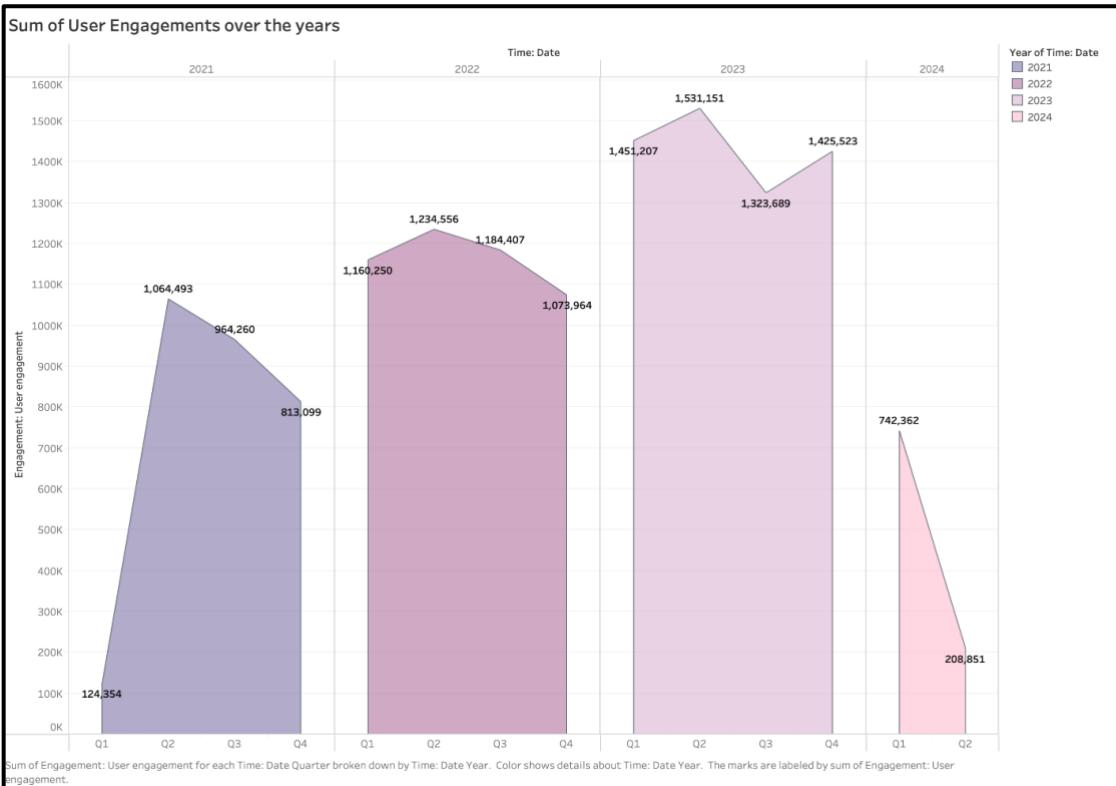
- 4.1.f: Total Engaged Sessions over the years



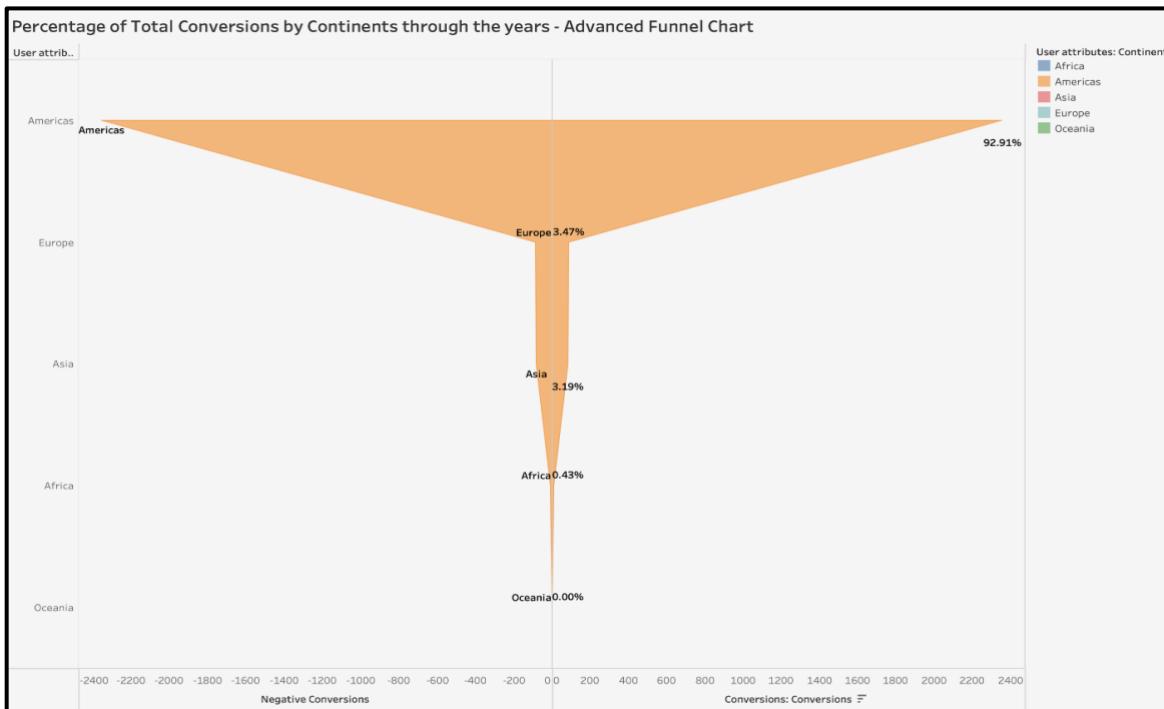
- 4.1.g: Total Event Counts by Years



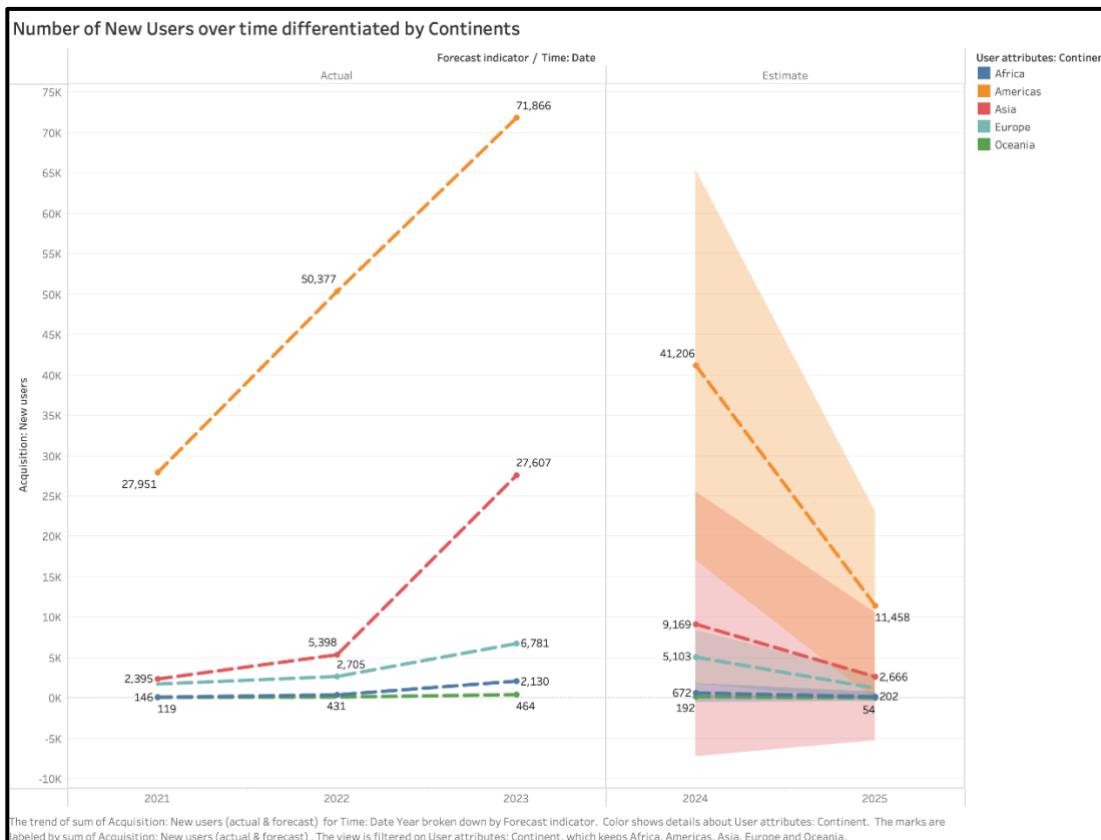
- 4.1.h: Total User Engagements over the years



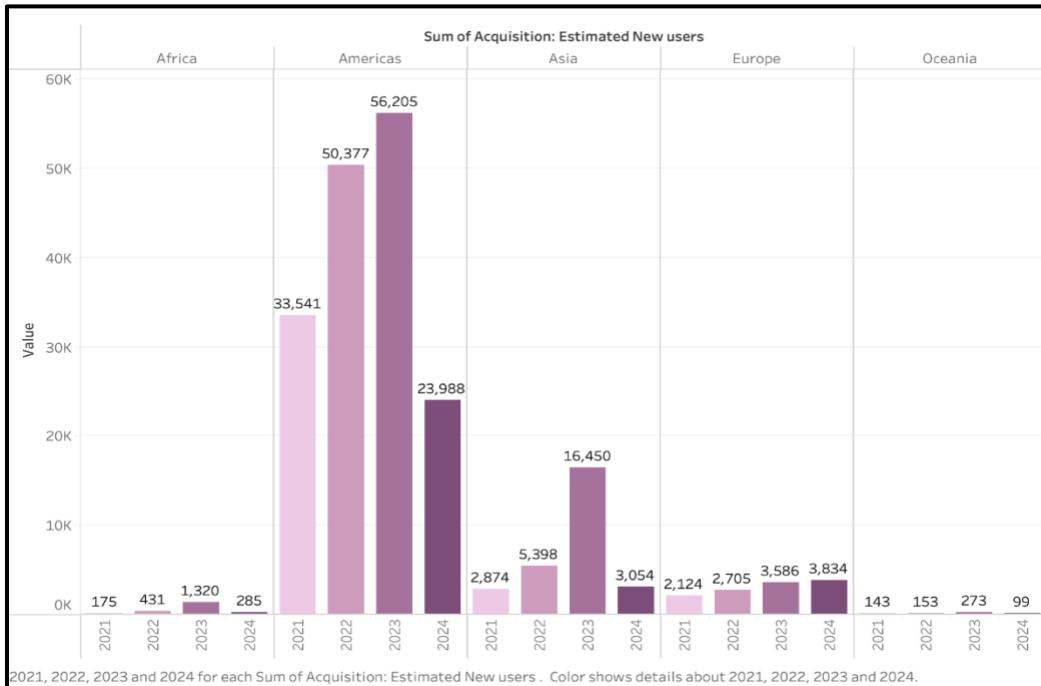
- 4.1.i: Percentage of Total Conversions by Continents through the years



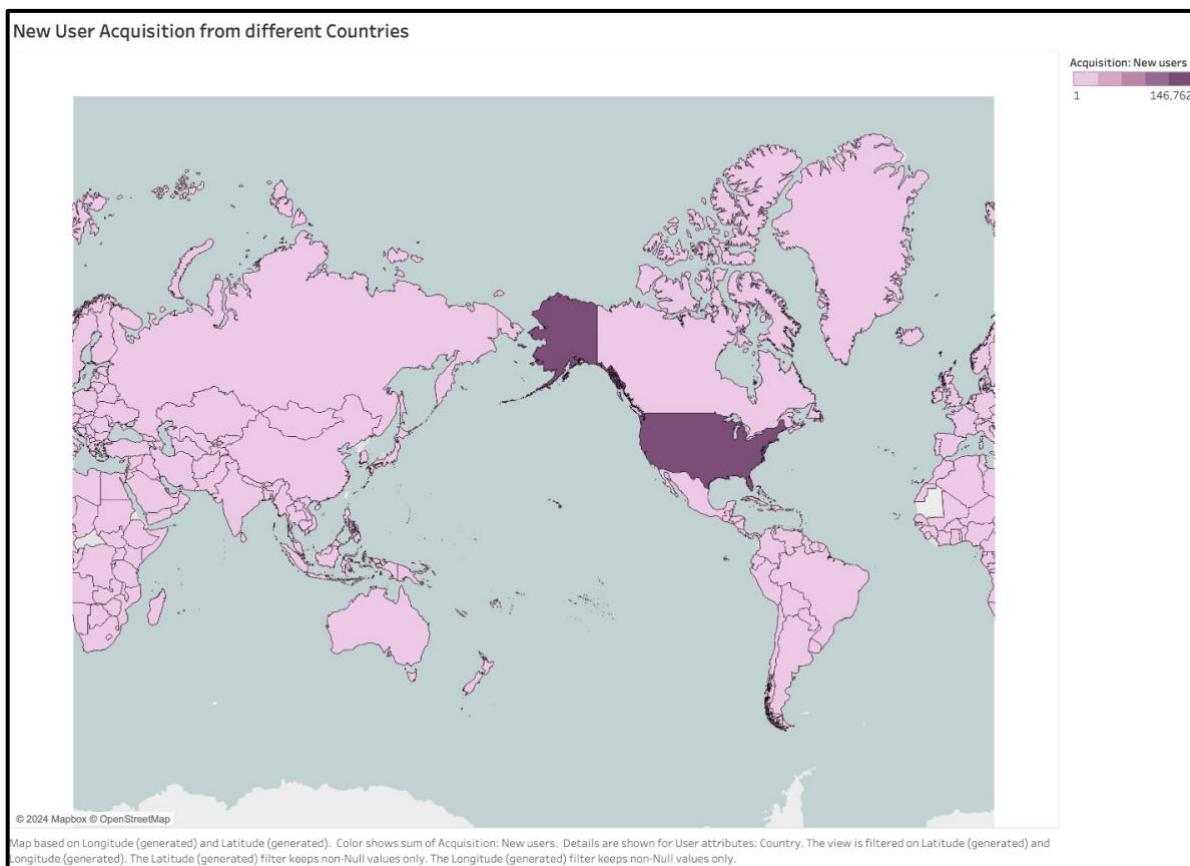
- 4.1.j: Number of New Users over the years differentiated by Continents



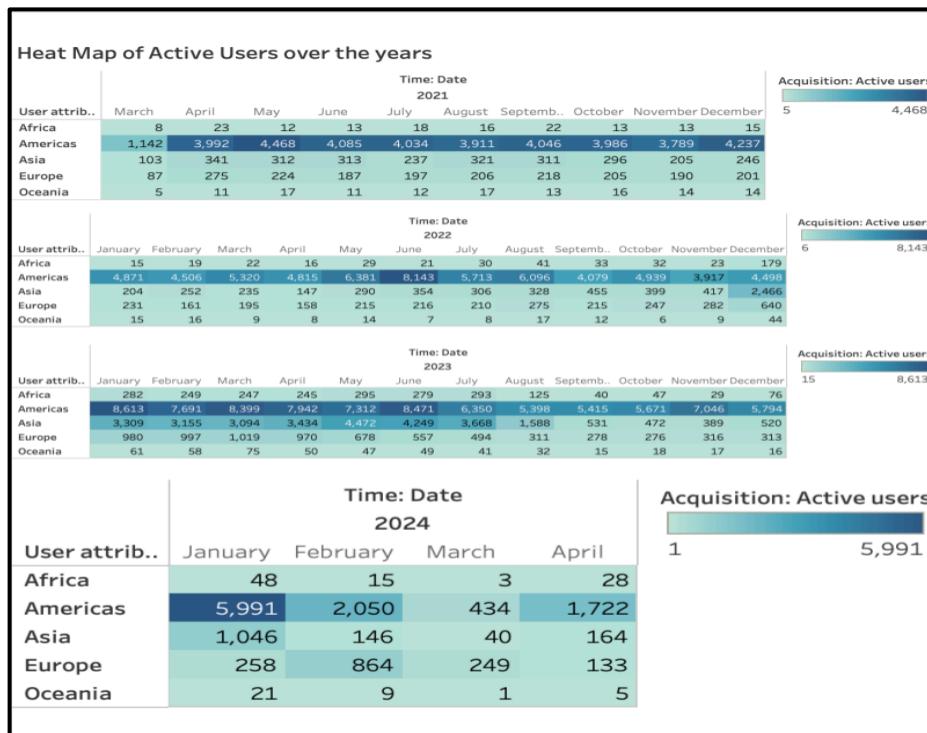
- 4.1.k: New Users over the years differentiated by Continents



- 4.1.l: New User Acquisition from different Countries



- 4.1.m: Heat Map of Active Users over the years differentiated by Continents



- 4.2.a: Total Number of Website Page Users each year

Total Number of Users each year

Year	Total Users
2021	101528
2023	177884
2024	29237

- 4.2.b: Website Page Engagement through the years

Average Session Duration(Engagement) through the years

Year	Average Session Duration
2021	56.751
2023	51.350
2024	62.267

- 4.2.c: Website Page Conversions through the years

Sum of Conversions by years

Year	Conversions
2021	0
2023	1338
2024	534

- 4.2.d: Top Performing Pages over time to observe their user-acquisition trend

Top-performing pages over time to observe their user-acquisition trend

Pages	Years		
	2021	2022	2023
skydesign.com/	20562	21768	4005
skydesign.com/products/	4828	9598	1674
skydesign.com/patterns/	3272	4484	956

- 4.2.e: Top Performing Pages over time to observe their engagement in seconds trend

Top-performing pages over time to observe their average session duration in seconds

Pages	Years		
	2021	2022	2023
skydesign.com/	151.9780219	101.7727984	107.7014843
skydesign.com/products/	122.7918189	73.21846687	85.41507015
skydesign.com/patterns/	192.7738782	70.92027491	76.53267053

- 4.2.f: Top Performing Pages over time to observe their conversions

Yearly Conversion Analysis for pages with high conversions

Pages	Year		
	2021	2023	2024
skydesign.com/thanks-for-reaching-out-to-skyline-design	0	980	86
skydesign.com/thanks-for-requesting-quote/	0	211	50
skydesign.com/contact/	0	40	17

- 4.2.g: Top Performing Pages over time to observe their views

Top-performing pages over time to observe the views

Pages	Years		
	2021	2022	2023
skydesign.com/	33251	57053	15344
skydesign.com/products/	8962	19627	3033
skydesign.com/patterns/	8062	11499	2006

- 4.3.a: Engagement Analysis of Active Users over the years

	Sum of Acquisition: Active users	Column Labels	2021	2022	2023	2024	Grand Total
Row Labels							
click		1469	2644	3899	572	8584	
click_email				1179	310	1489	
file_download		3803	5438	4635	561	14437	
first_visit		32363	61221	111960	11718	217262	
form_contact			65	18		83	
form_design_tool				1		1	
form_find_rep			241	39		280	
form_product_quote			34	5		39	
form_quote			346	49		395	
form_rep_locator				1		1	
form_request_sample			41	7		48	
newsletter_subscribe			48	13		61	
newsletter_subscription		43	28			71	
page_view		41157	73553	125361	13600	253671	
phone_call			1071	276		1347	
product_configurator_quote			28	22		50	
quote_request			190			190	
rep_locator_contact			129	376	41	546	
scroll		12238	16485	23613	3985	56321	
session_start		42486	74451	125351	13599	255887	
user_engagement		31372	46466	58601	7707	144146	
video_complete			2			2	
video_progress			2			2	
video_start			2			2	
view_search_results		2490	3037	3185	525	9237	
Grand Total		167378	283685	460064	53025	964152	

- 4.3.b: Engagement Analysis of New Users over the years

	Sum of Acquisition: New users	Column Labels	2021	2022	2023	2024	Grand Total
Row Labels							
click		0	0	0	0	0	0
click_email			0	0	0	0	0
file_download		0	0	0	0	0	0
first_visit		32385	61294	112176	11771	217626	
form_contact			0	0	0	0	0
form_design_tool			0			0	0
form_find_rep			0	0	0	0	0
form_product_quote			0	0	0	0	0
form_quote			0	0	0	0	0
form_rep_locator			0			0	0
form_request_sample			0	0	0	0	0
newsletter_subscribe			0	0	0	0	0
newsletter_subscription			0	0	0	0	0
page_view		0	0	0	0	0	0
phone_call			0	0	0	0	0
product_configurator_quote			0	0	0	0	0
quote_request			0			0	0
rep_locator_contact			0	0	0	0	0
scroll		0	0	0	0	0	0
session_start		0	0	0	0	0	0
user_engagement		0	0	0	0	0	0
video_complete			0			0	0
video_progress			0			0	0
video_start			0			0	0
view_search_results		0	0	0	0	0	0
Grand Total		32385	61294	112176	11771	217626	

- 4.3.c: Engagement Entity Event Count over the years

	Sum of Engagement: Event count	Column Labels	2021	2022	2023	2024	Grand Total
Row Labels							
click		2142	4303	5708	883	13036	
click_email				1707	521	2228	
file_download		6020	9269	8079	1095	24463	
first_visit		32385	61294	112176	11771	217626	
form_contact			65	18		83	
form_design_tool				1		1	
form_find_rep			268	40		308	
form_product_quote			42	6		48	
form_quote			357	50		407	
form_rep_locator			1			1	
form_request_sample			50	15		65	
newsletter_subscribe			57	16		73	
newsletter_subscription		201	56			257	
page_view		156689	250627	355412	49361	812089	
phone_call			1454	367		1821	
product_configurator_quote		60	54			114	
quote_request		347				347	
rep_locator_contact		228	937	114		1279	
scroll		21120	29674	39084	5808	95686	
session_start		51039	89877	162369	17047	320332	
user_engagement		135188	208641	223932	33397	601158	
video_complete			3			3	
video_progress			17			17	
video_start			5			5	
view_search_results		5039	6171	6353	1028	18591	
Grand Total		409622	660692	918187	121537	2110038	

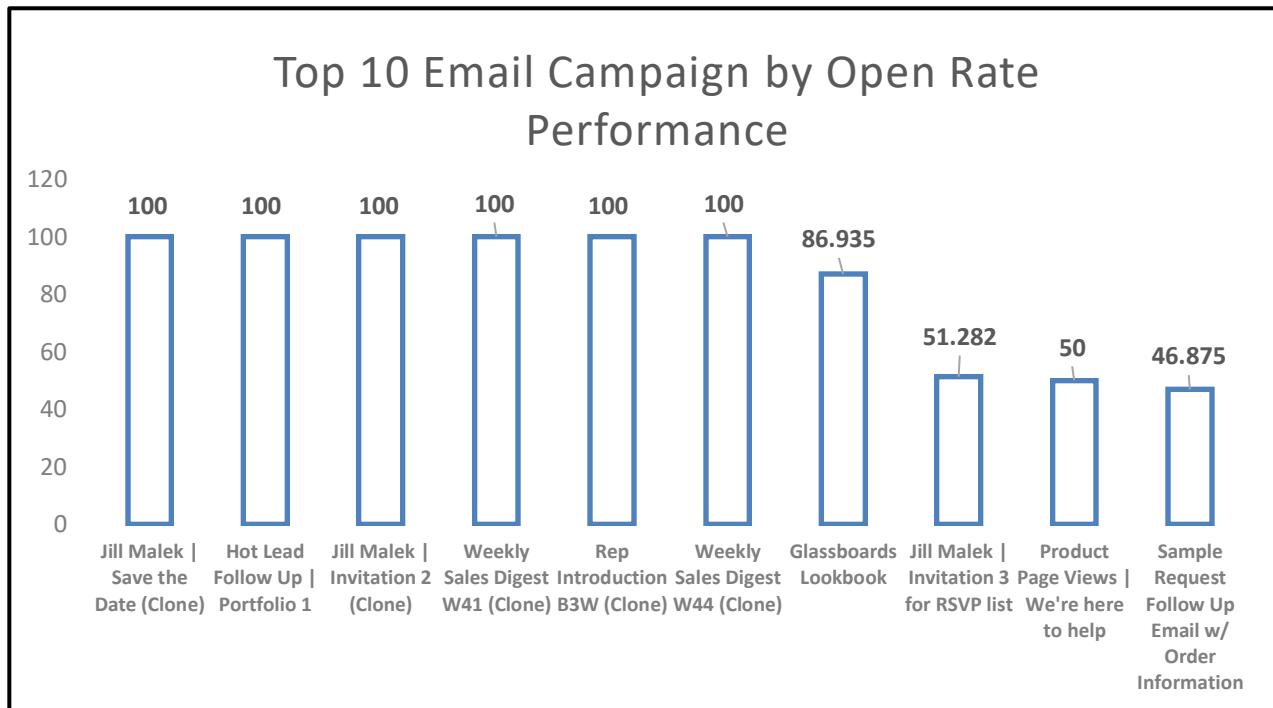
- 4.3.d: Engagement Entity Views over the years

	Sum of Engagement: Views	Column Labels	2021	2022	2023	2024	Grand Total
Row Labels							
click		0	0	0	0	0	0
click_email			0	0	0	0	0
file_download		0	0	0	0	0	0
first_visit		0	0	0	0	0	0
form_contact			0	0	0	0	0
form_design_tool			0			0	
form_find_rep			0	0	0	0	0
form_product_quote			0	0	0	0	0
form_quote			0	0	0	0	0
form_rep_locator			0			0	
form_request_sample			0	0	0	0	0
newsletter_subscribe			0	0	0	0	0
newsletter_subscription		0	0			0	
page_view		156689	250627	355412	49361	812089	
phone_call			0	0	0	0	0
product_configurator_quote		0	0			0	
quote_request		0				0	
rep_locator_contact		0	0	0	0	0	0
scroll		0	0	0	0	0	0
session_start		0	0	0	0	0	0
user_engagement		0	0	0	0	0	0
video_complete			0			0	
video_progress			0			0	
video_start			0			0	
view_search_results		0	0	0	0	0	0
Grand Total		156689	250627	355412	49361	812089	

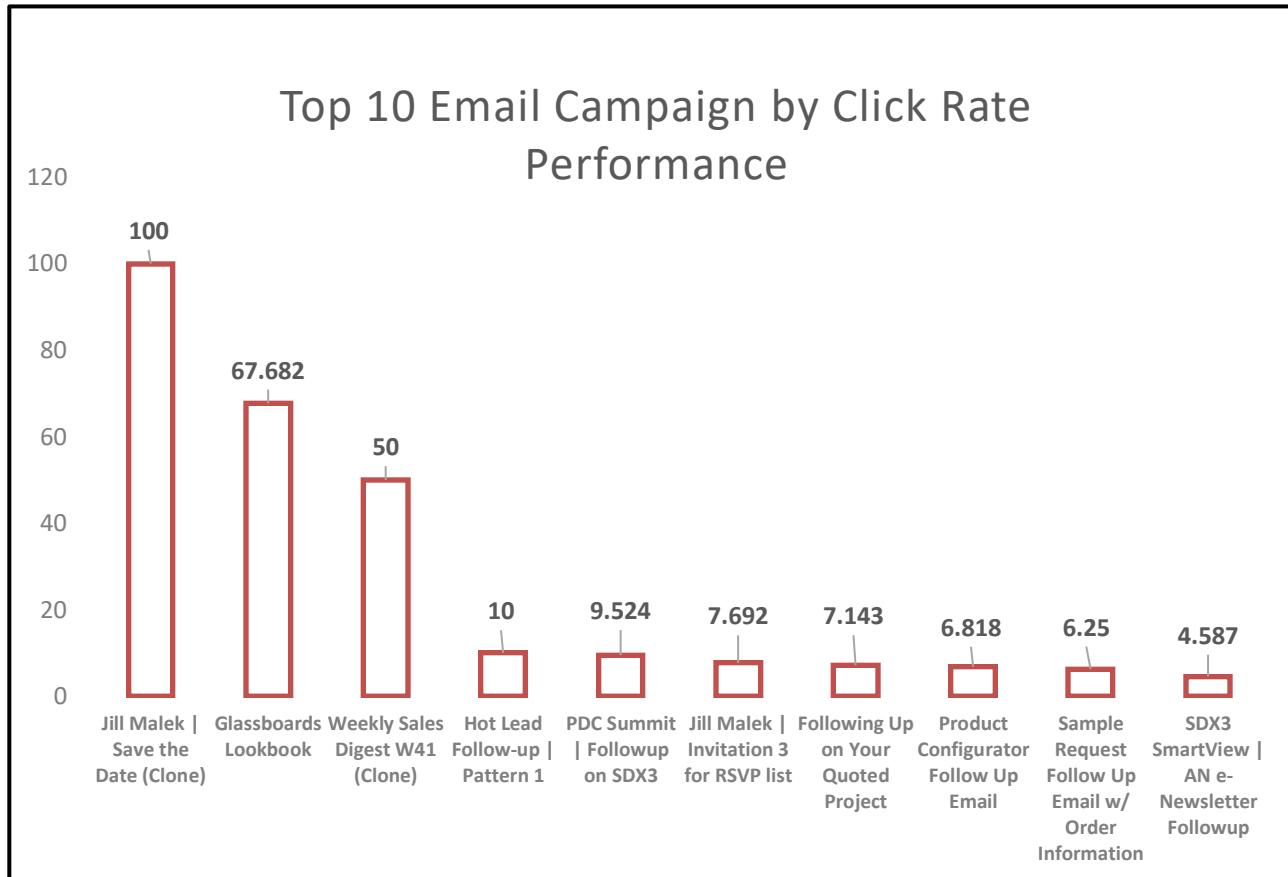
- 4.3.e: Engagement Entity Conversions over the years

	2021	2022	2023	2024	Grand Total
Row Labels					
click	0	0	0	0	0
click_email		0	0	0	0
file_download	0	0	0	0	0
first_visit	0	0	0	0	0
form_contact		40	18	58	
form_design_tool		0		0	
form_find_rep		143	39	182	
form_product_quote		19	5	24	
form_quote		212	50	262	
form_rep_locator		0		0	
form_request_sample		29	8	37	
newsletter_subscribe		0	0	0	
newsletter_subscription	201	55		256	
page_view	0	0	0	0	0
phone_call		1454	367	1821	
product_configurator_quote		60	54	114	
quote_request	347			347	
rep_locator_contact	228	895	47	1170	
scroll	0	0	0	0	0
session_start	0	0	0	0	0
user_engagement	0	0	0	0	0
video_complete		0		0	
video_progress		0		0	
video_start		0		0	
view_search_results	0	0	0	0	0
Grand Total	0	836	2901	534	4271

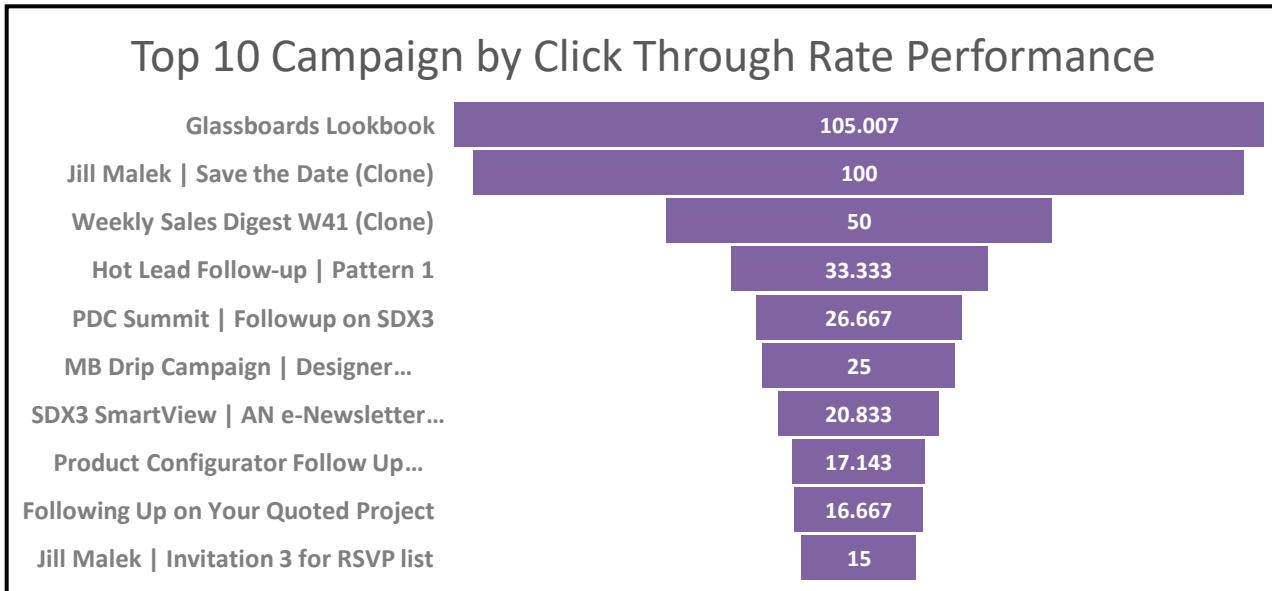
- 4.4.a: Top 10 Email Campaign by Open Rate Performance



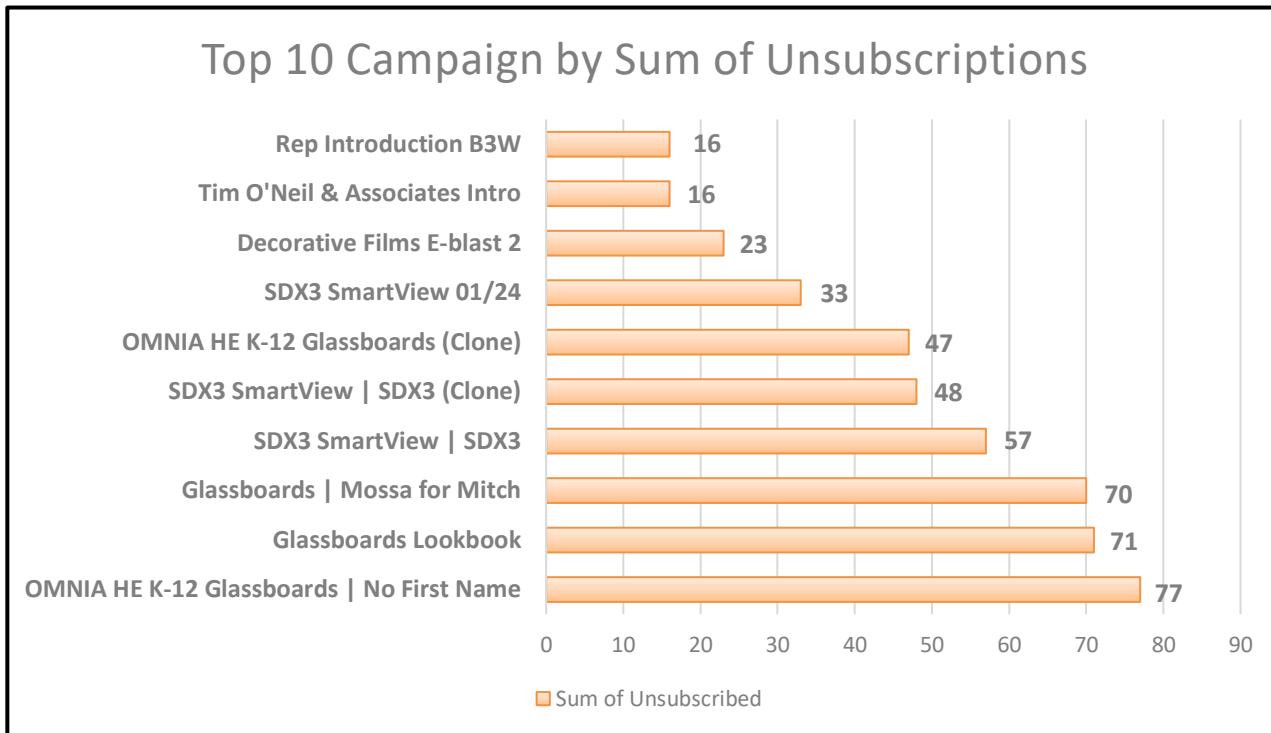
- 4.4.b: Top 10 Email Campaign by Click Rate Performance



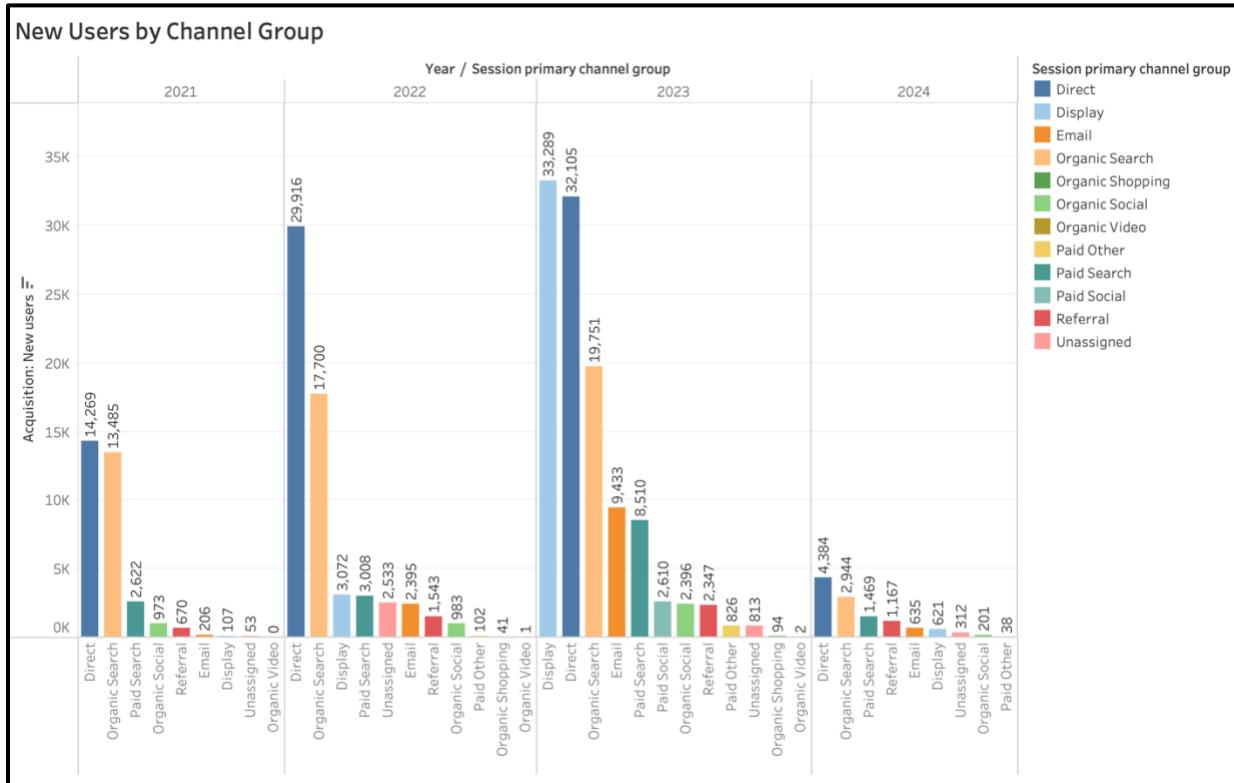
- 4.4.c: Top 10 Email Campaign by Click Through Rate Performance



- 4.4.d: Top 10 Email Campaign by Subscriptions



- 4.5.a: Marketing Primary Channel New Users Count per year



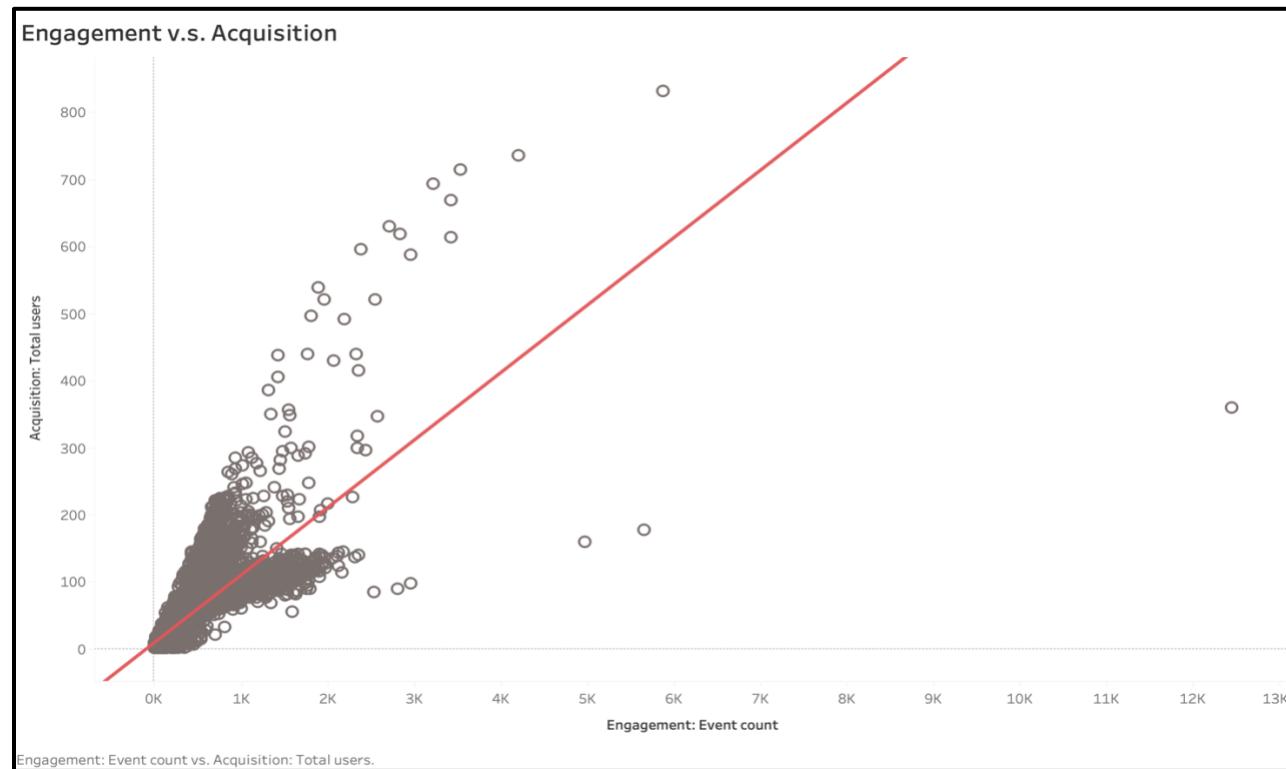
- 4.5.b: Heat Map of Marketing Primary Channel Total Users Count per year

Session primary ch..	Year				Acquisition: Total users	
	2021	2022	2023	2024		
Direct	17,485	33,763	36,229	4,876	1	42,249
Display	108	3,404	42,249	673		
Email	219	2,555	10,140	717		
Organic Search	19,691	26,435	29,723	4,418		
Organic Shopping		41	94			
Organic Social	1,156	1,194	2,820	229		
Organic Video	6	1	8			
Paid Other		103	1,495	131		
Paid Search	2,712	3,569	9,892	1,787		
Paid Social			2,689			
Referral	1,199	2,779	3,483	1,328		
Unassigned	198	3,524	2,651	639		

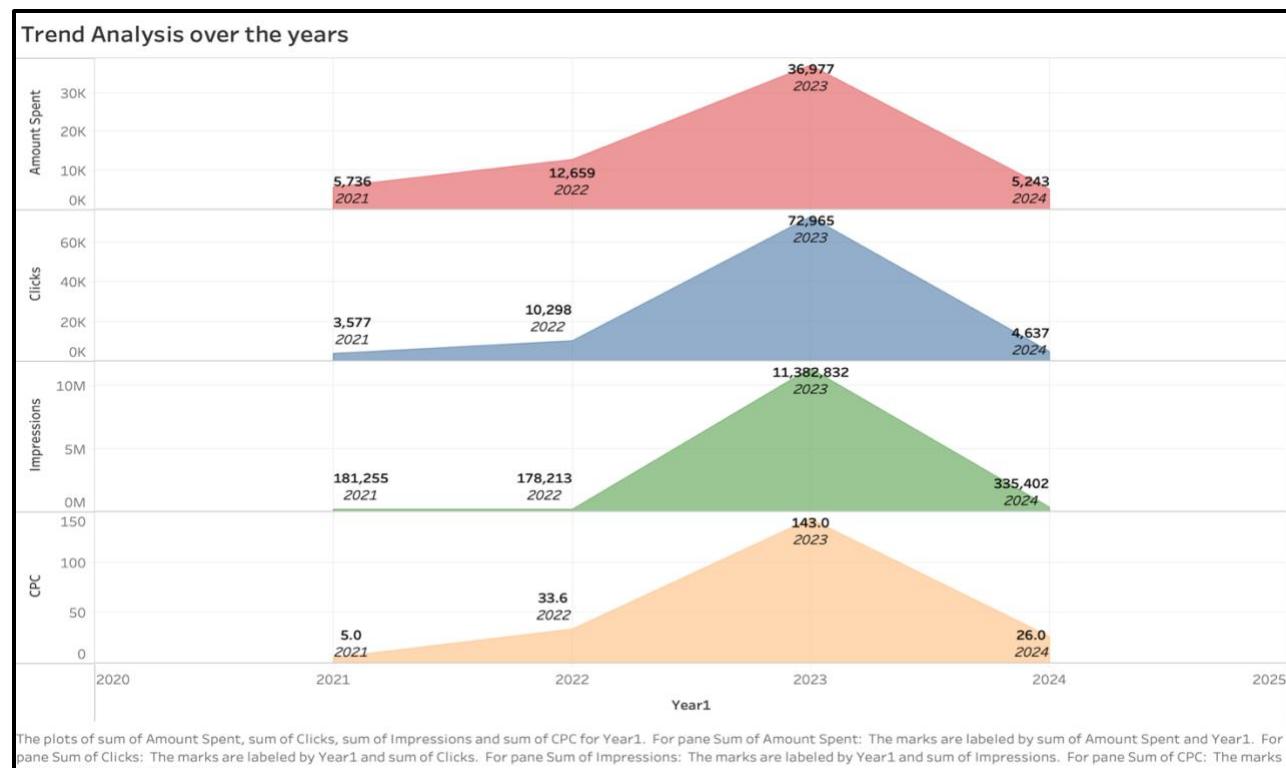
- 4.5.c: Tree Map of Marketing Primary Channel User Conversions Count through the years



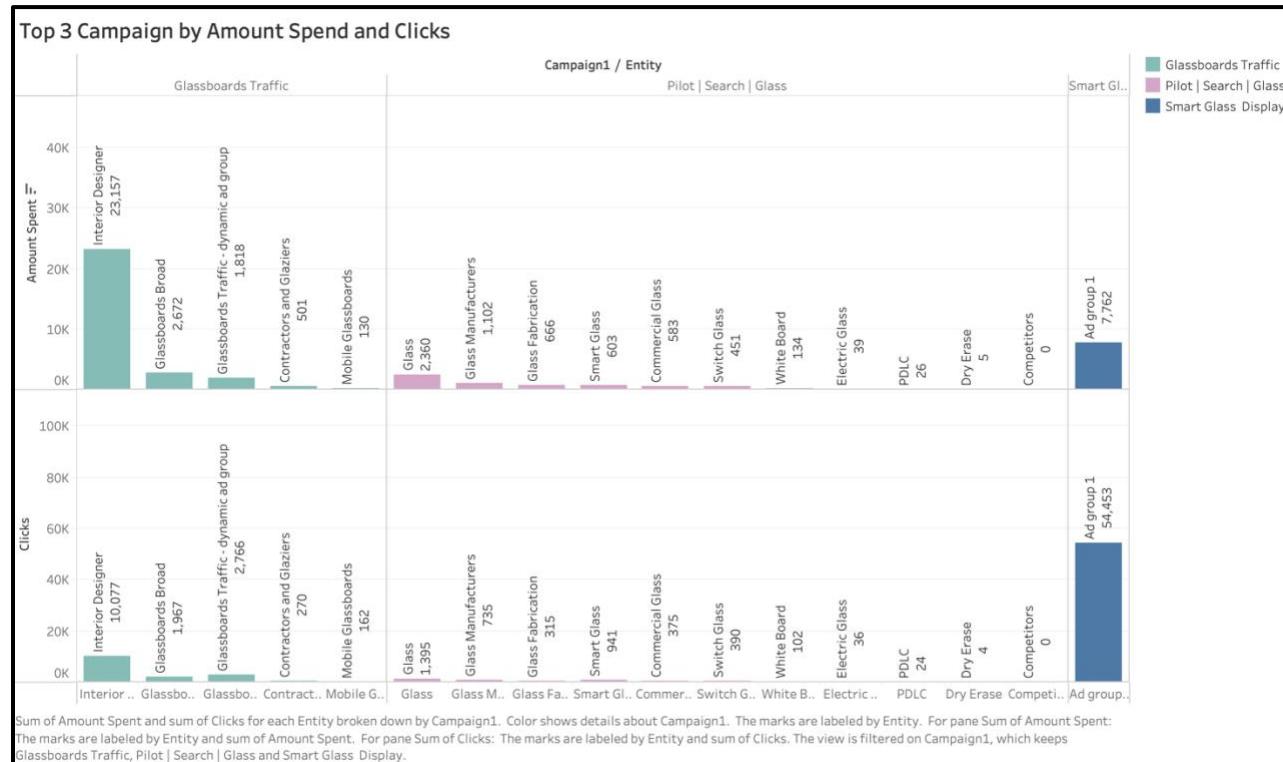
- 4.5.d: Scatter Plot of Total User Acquisition vs. Event Count Engagement of Marketing Primary Channel



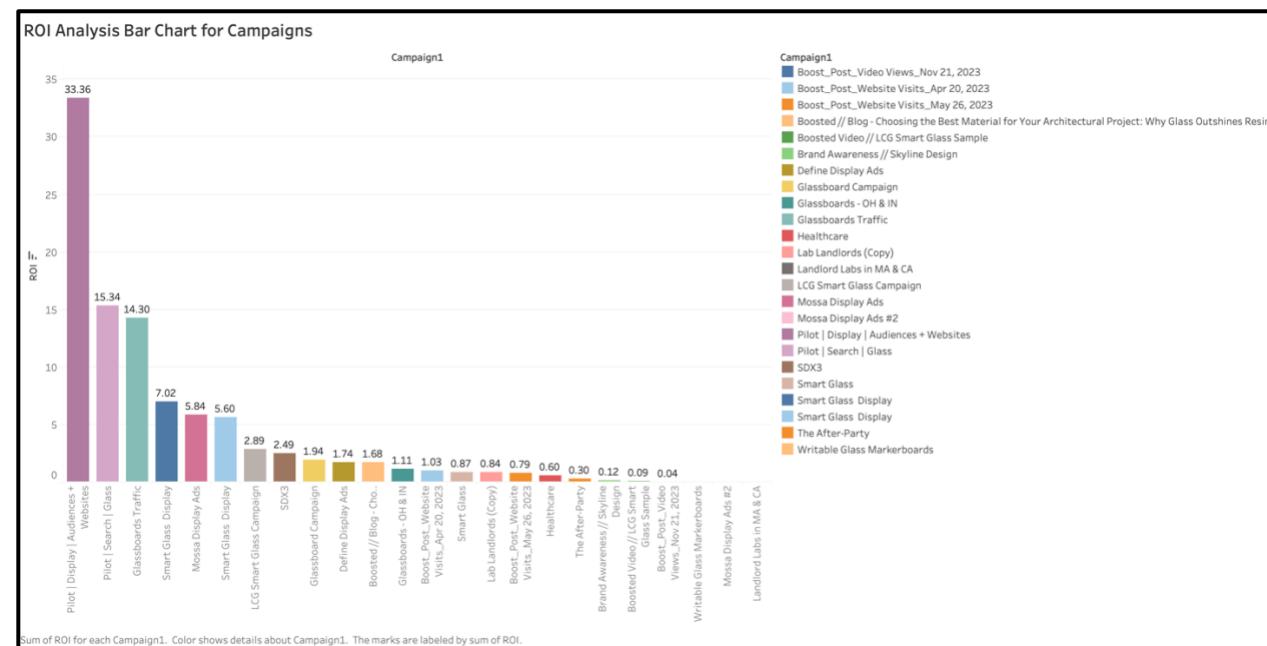
- 4.6.a: Trend Analysis of Ad-campaigns based on Amount Spend, Clicks, Impressions and CPC



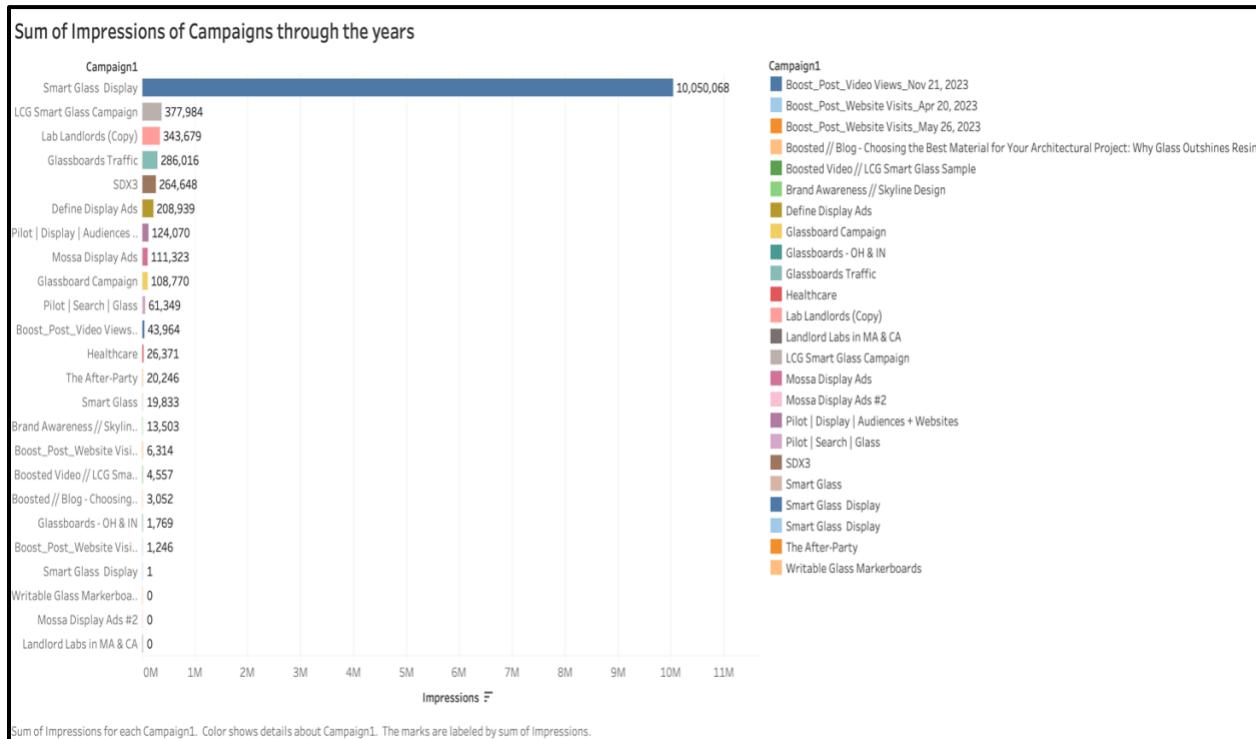
- 4.6.b: Top 3 ad-campaigns by Amount Spend and Clicks



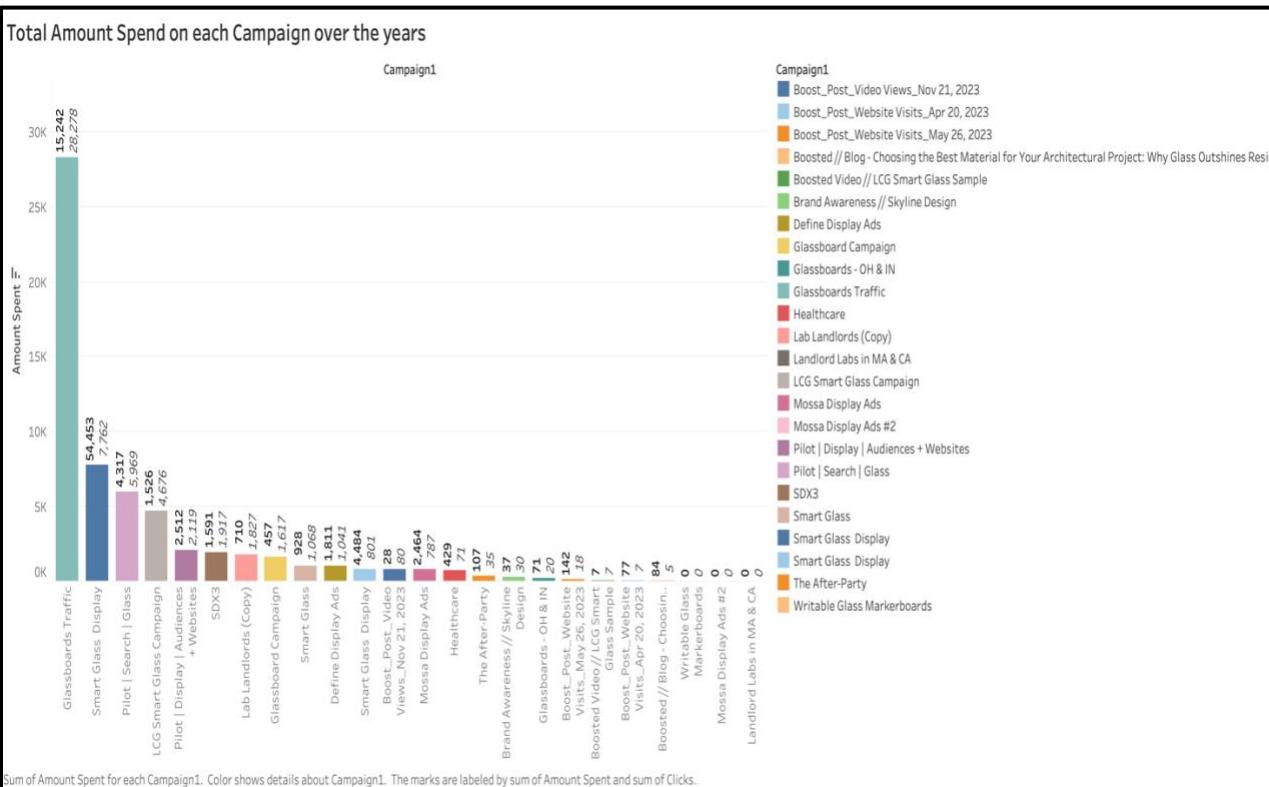
- 4.6.c: Return on Investment on each Campaign



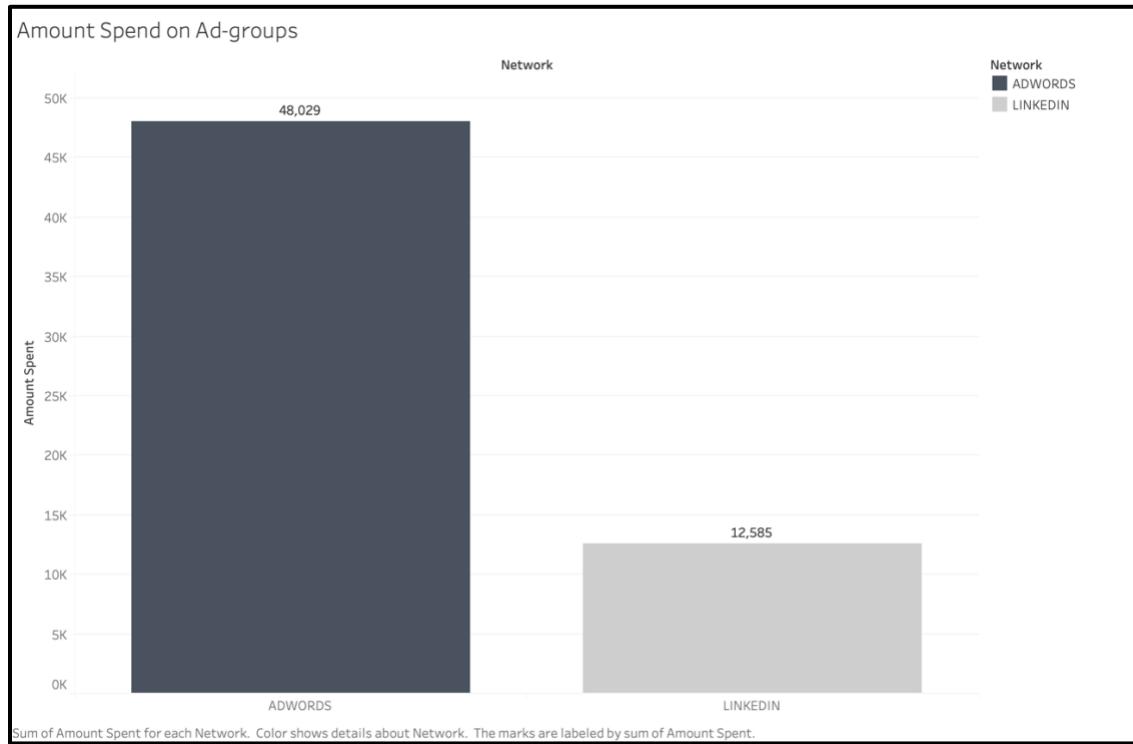
- 4.6.d: Sum of Impressions of Campaigns through the years



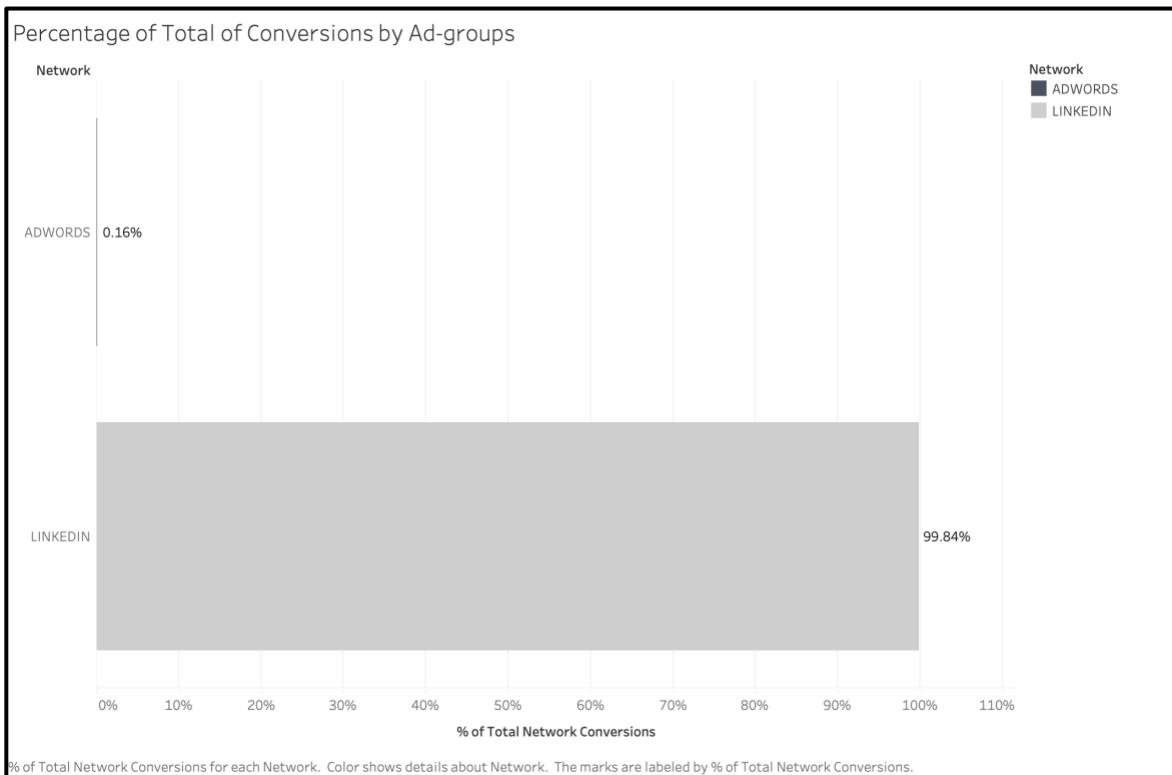
- 4.6.e: Total Amount Spend on each Campaign over the years



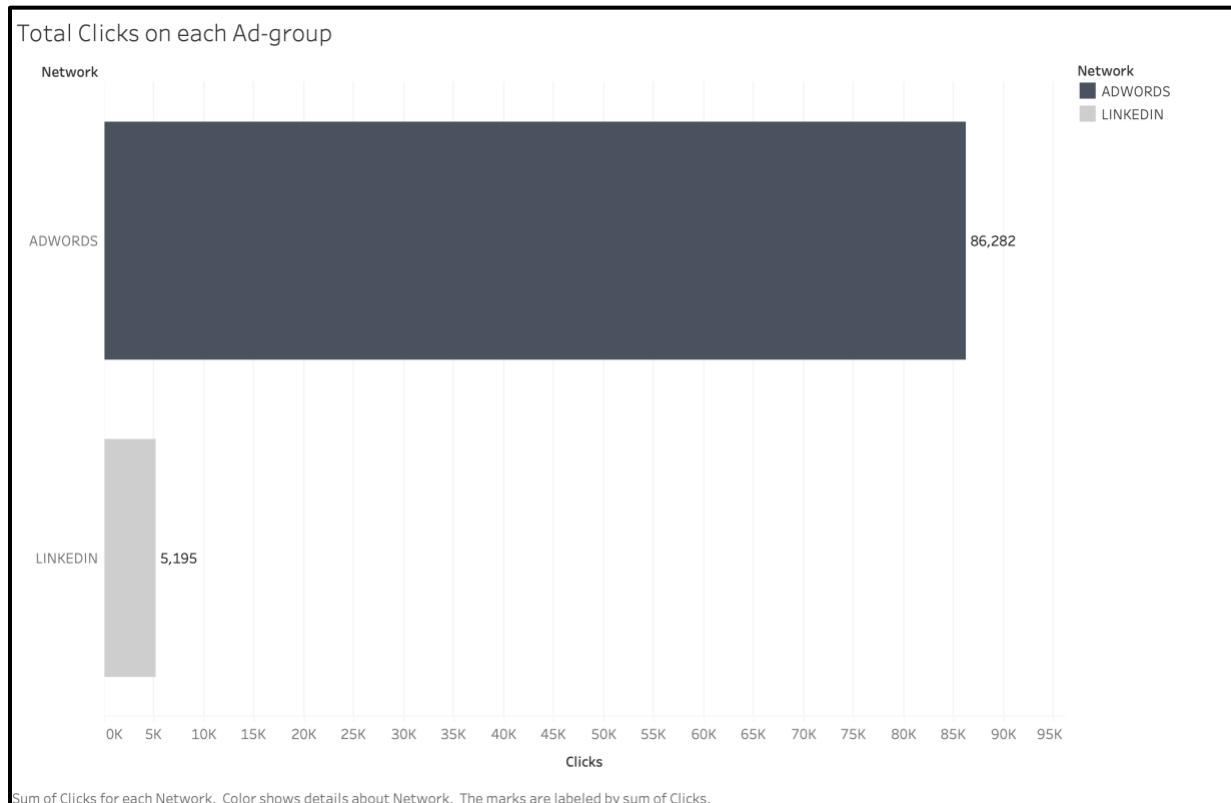
- 4.6.f: Total Amount Spend on Ad-groups through the years



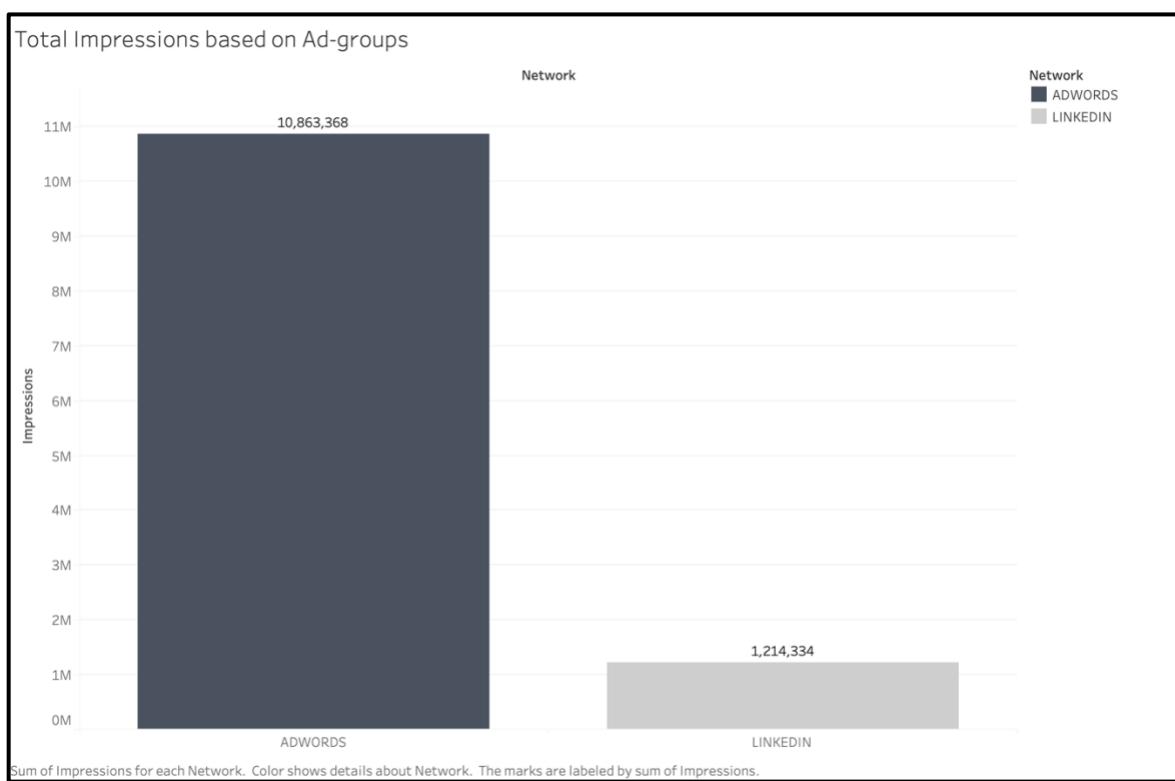
- 4.6.g: Total Conversions on Ad-groups through the years



- 4.6.h: Total Clicks on Ad-groups through the years



- 4.6.i: Total Impressions on Ad-groups through the years



- 4.6.j: Multiple-Linear Regression Model for Amount Spend Optimization and Maximizing Clicks

```

> model1 <- lm(Clicks ~ Amount_Spent + CPC + CTR + Impressions, data = traindata)
> summary(model1)

Call:
lm(formula = Clicks ~ Amount_Spent + CPC + CTR + Impressions,
  data = traindata)

Residuals:
    Min      1Q   Median      3Q     Max 
-1053.76 -5.55  -5.55  -5.55 1307.70 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) 5.548e+00 1.297e+01 0.428   0.669    
Amount_Spent 3.530e-01 1.416e-02 24.920  < 2e-16 ***  
CPC        -2.389e+01 4.586e+00 -5.209 4.96e-07 ***  
CTR         1.492e+01 2.172e+00  6.867 9.27e-11 ***  
Impressions 5.143e-03 1.942e-05 264.819  < 2e-16 ***  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 160.3 on 188 degrees of freedom
Multiple R-squared:  0.9984,    Adjusted R-squared:  0.9983 
F-statistic: 2.883e+04 on 4 and 188 DF,  p-value: < 2.2e-16

> |

```

- 4.6.k: Multicollinearity Check - Variance Inflation Factor

```

> vif(model1)
          Amount_Spent       CPC          CTR   Impressions
 1.525003     1.041374     1.021385     1.473834
> |

```

- 4.6.l: Checking Root Mean Squared Error value for Training and Testing Data based on Regression Model

```

> cat("Training Data RMSE:", train_rmse, "\n")
Training Data RMSE: 158.2439
> cat("Test Data RMSE:", test_rmse, "\n")
Test Data RMSE: 165.288
> |

```

- 4.6.m: Cross-Validation Machine Learning Method to reduce Over-fitting

```

> set.seed(1234) # for reproducibility
> # Define training control
> train_control <- trainControl(
+   method = "cv", # k-fold cross-validation
+   number = 10     # number of folds
+ )
> #train model using cross-validation
> # Train the model
> model_cv <- train(
+   Clicks ~ Amount_Spent + CPC + CTR + Impressions,
+   data = traindata,
+   method = "lm",           # linear regression
+   trControl = train_control
+ )
> # Print the results
> print(model_cv)
Linear Regression

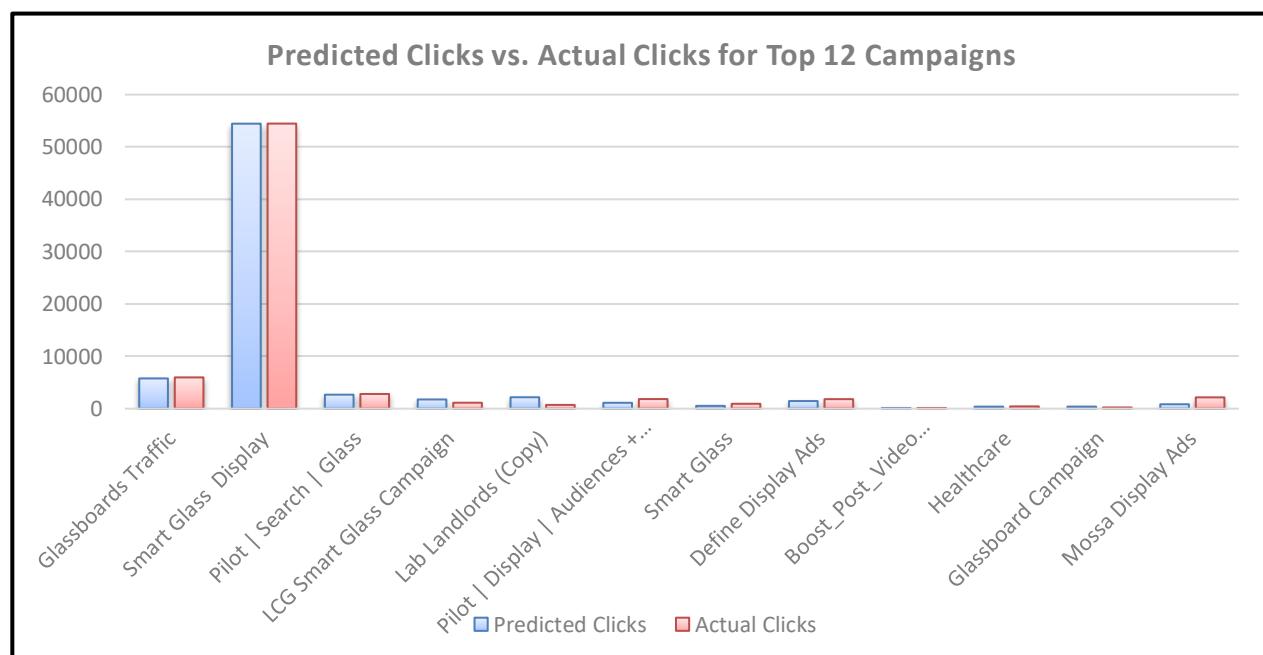
193 samples
 4 predictor

No pre-processing
Resampling: Cross-Validated (10 fold)
Summary of sample sizes: 173, 174, 174, 174, 174, 175, ...
Resampling results:

RMSE      Rsquared    MAE
277.587  0.8130475  94.47012

Tuning parameter 'intercept' was held constant at a value of TRUE
>
  
```

- 4.6.n: Predicted Clicks vs. Actual Clicks for Top 12 Campaigns



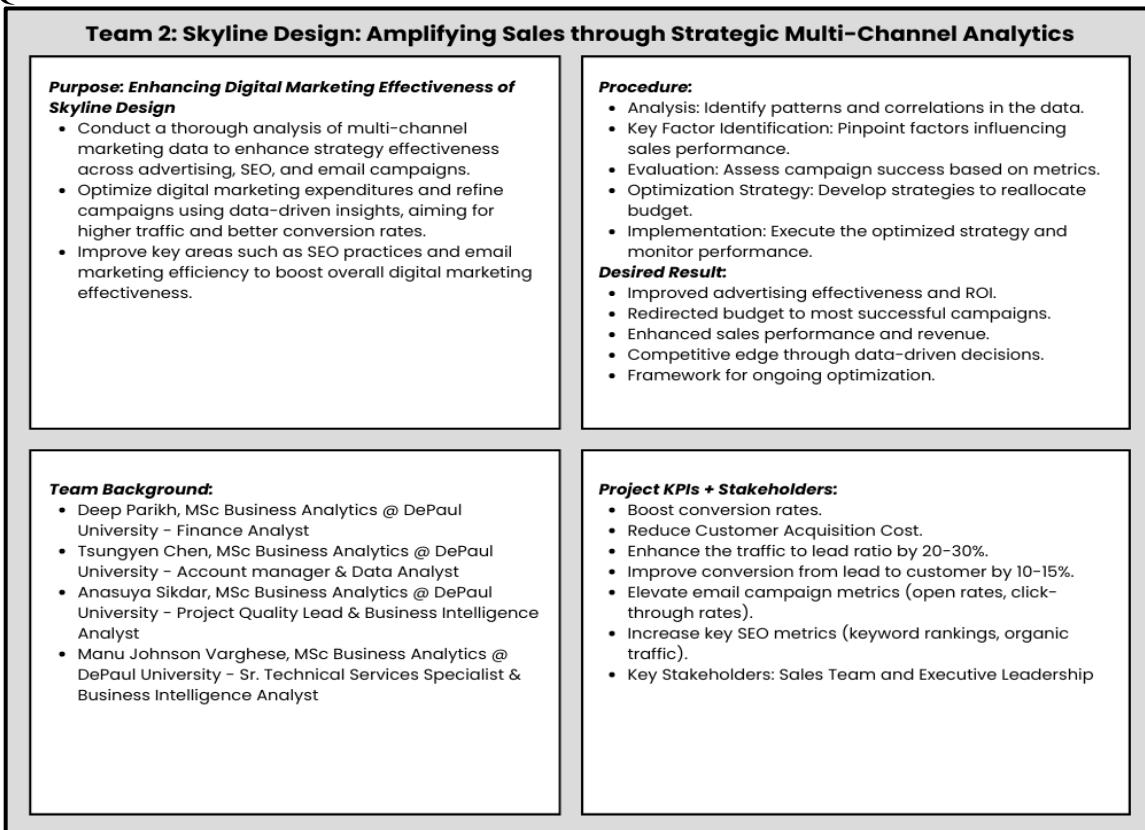
- Amount Spend Optimization Model

Campaign	Amount Spend	Predicted Clicks	Efficiency	New Budget	Minimum Budget	Maximum Budget	Total Predicted Clicks
Glassboards Traffic	12064.39	5769.190097	0.4781999	18096.59	9651.512	18096.585	105177.9793
Smart Glass Display	7761.72	54437.61352	7.01360182	11642.58	6209.376	11642.58	
Pilot Search Glass	4661.14	2665.887193	0.57193888	6059.482	3262.798	6059.482	
LCG Smart Glass Campaign	3082.24	1751.470457	0.568245969	3698.688	2157.568	3698.688	Total Budget
Lab Landlords (Copy)	1827.03	2173.434553	1.189599817	2009.733	913.515	2009.733	52186.285
Pilot Display Audiences + Websites	1400.67	1114.275941	0.795530668	300	100	300	
Smart Glass	1068.49	527.0311078	0.493248517	1175.339	801.3675	1175.339	
Define Display Ads	1040.98	1446.78708	1.389831774	1249.176	520.49	1249.176	
Boost_Post_Video Views_Nov 21, 2023	1280	1.873655437	0.001463793	1500	1280	1500	
Healthcare	712.12	377.1677888	0.529640775	783.332	356.06	783.332	
Glassboard Campaign	668.31	386.2449632	0.577942816	1336.62	668.31	1336.62	
Mossa Display Ads	666.8	834.8854518	1.252077762	733.48	400.08	733.48	
The After-Party	355.7	163.7029852	0.460227678	391.27	177.85	391.27	
Brand Awareness // Skyline Design	330	1.869502977	0.005665161	880	440	880	
Glassboards - OH & IN	188.66	163.2209057	0.865159046	400	200	400	
Boost_Post_Website Visits_May 26, 2023	180	104.83244439	0.582402466	100	50	100	
Boosted Video // LCG Smart Glass Sample	645	2.997223965	0.004646859	1290	645	1290	
Boost_Post_Website Visits_Apr 20, 2023	75	107.3639447	1.431519262	210	105	210	
Boosted // Blog - Choosing the Best Material for Your Architectural Project: Why Glass Outshines Resin	50	65.73841809	1.314768362	130	50	130	
Writable Glass Markerboards	1	5.901	5.901	50	1	50	
Mossa Display Ads #2	1	5.901	5.901	50	1	50	
Landlord Labs in MA & CA	1	5.901	5.901	50	1	50	
SDX3	1	5.901	5.901	50	1	50	
Total	38062.25	71997.13523	43.12971133	52186.29	27992.9265	52186.285	

- Gantt Chart for Project Management



- Quad Chart



- Organization Chart

