Proceedings of the International Conference on Industrial Engineering and Operations Management
Dubai, UAE, March 10-12, 2020

Optimization of Digital Advertising Portfolio using Analytic Hierarchy Process (AHP)- Based Goal Programming (GP) Model

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Abstract

This study utilized the Analytic Hierarchy Process (AHP)-based Goal Programming (GP) in the prioritization of the multiple goals in the digital advertising portfolio. AHP was used to determine the Prioritylevel prior to the formulation of Goal Programming. A questionnaire was formulated and distributed among the 30 respondents to conduct a pairwise comparison among the 7 criteria and 8 alternatives. The set of criteria was determined and agreed collectively by the domain experts as aligned to the strategic objectives of the organization. The GP results showed that the 5 goals were achieved, while the other 3 were not satisfied. Specifically, the p1was attained with a positive deviation of 9,969. The p3 was also satisfied with a positive deviation of 371,817. Furthermore, p6 was attained with a positive deviation of 284,371 while the p5 and p8 were achieved without any deviations. On the other hand, p2 wasn't satisfied as it has a negative deviation of 474,065. Also, p4 and p7 were not achieved as both have negative deviations of 194,160 and 184,398, respectively.

Keywords
analytic hierarchy process (AHP), digital advertisement, goal programming (GP)

1. Introduction

The rise of the internet has seen to be the game-changer in the way the businesses deliver their value proposition. This allowed businesses, specifically the advertisers, to leverage this growing technology from using conventional means. Hence, paving way for the various online activities to flourish, one of them is the digital advertising. The digital advertising industry has grown significantly in recent years as businesses prefer to effectively reach their audience on a wide reach. According to Google Analytics report, there are 3.5 billion searches made by users per day and the volume of searches continuously increased by 10% on an annual basis. This is contributed by the massive shift of the advertisers and marketers to the internet, from the conventional media platform. Truong et al. (2010) postulated that digital advertising is poised to disrupt the rapidly-evolving media industry. According to Freire et al. (2015), the growth of the digital ads is mainly contributed by the display ads and SEO at a combined 67%. Examples of display ads are the Ad Placement, Designing Ads, Animated Ads, Banner Ads, and Static Display Ads.

As the digital advertising space has catapulted its brand into prominence, this is not an outright choice for the businesses to mobilize their advertising campaigns. One major concern for them is the cost they might spend on digital ads. This is because advertising strategy involved significant amount of capital to be invested. This prevented organizations across industries as most of them is plague by the budget constraint. Hence, it raised the question of

cost-efficiency when utilizing these digital advertisements (Cole et al.,2017). Advertisers were typically charged through cost-per-click (CPC) and cost-per-mille (CPM), and as they are dealing with the tight budget requirements, they are on the constant lookout on the ways to effectively reach their prospective customers by finding right mix of budget allocation.

In the BPO-IT-enabled Services (BPO-ITeS) space, it became a dilemma for the companies to widen its presence through digital ads given that they operated on a niche market aside from the apparent strict budget requirements. Hence, a tall order for these companies to work on their limited budget capacity while finding the maximal customer reach based on the given budget requirement. Therefore, this study aims to formulate an AHP-based GP model to find the most satisfactory solution on the multiple goals stated by the decision-makers. This requires the application of GP and the Multiple Criteria Decision Making (MCDM) technique, particularly the AHP, as this study doesn't explicitly identify the goal prioritization.

2. Methodology

The data for this study was collected from an anonymous organization operating within the BPO-ITeS industry. As part of mobilizing the digital advertising campaign, it postulated by the interviewed advertising team to set and should not exceed the budget requirement to $150,000.

2.1. Analytic Hierarchy Process (AHP) Model

As the GP did not explicitly indicate the ranking for goals, the AHP helped this paper in providing the goal hierarchy based on multiple-criteria. As defined by Saaty (1980), it is a decision method that decomposes a multi-criteria decision problem which rank for each of the listed criteria.

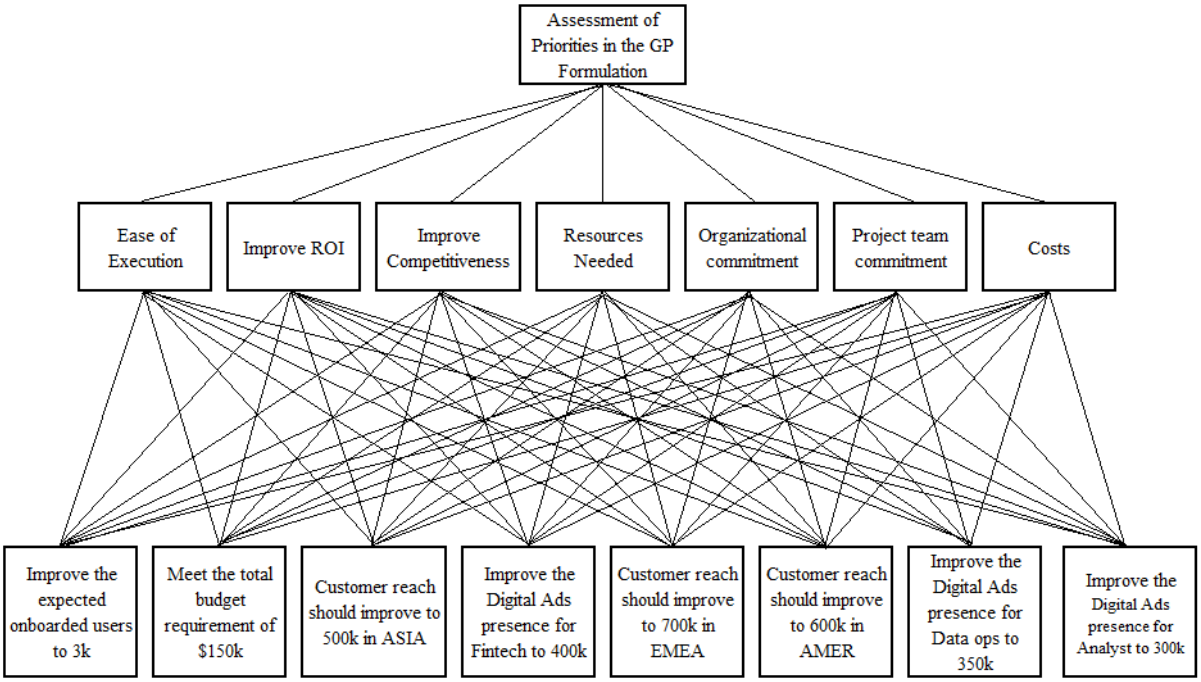

Figure 1. AHP Model

Figure 1 shows the 3 layers of the AHP. The first layer shows the main goal, which is the determination of the GP Priority hierarchy. In this regard, 7 main criteria were established. These criteria are the Ease of Execution, Improve ROI, Improve Competitiveness, Resources Needed, Organizational commitment, Project team commitment, and Costs. These criteria were given by the respondents themselves and the decision for the selection of the criteria was done through the Group decision-making. This helps the researchers in formulating the AHP questionnaire as well as allowing the respondents to draw a uniformed basis in answer the AHP questionnaire. Hence, it will help them to accurately determine the hierarchy of the priorities as seen on the 3rd layer or the alternatives in the AHP model.

In order to conduct pairwise comparison, a questionnaire was formulated and distributed among the 30 respondents. These are all regarded as the domain experts in terms of the marketing and advertising side of the organization. Breaking down the distribution of these respondents, there were 12 subject-matter experts, 2 team managers, 3 seniors, 10 account managers and 3 marketing specialists. The researchers emphasized that each of these respondents has given their individual judgments and were collated in order to be converted into group or collective decision for each of the listed pairwise comparisons through their geometrical average. In this regard, the scale ranges from one to nine where one signifies that the two elements are equally important. On the flip side, the number nine implies that one element is extremely important over the other in a pairwise matrix. Hence, the scale and the value of importance can be described in Table 1.

Table 1. AHP Scale

Importance	Scale Definition of Importance Scale
1	Equally Important
2	Equally to Moderately Important
3	Moderately Important
4	Moderately to Strongly Important
5	Strongly Important
6	Strongly to Very Strongly Important
7	Very Strongly Important
8	Very Strongly to Extremely Important
9	Extremely Important

As part of this, the pairwise comparison matrix will be established through the calculation of Eigenvalue and Eigenvector. The Eigenvalue and Eigenvector formula can be seen below:

Eigenvalue: $$\lambda_{\max} = \sum_{j=1}^{n} a_{ij} \frac{W_j}{W_i} \quad (1)$$

Eigenvector: $(A-\lambda \max I)\, X = 0$ (2)

In addition to the above, as this study will be utilizing the pairwise comparison, it is important to assess the consistency of the comparison matrix, hence, it requires the utilization of consistency ratio (CR) (Saaty,1990). The formula for CR can be seen below:

Consistency Ratio: CR= CI / RI (3)

Table 2. Sample AHP Questionnaire

Indicators	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Indicators
Improve the expected onboarded users to 3k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Meet the total budget requirement of $150k
Improve the expected onboarded users to 3k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer reach should improve to 500k in ASIA
Improve the expected onboarded users to 3k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve the Digital Ads presence for Fintech
Improve the expected onboarded users to 3k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer reach should improve to 700k in EMEA
Improve the expected onboarded users to 3k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer reach should improve to 600k in AMER
Improve the expected onboarded users to 3k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve the Digital Ads presence for Data ops
Improve the expected onboarded users to 3k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Improve the Digital Ads presence for Analyst
Meet the total budget requirement of $150k	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Customer reach should improve to 500k in ASIA

Table 2 shows the sample AHP questionnaire. Take note that these respondents have provided the criteria used in the AHP model as drawn from their experiential and logical-based reasoning. These established criteria were used in answering the AHP questionnaire.

2.2. Goal Programming (GP) Model

As the required decision-making in this context do not proceed from a single perspective or objective, the researchers utilized the GP approach. According to Valunjkar (2010), GP "allows the Decision-makers to specify a target for each objective function". Among the two forms of GP, this study utilized the preemptive GP. Although, this problem does not provide any hints of the hierarchy for the listed goals due to fact that difficulty to obtain an explicit statement of the organization's goals. Hence, the AHP was utilized to establish and set the priorities. Adding objectives of the company in order of importance or priorities, the goal, with no proper order, can be seen below:

Goal 1: Customer reach should improve to 500,000 in Asia Pacific.
Goal 2: Customer reach should improve to 600,000 in Americas.
Goal 3: Customer reach should improve to 700,000 in Europe.
Goal 4: Improve the expected on-boarded users to 3,000.
Goal 5: Improve the Presence for Research/ Market Analyst to 300,000.
Goal 6: Improve the Presence for Data Operations to 350,000.
Goal 7: Improve the Presence for Fintech to 400,000.
Goal 8: Meet the total budget requirement of $150,000.

In this regard, GP model can be formulated below:

$$\text{Minimize} \quad z = \sum_{k=1}^{K} \sum_{i=1}^{m} w_{ki} P_k \left(d_i^- + d_i^+ \right) \tag{4}$$

s.t.

$$\sum_{i=1}^{m} a_{ij} x_j + d_i^- - d_i^+ = b_i \tag{5}$$

$x_j, d_j \geq 0$, for all $_j$ is non-negative.
where:
b_i = the value for the $_i$th goal constraint.
d_j^+ = positive deviational variable
d_j^- = negative deviational variable
$P_k = {}_i^{th}$ preemptive priority

3. Results and Discussion

3.1. Descriptive Statistics

For the preliminary part of the analysis, the researchers looked at various perspectives to analyze the demographic summary of the given data. Given, the limited information about the users, the researchers looked at what is deemed to be one of the interesting parts- the job class of the prospective users, as this can leverage the ad content, hence, it drives the ads effectiveness.

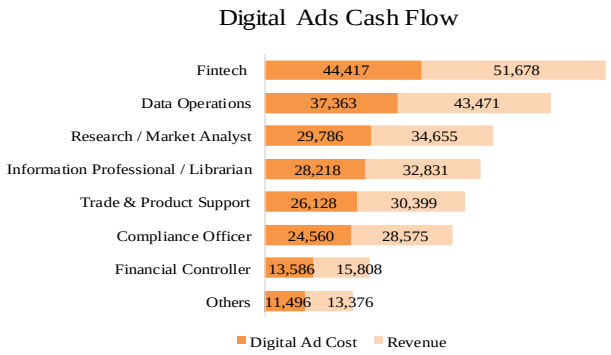

Figure 2. Digital Ads Cash Flow Summary

Figure 2 summarized digital ads cost and revenue in terms of the job class of the prospective customers. As observed, the trend for both cost and revenue are linear. Around 20% of the spending of the total budget is on Fintech class. Although it can also be seen that they are as well the highest revenue generator for the company. Hence, aside from identifying the right mix of budget allocation, the business can leverage these top job classes in order to create a cost-effective advertising approach.

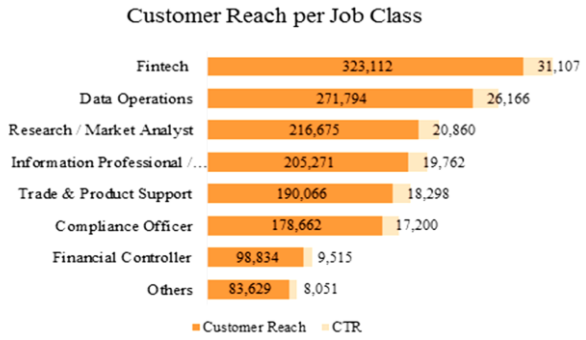

Figure 3. Customer Reach per Job Class Summary

Figure 3 shows the summary of customer reach per job clash. It can be seen the number of customers reached and CTR in terms of the job profile of the prospective customers. Out of the total of 1,568,045 customer reached, 21% are from Fintech class, followed by Data Operations at 17% and Research/Market Analyst at 14%. CTR on the other hand, showed similar percentage distribution. This only shows that Fintech has the highest brand recall and recognition. Hence, the business can anchor their digital advertising strategy, specifically their placement content based on the job class. The CTR can be a good indicator of the efficacy of the digital ad strategy, and based on Figure 2, CTR's trend is linear with the customers reached. This further supports the idea of enhancing the ad content based on the top job class' preferences. Additionally, job class can be targeted as the focus groups for tracking and assessing their user experience (UX) of the product.

Table 3. Summary of Digital Ads Portfolio

Digital Ads	Customer Reach	CT-Users	CTR	CPC	CPM	Total Cost	Onboarded Users
Ad Placement (x1)	285,741	28,003	10%	13,525.45	25,118.69	38,644.14	587
Designing (x2)	32,290	2,500	8%	866.25	1,608.75	2,475.00	250
Animated (x3)	288,081	47,653	17%	25,684.97	47,700.65	73,385.62	429
Banner (x4)	545,262	38,032	7%	15,307.88	28,428.92	43,736.80	618
Static Display (x5)	144,040	15,844	11%	6,876.30	12,770.26	19,646.56	301
SEO (x6)	272,631	18,927	7%	13,182.66	24,482.07	37,664.73	323

It can be seen in Table 3 the breakdown of the digital advertisement portfolio. This includes data such as the number of customer reach per digital ad type, the number of clicks generated out from the customer reach, as well as the number of users on-boarded from the Click-through users. It outlined the efficiency of the listed digital ads in terms of reaching prospective clients as well as how cost-efficient each of these can be.

Table 4. Regional Breakdown of Customer Reach per Digital Ad

Digital Ads	Asia Pacific	Americas	Europe	Total
Ad Placement	80,007	120,011	85,722	285,741
Designing Ads	15,499	10,333	6,458	32,290
Animated Ads	63,378	103,709	120,994	288,081
Banner Ads	234,463	229,010	81,789	545,262
Static Display Ads	25,927	60,497	57,616	144,040
SEO	40,895	68,158.00	163,579	272,631

It can be seen in Table 4 the breakdown of the Customer reach in the regional perspective. In this regard, there are 3 main regional classifications**:** Asia Pacific, Americas, and Europe. This added a new dimension on the examination of the given optimization problem. Banner Ads has the highest customer reach across all the region. This can help the business in their decision to put more weight on Banner Ads in terms of the budget allocation. On the other perspective, across all the digital ad types, Americas region has the highest number of customer touchpoints. Hence, it will help the business in formulation content based on regional flavor. As postulated by Huang (2018), personalized ads helped in gaining the attention of the prospective customers.

3.2. AHP Results

For the results of the AHP, this study used the BPMSG AHP Priority Calculator to compute for the pairwise comparison of the given criteria. The weights from the below results were computed from the principal eigenvector with a value of 3.002. Furthermore, the Consistency Ratio has an acceptable threshold of 4.6% for the pairwise comparisons. Since its value is less than 10%, the AHP results is considered to be consistent.

For the AHP calculations regarding the prioritization of projects, the development of the decision model has been chosen. In this regard, the preliminary step was done previously by determining the criteria for the AHP model. As already mentioned, the set of criteria was determined and agreed collectively by the domain experts as aligned to the strategic objectives of the organization. The following set of 7 criteria has been grouped into 8 categories or alternatives as shown in the Table 5 below. As the hierarchy was established, the criteria were evaluated in pairwise in order to determine the relative importance between them and their relative weight in response to the main goal underpinned.

Table 5. AHP-based GP Priorities

Category	Alternatives	Priority	Priority Rank
A	Meet the total budget requirement of $150k	29.55%	**1**
B	Improve the expected onboarded users to 3k	26.83%	**2**
C	Customer reach should improve to 500k in ASIA	14.98%	**3**
F	Customer reach should improve to 600k in AMER	8.72%	**4**
D	Improve the Digital Ads presence for Fintech to 400k	7.91%	**5**
E	Customer reach should improve to 700k in EMEA	7.07%	**6**
G	Improve the Digital Ads presence for Data ops to 350k	2.51%	**7**
H	Improve the Digital Ads presence for Analyst to 300k	2.42%	**8**

After formulating the tree as well as determining the Priority criteria, the prioritization has been made and therefore studied via pairwise comparison. Going into the essential part of the results, Table 5 shows the resulting weights for the listed criteria. In the identification of the ranking of the priorities as computed using the AHP, it can be posited that the goal to meet the total budget requirement of $150k is the top priority.

This was followed by reaching the users/customers across all the services offered by the company. On the other hand, Improve the Digital Ads presence for Analyst was the least priority. Hence, the business aims to focus more on the Ad Performance as indicated by how effective the ad can be in terms of generating views. This only suggested that in the perspective of the company, the selection of digital ads strategy is based primarily on its performance to generate impressions and views, followed by how much they are willing to spend for the ad. As the ranking of the priorities were computed and identified using the AHP, this has been used in the subsequent GP formulation.

The AHP process in this study was used to prioritize the goals. In this regard, the AHP model was successfully captured both the subjective and objective evaluation measures, providing a critical and reliable mechanism in determining the inherent consistency of the evaluation criteria and alternatives as asserted by the respondents in this study. Table 6 illustrated the assessment of the information regarding the preferences for these 8 goals. Hence, these 8 goals were compared using pairwise comparisons and was shown on its normalized form.

Table 6. Normalized AHP Pairwise Comparison Matrix

Category	A	B	C	D	E	F	G	H
A	0.2857	0.5693	0.2378	0.2581	0.3151	0.1833	0.2647	0.2500
B	0.2857	0.1898	0.4756	0.3226	0.2520	0.3054	0.1765	0.1389
C	0.1429	0.0474	0.1189	0.1935	0.2520	0.2443	0.0882	0.1111
D	0.0714	0.0380	0.0392	0.0645	0.0630	0.0611	0.1176	0.1111
E	0.0571	0.0474	0.0297	0.0645	0.0630	0.1222	0.1471	0.1667
F	0.0943	0.0380	0.0297	0.0645	0.0315	0.0611	0.1471	0.1667
G	0.0314	0.0323	0.0392	0.0161	0.0126	0.0122	0.0294	0.0278
H	0.0314	0.0380	0.0297	0.0161	0.0107	0.0104	0.0294	0.0278

The resulting weights are based on the principal eigenvector of the above decision matrix. The weights were computed from the principal eigenvector with a value of 3.002 for the 28 pairwise comparisons.

AHP-based GP Results

The result of AHP was used to determine the Priority of the goals in the GP as seen in the derivation below.

Objective Function:

Min Z = $P_1 (d_1^- + d_1^+) + P_2 (d_2^- + d_2^+) + P_3 (d_3^- + d_3^+) + P_4 (d_4^- + d_4^+) + P_5 (d_5^- + d_5^+) + P_6 (d_6^- + d_6^+) + P_7 (d_7^- + d_7^+) + P_8 (d_8^- + d_8^+)$

[Priority 1] $1.48x1 + 0.39x2 + 1.01x3 + 1.91x4 + 1.26x5 + 2.61x6 + d1^- - d1^+ = 150{,}000$
[Priority 2] $0.02x1 + 0.01x2 + 0.006x3 + 0.014x4 + 0.015x5 + .009\ x6 + d2^- - d2^+ = 3{,}000$
[Priority 3] $2.07\ x1 + 0.63x2 + 0.86\ x3 + 5.36x4 + 1.32x5 + 1.09x6 + d3^- - d3^+ = 500{,}000$
[Priority 4] $3.11x1 + 0.42x2 + 1.41x3 + 5.24x4 + 3.08x5 + 1.81x6 + d4^- - d4^+ = 600{,}000$
[Priority 5] $0.13x1 + 0.17x2 + 0.19x3 + 0.14x4 + 0.19x5 + 0.18x6 + d5^- - d5^+ = 400{,}000$
[Priority 6] $2.22x1 + 0.26x2 + 1.65x3 + 1.87x4 + 2.93x5 + 4.34x6 + d6^- - d6^+ = 700{,}000$
[Priority 7] $0.07x1 + 0.13x2 + 0.14x3 + 0.18x4 + 0.19x5 + 0.29x6 + d7^- - d7^+ = 350{,}000$
[Priority 8] $0.06x1 + 0.28x2 + 0.18x3 + 0.14x4 + 0.10x5 + 0.24x6 + d8^- - d8^+ = 300{,}000$

Table 7. AHP-based GP Priority levels

Goals	AHP-based GP Priority Weights	Rank	Results	Deviational Variable (d-)	Deviational Variable (d+)
Meet the total budget requirement of $150k	0.2955	**1**	Not Achieved	-	77,235
Improve the expected onboarded users to 3k	0.2683	**2**	Not Achieved	976	-
Customer reach should improve to 500k in ASIA	0.1498	**3**	Achieved	-	-
Customer reach should improve to 600k in AMER	0.0872	**4**	Achieved	-	-
Improve the Digital Ads presence for Fintech to 400k	0.0791	**5**	Not Achieved	377,277	-
Customer reach should improve to 700k in EMEA	0.0707	**6**	Not Achieved	372,118	-
Improve the Digital Ads presence for Data ops to 350k	0.0251	**7**	Not Achieved	324,158	-
Improve the Digital Ads presence for Analyst to 300k	0.0242	**8**	Not Achieved	282,869	-

The GP model contains 6 variables and 8 constraints which was solved using the MS Excel Solver. Table 7 shows the GP results and it can be postulated that only 2 goals were achieved, while the other 6 were not satisfied. P3 and P4 were attained with no deviations observed, suggesting that it achieved the goal of attaining 500k and 600k users, respectively. Although it can be seen that the top priority, which is the achievement of the budget requirement of $150k, wasn't satisfied with a deviation of +$77,235. This only proved that in the context of BPO-ITeS, mobilizing marketing and advertising activities with the abovementioned budget is not feasible and might seriously impact the effectivity of the digital advertising campaigns.

Given the AHP-based GP results, it can be postulated that in the Digital ads campaign in the context of BPO-ITeS, various goals cannot be attained all at once. There were two suggestions that can be given in this study. First, the advertising and marketing team should realistically align their customer reach target, and lastly, they should recalibrate their budget requirement. In this study, there were two paths that the decision makers ought to undertake, as both cannot be fulfilled at once, hence, they need to choose what they should emphasize; increasing the budget constraints or can be the lowering of the target number of audiences, in order to meet multiple objectives that were established by the organization.

This becomes a tall order for the advertisers in this specific context, to thoroughly consider what ought to be prioritized and what adjustments should be done if one of the pivotal goals wasn't attained. In this scenario, while the top Priority was far exceeded, the next Priority wasn't satisfied which could put the company into a tight and challenging situation, to balance the ad presence as well as recalibrating their existing budget requirements in order to solve and maximize the company's desire to leverage the digital advertising campaign.

The GP showed a more granular view of the actual use-cases and budget dilemma that the BPO-ITeS encounters. In this regard, the multiple goals identified should be met at a satisfactory level based on the same budget requirement of $150,000. While the main goal of attaining 3,000 CTRs, it is noteworthy to look at the regional distribution of the customer reach that the GP model attained. Same principles applied to the job class perspective, where the GP model showed both achieved and underachieved results. Hence, the AHP-based GP only showed a more comprehensive and more granular approach and the results served as an eye-opener to the decision-makers to revamp and create feasible and realistic targets.

4. Conclusion

As this study utilized the AHP, it was deemed to draw the interest of various researchers, primarily due to its promising method of determining the mathematical bounds of decision-making as well the fact that its intuitive and quite simple to formulate (Triantaphyllou & Mann, 1995). Thus, its inherent simplicity, according to Vargas (1990), was postulated through the pairwise comparison as anchored to its pre-determined criteria. Furthermore, its application to drive the advertising campaigns by efficiently managing the limited budget while the customer reach was being maximized allows the decision makers to have a highly reliable decision support tool (Aliyev, 2017). This allows the decision makers to reinforce their choices through mathematical model, hence creating a more

impactful and more granular decision support tool (Caine & Parker, 1996). As postulated by Coyle (2004), another key importance of the AHP is its inherent means of evaluations that can be the decision makers, given that a decision should be consistent with organizational strategy.

As this study utilized the AHP-based GP model, it allowed every organization in the BPO-ITeS to apply in their actual use-cases. Aliyev (2017) used the similar approach in the formulation of the GP model in the allocations of marketing campaign. This only suggested that the GP approach, as an extension of Linear Programming (LP), will help the decision makers to quantify their digital ads' effectiveness by considering the multi-dimensional viewpoints. Hence, this study exemplified a more granular approach to deal with the specific dilemma in the digital advertising campaign. Hence, the AHP-based GP showed a more comprehensive and more granular approach. Kwak et al. (2005) also applied the similar AHP approach or Multiple-Criteria Decision Analysis (MCDM) in the for the media selection. Given the results from these past studies, it was postulated that AHP-based GP model are indeed the most logical approach in dealing the with the digital advertising allocation problem.

Lastly, the primary purpose of this study is to formulate and analyze AHP-based GP model specifically for the cases where the Priority levels or goal hierarchy is unknown or not explicitly stated. Hence, AHP creates a compelling basis on determining the hierarchy for the GP goals which deemed to be crucial in the resolution of the digital ads problem. This study highly emphasizes the need for the advertisers to adopt quantitative approaches, specifically the models that were utilized in this paper, in order to create a cost-efficient and more effective digital ad strategy. As according to Mihiotis and Tsakiris (2004), the AHP-based GP could be extended to a wide range of use-cases, encompassing all the available advertising platforms both within and beyond the digital ads space.

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Biographies

Rex Aurelius C. Robielos is the Dean of the School of Industrial Engineering and Engineering Management at Mapua University. Before joining Mapua, he was Section Manager of Operations Research Group, Analog Devices General Trias. He has a BS in Applied Mathematics from the University of the Philippines Los Baños, and a Diploma and MS in Industrial Engineering from the University of the Philippines Diliman. He is pursuing Ph.D in Industrial Management (candidate) at National Taiwan University of Science and Technology in Taiwan. He is the current Secretary of Human Factors and Ergonomics Society of the Philippines and Director of the Philippine Institute of Industrial Engineers and Operations Research Society of the Philippines.

Neil T. Awit is a graduate of Master of Business Administration at Colegio de San Juan de Letran and candidate of Master in Business Analytics at Mapua University. He is currently working as a Business Analyst at Thomson Reuters (Now Refinitiv) for 7 years and 9 months. Key projects and processes have been initiated and deployed within the company such as the application of Machine Learning algorithm to analyze and predict customer churn, end-to-end reports automation using Python Programming, and development of a chatbot to leverage and mobilize the marketing activities of the company.