Digital Marketing knowledge transfer to a rule-based reasoning system for massive optimization of campaigns

Fernando Perales[1] Ignacio Martínez[1], Javier Bielsa[1], Jose Cabanillas[1] and Francisco Rodríguez[1]

[1] JOT INTERNET Media, Madrid, SPAIN
{firstname.lastname}@jot-im.com

Abstract. Digital Marketing is a domain where the reaching impact and market engagement drive the financial investments. Today, ad platforms allow the monitoring of the digital campaigns by means of a large set of variables which makes almost impossible to human account managers to process and exploit properly. Also account managers are generated background and unique experiences to optimize the campaign configuration to create the maximum impact with limited budget. In this paper, we detail the development of a rule-based system integrating the human knowledge concerning campaign optimization and, at the same time, enabling higher amount of data and variables that generate executable actions in the ad platforms. The rule-based system developed integrates all data value chain: data collection to a data base managed by SQLServer, data set processing and insights generation. The application user interface, coded in Flask, provides the account manager the freedom to define the rule in terms of indicator, analytics, periodicity, and executable action. In the discussion, the results of the rule-based system integration show that it has enabled a new massive and automated optimization methodology.

Keywords: Digital Marketing, Optimization rules, rules evaluation.

1 Introduction

Digital Marketing is an industry moving from a completely creative approach to a fully data driven methodology thanks to the complete set of performance indicators provided by the ad platforms like Google Ads (https://ads.google.com/), Bing Ads (https://ads.microsoft.com/) and Facebook (https://es-es.facebook.com/business/ads). The access to such amount of information and the possibility of impacting any user worldwide enables the development of new analytical services automating the optimization process.

In this paper we report on a pilot implementation that enables the marketing knowledge transfer from high skilled account managers into a rule-based system for massive digital marketing campaign optimization. The pilot has been fully developed

by JOT Internet Media[1] – a Spanish SME operating in the digital marketing domain. The main mission of the company is to reach the right audience (web traffic) at the right time by investing in sponsored ads (Search Engine Marketing, SEM) in the most popular search platforms, such as Google and Bing. How to engage the users by this strategy has been widely studied in the last years [1] [2]. Currently the company is implementing campaigns and investing in more than 75 countries and 17 different languages. This unique approach allows the accounts to gather large amount of data describing the campaign performance [3] [4], but at the same time, makes it almost impossible to keep a manual data processing and campaign optimization [4],[5] . At the same time, this human intensive activity has generated a very deep knowledge concerning how to optimize the campaigns to reach high impact values in terms of clicks, impressions, revenues and return of investment.

Main goal of this rule system is to replicate the process interiorized by the account managers to optimize the campaigns while adjusting to the specific data model and structure of the digital marketing campaigns. To this aim, a complete end-to-end system has been developed to exploit the existing APIs and databases, mainly in the cloud [5] and integrating the application within the JOT internal suite of tools to execute the actions generated when the conditions are fulfilled. [6]

In the rest of the paper the technological developments and main results are presented. Section 2 describes the business case and the approach implemented to integrate the rule system at productive level. Section 3 presents the main technological challenges solved to implement all the rule generation. Section 4 explains the rule generation system as well as their evaluation and data access. In Section 5 main results are presented in terms the implementation of the final application and interface. Section 6 summarizes the main impacts of JOT's business model related to digital marketing campaigns optimization. Finally, Section 7 highlights the conclusions and outlines the roadmap for future work.

2   Business case: Case and value proposition

JOT's business case was motivated by the account managers who noticed there was a set of rules and methodologies that are repeated when certain conditions are fulfilled. Today, account managers must analyze the collected data using large Excel sheets containing just a small number of KPIs that are selected based on the background of the specialist and expertise. The assumption was that it is possible to identify core indicators together with trends and patterns that motivates the generation of pre-defined actions over the digital marketing campaigns configurations and optimize their impacts, mainly based on clicks and impressions.

The workflow describing the generation of the rule-based system enabling the digitalization and automation of the human knowledge is shown in *Fig. 1* and explained as follows.

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[1] https://www.jot-im.com

Performance data and digital marketing campaign optimization background. These represent the input for the rule definition. The performance data is formed by all the indicators provided by the ad platforms describing the impact of the campaigns. These indicators are gathered per account, campaign, code and keywords. In addition, account managers provide procedures, actions and optimization strategies in order to improve business related indicators, like cost, revenue, profit, clicks and impressions.

Rules Definition and Generation. With the aim of transferring the human knowledge into the system, a dedicated application was developed where account managers can define the rule. The rules specification must contain the variable to be analyzed, the analytics to process the information, the action to be implemented and the periodicity of the rule.

Rule Selection and Actions Activation. Every time a rule is active, the system will launch it over the specified marketing structure to check if the related optimization action, also included in the rule definition, has to be generated and executed via API in the required ad platform.

Data Output. The day after the actions are implemented and the campaigns configuration is updated, the account manager collects the new performance indicator to check the effectiveness of the action and activate the corresponding rule based on the new conditions.
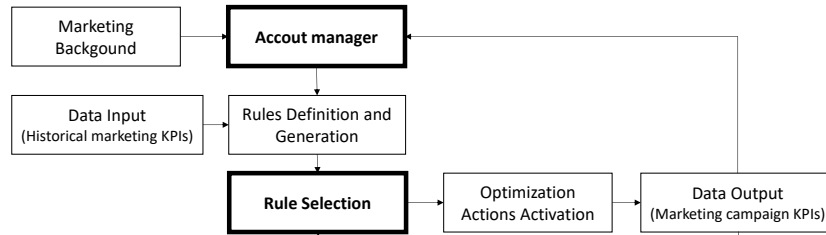

Fig. 1 Marketing data flow and the integration of human knowledge to implement the rule-based optimization process

With this approach, it was possible to integrate the human knowledge with data to generate an end-to-end rule system supporting the data analysis and action generation over large marketing structure, reducing optimization time and human errors due to lack of experience.

3   Technological challenges: why the business case is difficult to be solved by using traditional technologies

Traditionally digital marketing has been focused on the management of small number of campaigns for a specific client, dedicating 1-2 persons to daily optimize the campaigns configuration directly in the ad marketing platforms based on the reported performance indicators. However, this approach is not scalable in global marketing campaigns with more than 40 different landing pages with general content, which results in more than 3,000 different campaigns. This situation has motivated

the JOT develops a new data driven approach to automate the optimization of marketing campaigns at large scale without reducing the effectiveness of the strategy supported by the account manager team skills.

The implementation of a data-driven approach applied to digital marketing followed by the generation of a rule based system automating the decision making is associated to the development of technical solutions dealing with the whole data value chain: (i) Acquisition and access to data sources, (ii) Definition of rule periodicity and (iii) integration of human knowledge

3.1   Databases and data models

As explained in the introduction, JOT Internet can implement this methodology thanks to the disposal and access of a huge database containing the main performance indicators of world-wide all-categories marketing campaigns. Currently, data are stored in the Cloud to ensure the architecture flexibility and storage scalability. The access to the required data used by the rule system is managed by SQL Server. In this case, the database is divided in two different schemas named: dimensions and automations.

I.   The Dimensions database contains all the values that can be assigned to each variable.

II. Automations contains all the parameters defining the actions like rule name, KPI-based conditions, periodicity, filters at code (identifier of a list of keywords by which ad platforms report the revenue), campaign and keyword level and keyword-based conditions.

Depending on the type of information and the level of the rule application, this information is hierarchically structured in: Action, periodicity, campaign and keyword levels.

3.2   Periodicity

When dealing with the development of a rule-based decision support, the definition of which data and time period is used in each case is critical. It has been observed in different projects like EWSHOPP[2] and other works like published by Rajagopal [7] and Pei Ling Lim [8] that user behavior is highly affected by external factors [11] like weather, events, and spontaneous hot topics. Therefore, the best way to define the time period used for data analysis is a combination of short term and periodic analysis, depending on the rule and type of action implemented.
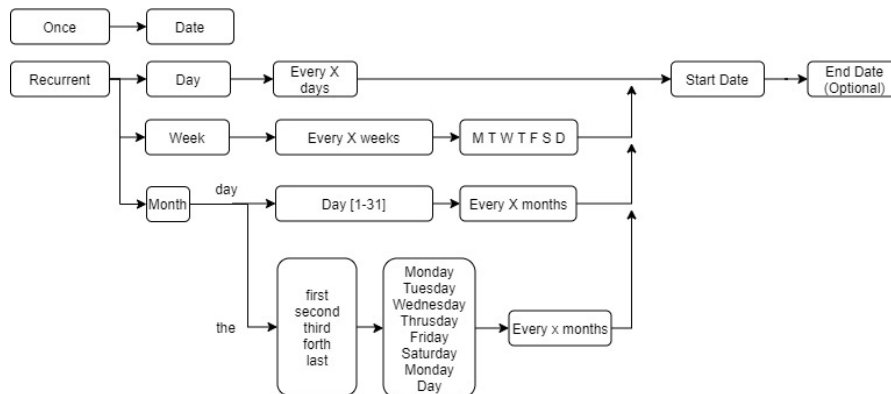
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[2] www.ew-shopp.eu

Fig. 2 Definition of rule periodicity, detailing all the parameter to be defined by the account manager

Fig. 2 shows the flow used to define the rule periodicity, which can be either "once" (single execution) or "recurrent" (multiple executions). In the second case, it is possible to work on day, week, and month level, customizing the rule periodicity depending on the type of action to be implemented by the associated rule. It is the account manager, based on his/her experience who decides when the rule must be applied, increasing the embedding and automation of no added value human actions into the rule-based system.

3.3 Human knowledge integration

The rule based system aims to be the core engine driving the optimization strategy of the marketing campaign, for that reason; the user interface has to : (i) be integrated in the internal toolkit of the company, (ii) enable modifications and adjustments depending on account manager teams and (iii) be edited following the company look and feel to avoid usage refusal and "pilot" feeling. To solve all these issues, the JOT rule system has been formatted following the company HTML and CSS templates and colors. The configuration and development of the forms has been coded in Flask and JavaScript which supports Python coding. At technical level, the daily evaluation of the rules is processed by a console application code in VB.NET. The final version of the framework and interface is show in section 5.

4 Rule-based solution (technical details and usage of rules)

4.1 Rules definition and conditions

The main goal of this solution is the knowledge transfer from high experienced and skilled account managers and the rule system. In this way, the definition of the rules is based on the most typical and simple operations a human analyst can apply without using advanced tools: addition, average, trend, and analysis.
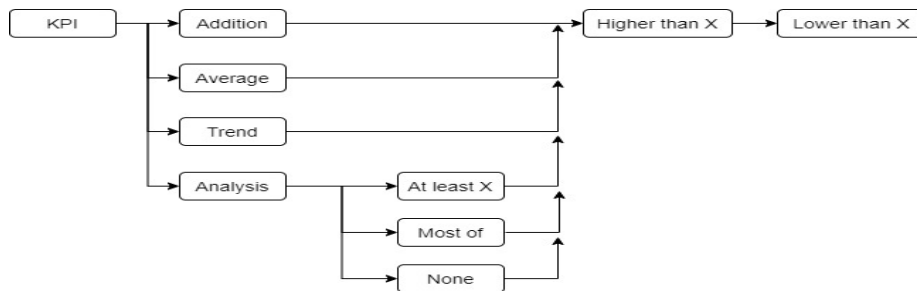
Fig. 3 Selection of KPIs type of analytics supporting the rule definition

Fig. 3 summarizes all the options and calculations that can be applied to each KPI. All the conditions that can be defined following this schema will be applied to the data constrained to the corresponding periodicity (time frame). In the following sections it will be explained how the system accesses to the data depending on the marketing structure level it must be applied to.

4.2 Data access in Campaign Structure

The rule-based system implemented also allows the data filtering when launching a specific rule. The different layers as well as main parameters and its relation to the periodicity is shown in *Fig. 4*. For example, if the account manager would like to activate a rule to increase the number of impressions, it will be active the days selected in the periodicity section and will be launched only when the particular conditions (filters) selected are fulfilled.

In this case, it is important to mention the different data structuring and configuration in the ad platforms and the finance related data collected. For campaign configuration data are divided in the following layers: Account/Campaign/Group/Keyword, so the configuration parameters can be defined at keyword level. However, when collecting the financial data, like the revenue or profit, they are acquired at code level, formed by the aggregation of many keywords. That is the reason justifying the integration of a code-based filter at the beginning, as the financial data is one of the most critical to check the performance of the campaign and is directly linked with JOT business model.

There are two cases where the period of time definition is not needed to select the statistics and process the data. When the filter is based on campaign name and account. In these cases, time frame is not needed because the rule will be directly acting on a specific campaign filtered by the corresponding attribute: language, category, list, matching, code, money, and location.
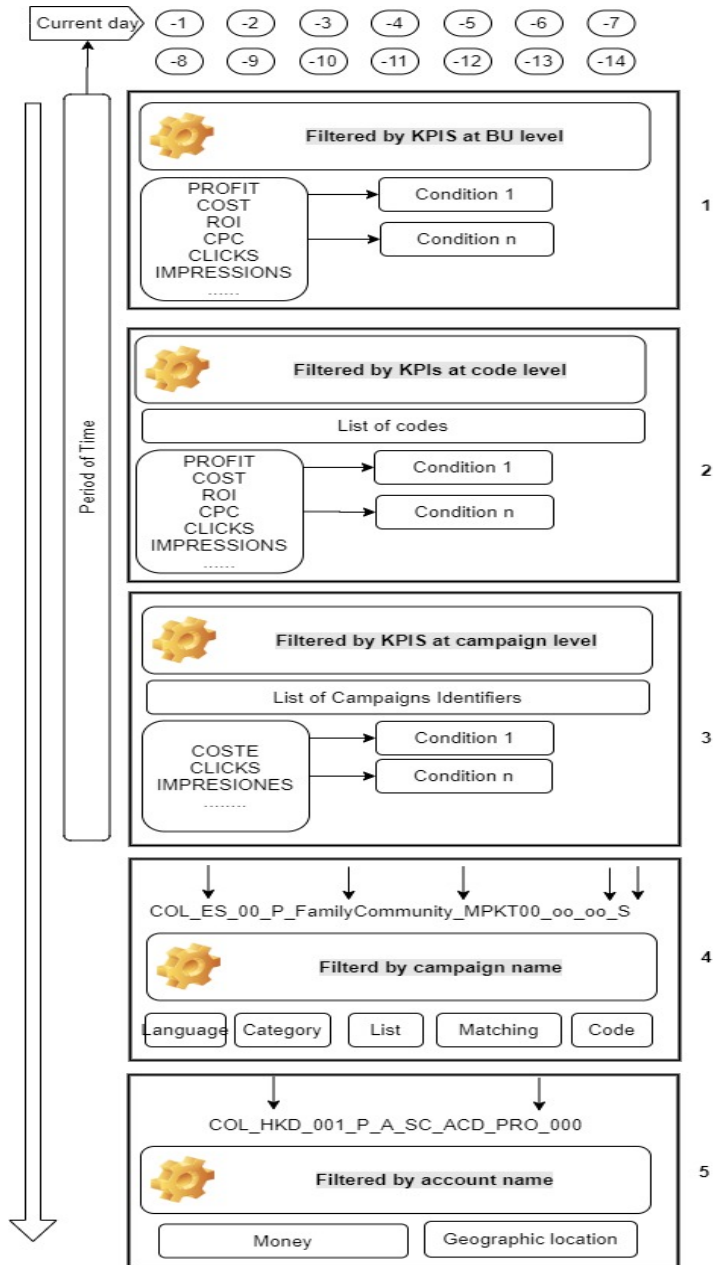
Fig. 4 Hierarchical access to the data and connection with the KPI evaluating rules

4.3 Rule evaluation

Once the type of rule, set of parameters to be analyzed and the level of data access are defined, the next step is to evaluate if the rule must be applied or not.

In order to automate the evaluation of which rules have to be activated, every day the algorithm shown in **Fig. 5** is launched.

It starts with the list of active rules and evaluating if they must be applied based on the periodicity definition. If so, a step by step phase is carried out, checking:

(i) The KPI conditions at business unit level
(ii) KPI conditions at code level
(iii) KPI conditions at campaign level
(iv) Filter the campaign name to apply the rule
(v) Filter and select the account name
(vi) Generate the actions linked to the rules such as bid adjustment in terms of percentage or absolute value.

If only one of the conditions is not fulfilled the related rule will not be applied and the next one is analyzed. For example, conditions at code and campaign level will be applied to all codes and campaigns, it is only required that the condition fulfills for one of them to pass to the new condition.

When all the conditions are fulfilled, the associated keywords are selected, and

Fig. 5 Schema of rule evaluation and generation of actions when possible

the actions launched. One example of the most common action is the update of the Cost Per Click (CPC) at keyword level, which is one of the most important variables, together with landing quality and relevance, used by the ad platforms to rank the ads in the most visible positions.

5 Status and results

The main result of this development is the generation of a data system embedding the marketing knowledge generated by account managers during several years of human optimization. The paper has demonstrated that the performance of the digital
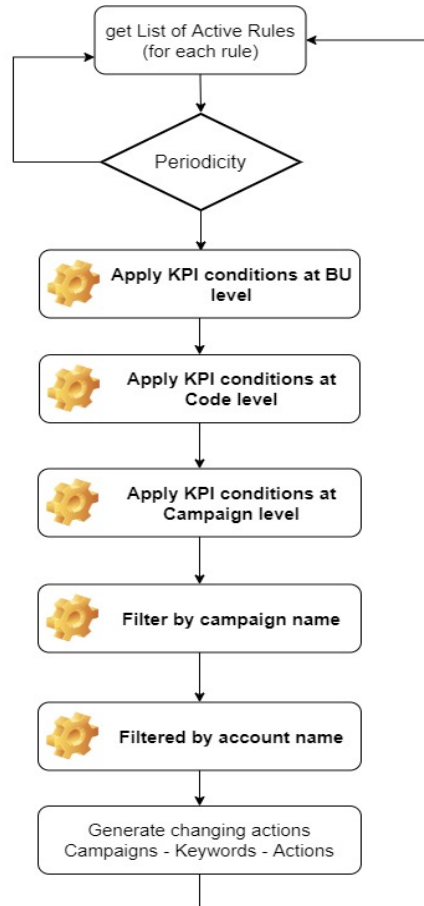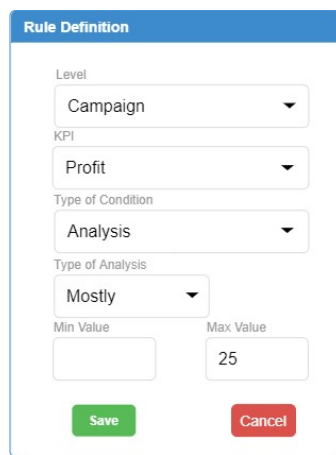
marketing campaigns is monitored by tens of different variables and optimization actions can be customized depending on the marketing business goals. In order to enable an agile and user-friendly knowledge transfer involving the definition of the most common rules, it is required that the user interface of the application is simple, easy to use and easy to modify.

In this section are shown different mock-ups. **Fig. 6** presents the form used to define the rules. It includes the application level, the KPI to be analyzed, type of condition and analysis as well as range of the values.
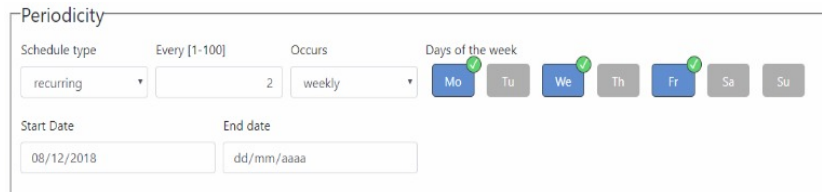
Fig. 6 Account interface for rule and type of analysis definition

Once the rule is set, the periodicity must be selected, **Fig. 7** shows how the concept illustrated in **Fig.2** is implemented. The main variables are schedule type (once or recurrent), start/end day, day of the week and so on.

Fig. 7 Account interface enabling the definition of the periodicity of the rules

The former actions generate the rule library available to be used for the account managers. The next step is to select which ones can be applied to a specific business unit. In *Fig. 8*, it is summarizes the selection of the rule for a particular business unit, defined by the ad platform (Google, Bing,…) destination landing, country and device, also the account manager name is included for traceability issues.

Fig. 8 Mock-up of the account interface for rule application

The last step is to monitor the conditions applied to specific KPIS a dedicated table has been also created. ***Fig. 9*** shows the interface to manage the conditions for specific KPIs, in this case "Cost", the same KPI can be applied at different levels (campaign, code or business unit) and with different conditions in this case, like average, at least, and most.

Fig. 9 Account interface used to monitor the application of conditions to the KPIs

In this way, the rule system support has been fully embedded in an application covering all the rule value chain: definition, periodicity, implementation and monitoring, so the marketing knowledge that marketing specialists possessed, can be digitalized and transferred to a unique data analytic system enabling the automation of the marketing campaigns optimization.

6   Importance and impact

In order to evaluate the performance of the system on the business side and the impact on the account managers productivity, it was evaluated some general indicators like number of rules implemented, number of actions executed and business unit managed per account.

Since the generation and integration of this rule system it has been created more than 4,000 different rules to automate the optimization of the marketing campaigns. All of them have been created by the JOT account manager teams, which shows that

the process is fully integrated in the workflow it is enough easy to use to be massively exploited by the team.

In *Fig. 10* is shown the monthly number of optimization actions executed by the account managers. The beta version of the rule-based system was integrated in April'19 and the full version in May'19. The figure shows that on average the account team generated 1,000 – 2,000 actions manually without this system. After the system integration manual actions were kept at the same level, but the number of automatic actions was significantly increased. It is also shown that, as an innovative tool, its usage experienced a hype-type curve, reaching the peak during summer vacation, when many accounts were on holidays, and then trending to stabilized the number of automatic actions around 20,000. Additionally, the Covid pandemic has generated anomalous behavior in the campaign performance and has shown a requirement for more specific and low-level actions.
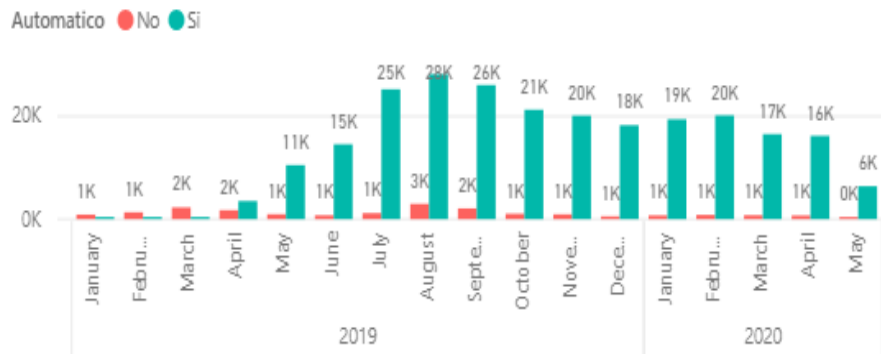

Fig. 10 Number of automatic (green) and manual (red) actions activated for marketing campaign optimization

If the data are analyzed at daily level, the integration of the rule system has also modified the account production model. In *Fig. 11* is presented the distribution of the number of actions per day of the week. In the figure it is compared the same time period, from January to March of 2019 (blue) and 2020 (orange). Before the development of the rule-based system the account managers used to implement the manual actions during the working days, with low activity on Friday (in order to avoid unexpected occurrences over the weekend) and no actions during the weekends. Now, the actions are distributed over entire week, keeping Friday and Saturday as less-active days but with a significant number of actions. The most remarkable success indicator is that now Sundays' are a very active optimization day, as the rules are scheduled and launched automatically, preparing the marketing campaigns, mainly keyword prices, for the working days period.
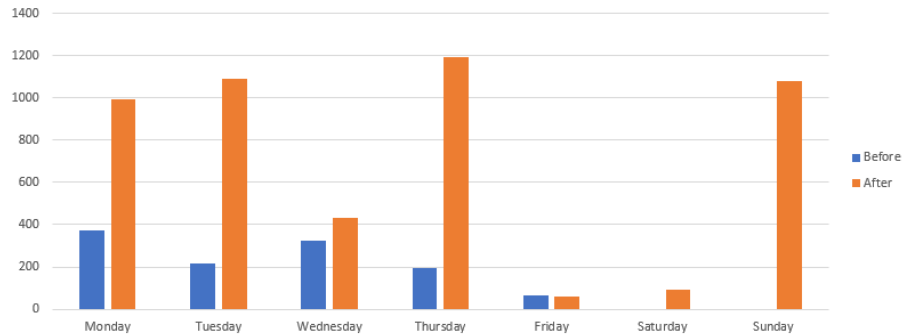
Fig. 11 Daily distribution of the number of actions before (blue-2019) and after (orange-2020) the development of the rule-based optimization system

Finally, we mention that the development and integration of the rule-based system for massive optimization of the digital marketing campaign has represented an innovative way to work for the account managers and was successfully received. This has enabled the management and web traffic generation to more than 40 different landing pages of 4 partners. The final consequence is that now the account managers are more focused on special optimization requirements from the client dealing with specific business units, definition of new highly efficiency rules and the learning curve of new members of the account team is much quicker as the knowledge transfer is also embedded in the system.

7. Summary and Outlook

Digital marketing is an industry that reapidly has integrated analytical solutions to analyse and process the data provided by the ad platforms to monitor the performance of the marketing campaigns. In this paper, we have shown how the combination of human knowledge and data has enabled the generation of a rule-based system supporting the account managers to analyze more information and activate massive campaign optimization actions. The technical development process has covered the whole data value chain, from the acquisition and collection to the rule definition and generation executable actions activated by means of the ad platforms. The rule-based system has been developed based on the marketing structure and performance data hierarchy as well as all the marketing knowledge that was so far only at human side. Results of the paper showed that the use of this system has allowed the implementation of more optimization actions as well as the distribution of the action over the whole week.

As part of future work, we consider the development of action triggers that digitalize and automate the selection of the most adequate rule and action depending on the case. This will represent the next step for the full digitalization of the account manager and the generation of the digital twin. This approach can be initially tested on small business units to check the performance of the actions limiting the potential damage on the marketing budget.

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