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Large scale User Experience research on trivago Intelligence

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Abstract

In large companies with huge number of customers, like trivago, there is a high need for analyzing user experience on a large scale. User testing sessions have their own benefits for user experience research, but this approach is limited to small number of users. What needs to be applied is a modern and challenging concept that will analyze massive amount of data about the users' behaviour, gathered from many different resources. For this purpose, convenient concepts have been utilized with one of the vital trivago platforms for its partners called trivago Intelligence. Evaluation of the heat maps has been performed for analyzing the users' interaction with user interface, while HEART framework and Goals-Signals-Metrics process (developed by Google) have been applied for tracking the user actions. These users actions have been defined with metrics that are used for measuring the progress of the product towards key goals while making user-centered decisions.

Key words: user actions, heat maps, metrics, logs, user tracking, feature goals

1 Motivation

Being a consumer-oriented company with sustained growth trend in number of users, trivago seeks for a way to examine the user interaction with its products on a large scale. This increasing number of users brings a lot of new challenges, but the opportunities as well. Since the users are extremely important element that drives this company forward, examining the user experience with *user-centered metrics* would create a useful guidance towards key goals. Measuring the product usage has always been done with user testing sessions on a small scale or by surveys on a large scale. Nowadays, however, we can use web server log data to achieve the same thing and get even more accurate picture of the product usage [6]. When this log data is correctly transformed to user experience metrics, the results are immensely valuable.

As a system that supports trivago's business model, trivago

Intelligence can be considered as one of the crucial platforms whose operation directly affects the entire company's business flows. Taking that into consideration, we can say that knowing everything about its usage gives the power to control its efficacy and drive product decisions towards positive outcomes which then helps in the successful operation of the entire organization and structure of the company. Small changes in trivago Intelligence could make big impact, so it is important to make those changes as improvements and not breakdowns.

Within trivago Intelligence application, Automated Bidding feature represents one of the newest ones. This feature adds additional value for the business process and users by giving them another option to make their performance on trivago better and actions more profitable. Analyzing how the users have accepted this new feature, how are they exactly using it and what is their approach to it, is very insightful and conclusions accompanying this analysis can only lead to improvements.

2 Introduction

As a hotel search engine, trivago¹ was first of its kind in Germany, 13 years ago. It is a meta search for hotel prices with 55 markets served worldwide and rates compared from over 250 booking sites and more than 1 million hotels. Trivago's hotel search tool, by scanning hotel booking sites, provides information about prices, images, availability, reviews of hotels and all the other relevant information. The booking process is completed at the partner's website where the users are redirected after selecting their desired hotel.

The business model of trivago is based on advertising partners using cost-per-click (CPC) model. Hotel chains, online travel agencies and hoteliers advertise themselves on trivago website by paying for the clicks received from trivago users. In a nutshell, partners set different bid levels for their hotels which then affects how will their offers be positioned when users make a hotel search. Consequently, that influences the growth or decline in traffic for a specific hotel. This process is carried out with the help of a system called trivago Intelligence.

¹Marketed with lowercase styling.

Trivago Intelligence is a platform that helps trivago's partners track and monitor their performance, manage their inventory and optimize their campaigns on trivago. That makes their actions more efficient and helps in their decision-making process by presenting them performance data of their campaigns. Launched in 2012, trivago Intelligence has more than 500 registered active partners and increasing traffic growth every year.

The idea behind this User Experience research is to analyze the usage of the existing user interface and features of trivago Intelligence platform, point out good and bad characteristics and propose the possible improvements. The research is done from two perspectives, one of them focusing on user interface and its usability and the other one targeting the functionalities and the features of the system and how the users have embraced them and utilized on a daily basis. Those two approaches would give the overall image of the system as a whole. Before the analysis it is important to understand the context of use of the system.

2.1 Context of use

This section provides the information about trivago Intelligence users, tasks that they perform within the app and the technical environment. The objective is to define all the aspects of the context of use of the application to be able to do an appropriate evaluation of the system and meet the overall usability criteria. Information about the context of use is generally an essential input to the product goals, but as well for the planning of the usability and user experience research [9].

Main functions that this platform provides are:

- Give partners a manner to manage their inventory (hotels) and upload bids.
- Provide an overview on campaign performance with data visualization, filtering options, clusters and views.
- Produce performance reports with different metrics and analytics combined.
- Allow partners to create automated bidding campaigns with specific cost-per-acquisition (CPA) target.

2.1.1 User types

Primary user types or target groups can be considered as *Hotel Chains*, *Online Travel Agencies (OTAs)* and *Hoteliers*. These groups benefit from the system in a similar manner, but the difference is the inventory they bid for. Online Travel Agencies bid on an enormous inventory of hotels. In this case, the rates have been distributed to them by hotels. Hotel Chains bid on their own rates for properties within the chain. And finally, Hoteliers have inventory which is much smaller compared to previous two groups.

Secondary or indirect users who interact with the product are *Account Managers*. Each of the partners from primary user types have their personal Account Manager (from trivago). Their responsibility is to communicate everything related with partners' accounts in trivago Intelligence, offer ex-

pert knowledge regarding bidding and different metrics, tool improvements and product launches.

2.1.2 Skills and knowledge

Regarding the skills and knowledge needed for using the system, users don't require training in order to use the software main functions, but they should be familiar with the business processes and methods that the product provides. Within the platform, users have access to information of over 20 metrics helping them analyze their performance and make decisions to optimize their bidding efforts. Metrics like Opportunity CPC, Outbid Ratio, Booking Value Index, Beat, Lose and Meet at the first interaction with the system may not sound familiar or self explanatory. However, for all those metrics and other ambiguities, there's a Knowledge page within trivago Intelligence that represents a resource base where partners can find everything they need to know about how to use the platform.

Although the users vary from many different countries, where different languages are spoken, they don't need to possess any additional linguistic abilities (apart from their native language) for interacting with the application, since the content of the application is translated into the corresponding language of the user from one of the 55 markets. Additionally, background knowledge and experience in using similar systems could be useful for every user.

2.1.3 Physical and mental attributes

There are no specific physical attributes that need to be mentioned for describing the users. Their age range varies a lot with normal male/female population distribution and there are no users with significant physical limitations and disabilities. For the mental attributes as well, there are no particular ones that need to be taken into consideration apart from users' attitude to tasks and product which can be described as *highly motivated to complete the tasks due to the business value that it brings*.

2.1.4 Tasks

Platform provides a wide range of different tasks, but the most common ones are:

- Change Point of Sale (POS) in drop-down selector
- Customize data ranges
- Sort data
- View data as customized chart
- Export data
- Create customized views and filters
- Change CPCs
- View import log
- Analyze dashboard
- Read knowledge pages
- Automated Bidding tasks

These tasks will not be described in more detailed manner, except for the *Automated Bidding* tasks since they will be

Task name	Create a campaign	Manage campaigns
Task goal	To create an Automated Bidding campaign with specified name, market(s) and target CPA.	To administer campaign status (Pause, Re-activate, Cancel), to edit campaign properties (name and target CPA) and to have insight about each of the campaigns.
Choice	Yes.	Yes.
Task Output	Campaign created and shown in “My campaigns” grid.	Campaign status or properties changed and shown in the grid, information about desired campaign(s) displayed in the grid.
Side effects	None.	None.
Task frequency	Approximately 8 times daily for all users ¹ .	Approximately 41 times daily for all users ² .
Task duration	1 minute and 1 second in average ³ .	Variable.
Task flexibility	Users are obliged to follow a predefined order.	Users are not obliged to follow a predefined order, although they normally will due to force of habit.
Factors which make task demanding	Low level.	Low level.
How demanding in comparison with other tasks	Equally demanding.	Equally demanding.
Task dependencies	Internet connection, session as a user, correctly filled “Create a campaign” form.	Internet connection, session as a user, having already created campaigns.
Linked tasks	None.	None. Except for having at least one created campaign.
Safety	Not hazardous.	Not hazardous.
Criticality of the task output ⁴	None.	None.

Table 1: Context of use of “Create a campaign” and “Manage campaigns” tasks

particularly evaluated for usability and user experience. Automated Bidding is a solution that helps partners create and manage competitive campaigns more efficiently. Basically, partners select bidding levels or targets which are automatically calculated into individual CPCs for each hotel. There are two types of Automated Bidding campaigns: Target cost-per-acquisition (CPA) Bidding and Traffic Bidding. In this work, focus is on Target Based Bidding. In a nutshell, *Target Based Automated Bidding* provides the partners a possibility to create campaigns at POS (market) level. They firstly set the target CPA as a percentage value for the campaign, which means that they decide how high the investment into campaign will be relative to the total booking amount (gross revenue) that campaign generates. For example, if partner sets 15% target CPA for a campaign, that means that partner wants to pay 15% of the gross revenue which results from this campaign ($\text{costs} / \text{gross_revenue} * 100$) and then trivago automatically sets individual CPC bids for hotels based on that chosen target CPA. There are two distinct tasks when it comes to this type of automated bidding and they are:

- Manage campaigns
- Create a campaign

Context of use of these two tasks is described in the Table 1.

2.1.5 Organizational and technical environment

Regarding the organizational environment, the work using the product is done individually, meaning there’s no group working. Assistance is possible and available over the Account Managers. Normally there are no interruptions using the product, possibly only due to weak Internet connection. When it comes to technical environment, hardware for running the platform is most commonly a desktop computer with Mac OS, Windows or Linux. Browser most likely to be encountered when using the product is Google Chrome or Mozilla Firefox.

3 Tools

In this section, all the tools used for the purposes of this UX research will be described in order to have a better understanding on how they add up to the results of the research and overall value. Apart from the tools that will be mentioned, information is also taken from the logs of the application and the database. Database holds everything that is needed for the system to work properly, but having that data extracted in a

¹Data taken from Google Analytics.

²Data taken from Kibana.

³Data taken from Google Analytics.

⁴Criticality is defined as importance of managing the task duration [10].

specific way, provides a valuable insight for the analysis of UX. The idea is to take information from many different resources for the sake of having the most accurate image of user interaction with the system. Depending on each user action defined and availability, information is taken from the corresponding and convenient resource.

3.1 Hotjar

Hotjar is an analytics tool that exposes the online behavior of the website visitors. Aside from the features like visitors recordings, feedbacks from the users and surveys, conversion funnels, form analysis and recruitment of the test users, one of the most useful components that this tool provides is the heat maps. Heat map is a visualized users' behavior, with their clicks, moves and scrolling visually represented in a form of a map over the website UI. The brightest areas of the heat map show visitors' strongest interest, while the least points of interest remain transparent. We can find more information about this tool on the official website (<https://help.hotjar.com/hc/en-us/>).

3.2 Google Analytics

Google Analytics is another web analytics tool, developed by Google. The difference between Google Analytics and Hotjar is that Google Analytics provides data on website traffic rather than visitors' behavior data. So, it is mostly used for measuring the performance of the website with metrics like number of views to a page or number of downloaded files. However, there is many valuable information that Google Analytics provides which is beneficial for UX research. We can find more information about this tool on the official website (<https://developers.google.com/analytics/?hl=es-419>).

3.3 Kibana

Similarly to the previous tools, Kibana is analytics and visualization tool. It is used for analyzing the logs that are generated by applications, by servers. In addition to that, Kibana also visualizes log data providing an easy way to explore and gain valuable insights about the application and the users. We can find more information about this tool on the official website (<https://www.elastic.co/guide/en/kibana/current/index.html>).

4 Methodology

As already mentioned, the approach for research is consisted out of two aspects, first one targeting the user interface (UI) and the second one targeting the functionalities of the system. This decision has been made for the sake of the advantage of having the whole understanding on how the users are using the system and combining those results gives more meaning

and truthfulness to the research. This approach to the user experience research is designed to be done as a complement and not a replacement to the existing user experience research methods like user testing or surveys, because the combination of two allows cross validation of data and a better picture of users' behavior [5].

Regarding the interactions with the UI, the analysis has been done using the *heat maps*. There are countless findings that could be extracted from the heat maps and it only comes to considering all those views and information that the heat maps hold about the usage of the UI [8]. Heat maps gather all the users' activity and in the end it results in an impressive fingerprint made by users which is the only thing that matters, to have a realistic image about users' incorporation with the system. The methods for extracting this valuable information from the heat maps are explained in one of the following sections.

One the other side, deeper insight on the users' integration with the system and its facilities is retrieved from the analysis of *user actions*. User actions represent every level of their interaction with the features of the platform and they are defined in a way that can be easily measured as metrics in order to get valuable information about how the users use trivago Intelligence platform. These metrics are calculated using the framework that oughts to combine attitudinal and behavioral data on a large scale by using the information from the logs. This framework is explained in detail in one of the following sections.

4.1 How to evaluate heat maps?

First of all, there are 3 different types of heat maps provided with Hotjar tool:

1. Click Heat Maps - based on where the users are clicking
2. Move Heat Maps - based on where the users are moving the mouse cursor
3. Scroll Heat Maps - based on user's scrolling actions

One of the main objectives of analyzing the heat maps is to figure out which elements the users prioritize on each screen and determine if they find the user interface simple enough. But when we dive deeper into the evaluation, there are several categories that we can learn from the heat maps:

- Discover from users' behavior patterns
- Learn which elements attract the most attention
- Learn where users click the most
- Learn how the users react
- Learn from scroll maps

By the users' behavior with the UI, we can construct different patterns that describe their attitude towards the app and discover what lays beyond their intentions. People normally act in accordance with one of the following patterns: F-shaped pattern, Gutenberg diagram and Z-shaped pattern [3] as it is shown in the Figure 1.

In general, people follow a F-shaped pattern when scanning

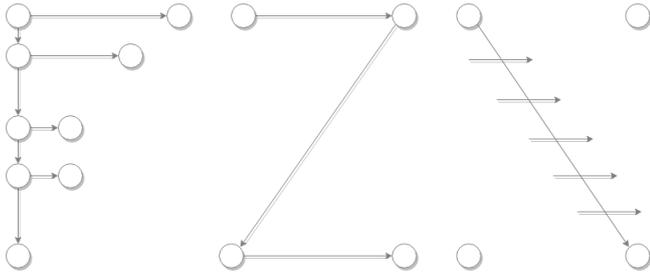


Figure 1: Behavior patterns: F-shaped, Z-shaped and Gutenberg diagram, respectively

a page. They start vertically from the top towards bottom, with quick checks on each horizontal line, more often closer to the top and rarely in the bottom, which creates a shape of a letter F. This pattern occurs in numerous designs of websites. However, with content-heavy pages, we encounter the Gutenberg diagram. In this case, visitors start to scan the screen from the top left corner which is a primary optical area. Reading gravity then strives to the bottom right corner which represents the terminal area. So, when the websites are full of text or filled out with a lot of same elements, users try to scan them all by going through the website diagonally from top left corner to bottom right one. This happens due to the fact that users cannot figure out which elements of the page are the most important ones, so they search for them in the beginning of page, in the center and in the sole end. When the page has a lot of important elements that are presented in a graphical way, than the pattern takes a shape of letter Z. The visitors scan all the elements one by one going row by row vertically and from left to right horizontally in order to check all of them. Knowing how the users scan each of the screens within the platform, helps strategically place the most important features and information along their visual path which increases the possibility that they'll spot it.

It's very important to assess if some of the design elements attract unnecessary attention, since it could become problematic when this is the case. Less significant page elements shouldn't get larger amount of user's attention. It's generally known that users tend to interact first with elements that stand out visually like images, graphics or elements that have contrast in color and light.

Screen elements the users are clicking the most (e.g. links, graphical elements, etc.) can be classified as parts of the page that are the most important to them. However, if the users are attempting to click on static elements that do not provide any further action - that's an obvious red flag. If those clicks are landing on prime content areas, the results support design decisions.

We can learn how the users react to the design by knowing where are they curious the most. The screen areas to which they pay attention the most are the ones where the cursor has stopped for the longest time.

There are many useful things that scroll maps provide us: how far down users actually browse, how many pages do they

visit (pagination), etc. If we figure out that the users are not scrolling down on important content we might want to move it higher.

All these recommendations regarding the valuable information that heat maps hold are summarized into the following process which is used for the evaluation and with whom we are able to directly point out positive and negative characteristics of the UI and provide the way of possible improvements. The process is mainly based on the guidance from the official Hotjar website (more information on <https://www.hotjar.com/heatmaps>). These guidelines are constructed in a shape of tests that can be performed for each of the heat maps. Tests include each of the numbered types of heat maps and are defined in the Table 2.

4.2 User actions planning

The purpose of defining the user actions is to, by associating them with the exact metrics, obtain valuable information about the way users use the system features and functionalities [1]. The idea is to calculate these metrics with the use of the logs.

There are metrics that can be associated with any system, meaning that they can be measured no matter what is the domain of the project [2]. For example:

- Time to finish the task (speed) - how much time do the users need to complete their desired task.
- Success rate - in how many cases have the users been able to finish their task with a successful outcome. If this metric is low it could cause the increase of frustration level among the users.
- Accuracy - in how many cases have the users done their tasks as 100% of what they've expected to achieve in the first place.
- Ease of use - do the users utilize the shortest and the quickest paths (shortcuts) to perform certain actions, or they perform unnecessary clicks.
- Consistency - do the users perform tasks in the same manner or it varies. In the second case it could mean that there's a certain level of confusion present.
- Error rate - in how many cases user actions trigger errors.
- Pages and features most frequently used - users' preferences within the website.
- Back button usage - how frequently the users use the back button. Higher number means that there could be something wrong with the structure of information.
- Stickiness - how many users after landing on the home page explore the other parts of the website as well [7].

All those metrics can provide great insights about the usage of the system, but they are only "indirect" user experience metrics and don't carry any guidelines on how to make the improvements which will bring benefits to the system and specially benefits for the users. Since these metrics are too general, there's a need to define ones that will be related and tightly coupled with the specific application, which is in this

Name	Test failed	Test passed
Link Test	The users click on the elements that are not links - no further action is performed.	The users know what are the clickable and not clickable elements on the web page.
Distraction Test	Users' attention is driven by unimportant or irrelevant elements on the page.	Users' activity in move heat maps is focused on primary elements - user's engagement with these elements brings value.
Information Test	Users are looking for the information that doesn't exist.	The elements that keep the users' attention the most provide large amount of information.
Device Test	Web page differs a lot when switching between different devices.	The design of the web page is responsive, so consistency between different devices is guaranteed.
Depth Test	The users are not reaching all the content of the web page.	Users are easily accessing all the information even when it's placed below the fold.
Engagement Test	Users are engaging the most with the content of the web page that is not considered to be the most important.	Users visit the web page mainly because of its purpose and the most important content.
Fold Test	Users are leaving the web page already after accessing the landing page. Important content is hidden.	All the reasons that should keep the users on the website are placed above the fold and their purpose is to capture users' attention.
Header Test	Users are heavily engaged with the header or navigation of the page.	Headers are intuitive and users don't spend a lot of time figuring out where are they on the site map and know exactly how to navigate through the site.

Table 2: Tests for evaluating the heat maps

case trivago Intelligence. For that reason, two methodologies are consulted: HEART framework and Goals-Signals-Metrics process.

4.2.1 HEART framework

HEART framework extends the ability to use web server log data to track product usage on a larger scale. It is a discipline of User Experience to revenue-driven metrics and, of course, it should only complement and not replace the existing UX research methods in use.

As a metrics framework that enables the measurement of user experience quality and provides actionable data, HEART stands for *Happiness, Engagement, Adoption, Retention and Task success* [11]. From these 5 categories teams define specific metrics with whom they track progress towards goals. Of course, it is not always necessary to employ metrics from all of the categories.

In this framework, *Happiness* stands for satisfaction, likelihood to recommend, visual appeal, perceived ease of use. Metrics from this category normally get tracked with a general, well-designed survey. The purpose is to figure out how interactions impact the users' happiness. It is recommended to track the same metrics over the time to check the progress as changes are being made.

Engagement represents the users' level of involvement with a product, how frequently are they using it, if the usage is intensive and what is the depth of interaction over the period of time. It is usually better to measure the level of engagement

per number of users instead of total engagement, since the increase in engagement can be caused by the increase of number of users.

Adoption metrics show how many new users have started to use the product during a given period of time, while *Retention* metrics track how many users from a given time period are still using the system in the posterior time period. These two categories tend to be especially useful for testing new products and features and the ones going through redesigns. Adoption is often linked to User Onboarding concept².

Task success category is pretty self-explanatory: it means efficiency (time to complete the task), effectiveness (percentage of tasks completed) and error rate. With web server log data it's difficult to track these metrics since it's not easy to figure out which task the user was trying to accomplish. However, when there's a optimal task path it is possible to measure whether the users are following it or not.

4.2.2 Goals-Signals-Metrics process

As we can notice, HEART framework metrics by themselves still aren't specific UX metrics, neither they are related to any of the characteristic of the platform of our interest. Even if they were more specific or more user-centered, it is unlikely that they'll be useful in the practice, until we explicitly relate them to a goal. Then they can be used to track the progress towards that goal in particular. For that reason we utilize *Goals-*

²User Onboarding is the "process of increasing the likelihood that new users become successful when adopting the product" [4].

User Action		
Goal	HEART	Metric

Figure 2: User action characteristics

Signals-Metrics process.

Goal-Signals-Metrics process is a simple process which is used as a guide through articulating the goals of a product or single feature, identifying signals that indicate success and finally building specific metrics to track [11]. One of the most important parts is to define our goals and main goals for the users.

The first step is to identify the goals of the product or feature, especially in terms of user experience. It's convenient to use the HEART framework to support the articulation of goals (e.g. if it is more important to get the users more engaged or attract new users). Second step is to define the signals that indicate whether the goal had been met. In other words, what feelings or perceptions could be correlated with success or failure. After that the signals are translated into specific metrics, suitable for tracking over time using logs. The step of defining the signals can be skipped and it's possible to go directly from goals to the metrics.

Generally, the procedure for defining the user actions begins with the HEART framework, where each of the 5 categories are related to a specific goal of the product or feature taking into the consideration its purpose. Also, it's not mandatory to include all HEART categories if some of them don't seem to be related with the project, and it is possible to add more categories optionally. So when we define goals for specific categories, we follow the steps and determine signals and finally metrics for those goals. However, in this research, the procedure is a bit different then the common one. Firstly, the goals for the feature are specified. Secondly, individual HEART categories are associated with those goals according to the nature of each goal and what we are trying to achieve with the feature regarding the product and business background. And in the end, specific metrics are directly defined from the goals. As a result of this process we have each user action characterized with the goal, HEART category of interest and specific metric to track (Figure 2).

5 Heat map evaluation

There are nine pages within trivago Intelligence platform that have been tested with Hotjar tool, and from which we have available heat maps. So, the evaluation is possible on nine pages that have tracked the user behavior and resulted in different heat maps. In trivago Intelligence application, there are more pages of course, but these nine have been chosen as the ones of interest. In this section, three of these pages will be evaluated since they are the most important ones. The other six are discussed in Appendix A.

Three pages that are evaluated here are *Dashboard*, *Create a campaign and Campaigns*. The reason why these three pages have been chosen as the more important ones is the following. Dashboard is the default page that the users see when they access the application and it shows the most relevant and essential data and metrics to them. Create a campaign and Campaigns pages both support the Automated Bidding by target feature (already described in Context of use subsection) which is very important because of its business value. Moreover, they are the newest features released on 14th February 2018 and it is important to know how have the users accepted them.

Each heat map is evaluated using some of the tests mentioned in the previous section. The tests are chosen by their relevance and suitability for each page. As results from the analysis of the heat maps, possible ways of improvement are emphasized.

5.1 Dashboard

Dashboard is the default view that helps the partners to easily monitor and analyze their top-line performance on trivago and to identify possible performance changes at a glance. A selection of charts and tables allows them to compare metrics, such as Clicks & Top POS Share, a Performance Summary, Cost & Avg CPC, POS Development, CPC Allocation and other charts related to tracked bookings. Click, Move and Scroll heatmaps are shown in Figure 3.

Over the time that the users' behavior has been tracked, this heatmap recorded 2065 clicks and 2000 page views. Observations are as follows.

For each of the graphs that Dashboard provides it is possible to see the detailed view which shows several graphs per each point of sale. If we examine this heatmap according to Engagement test, we can notice that less than 1% of the visitors wanted to visit more detailed view of the graphs. So, for the future design or redesign, do we really need the detailed view of the graphs?

Regarding the Header test, it is noticeable that a lot of the clicks are landing on the navigation bar, 825 or 39.95% to be exact. So, all of these clicks led to access to another part of the website. It is important to understand does this page provide the users what they need the most. According to the heat map, most visited pages from Dashboard are POS (378 clicks or 18.31%) and Hotels (296 clicks or 14.33%). So, it is valuable to give the users easy access to POS and Hotels pages. However, if from the business side is important to engage users more in other pages as well, it is needed to introduce additional features there, which will be very useful for the users.

If we assess this heatmap with Link test, we can detect that the users are specially interested in the following rows in Performance Summary table, and these rows are not even links: Gross Rev - yesterday data (33 clicks), Cost - yesterday data (13 clicks) and Bookings - yesterday data (12 clicks). Based on these findings, those values could be more highlighted in the new design.

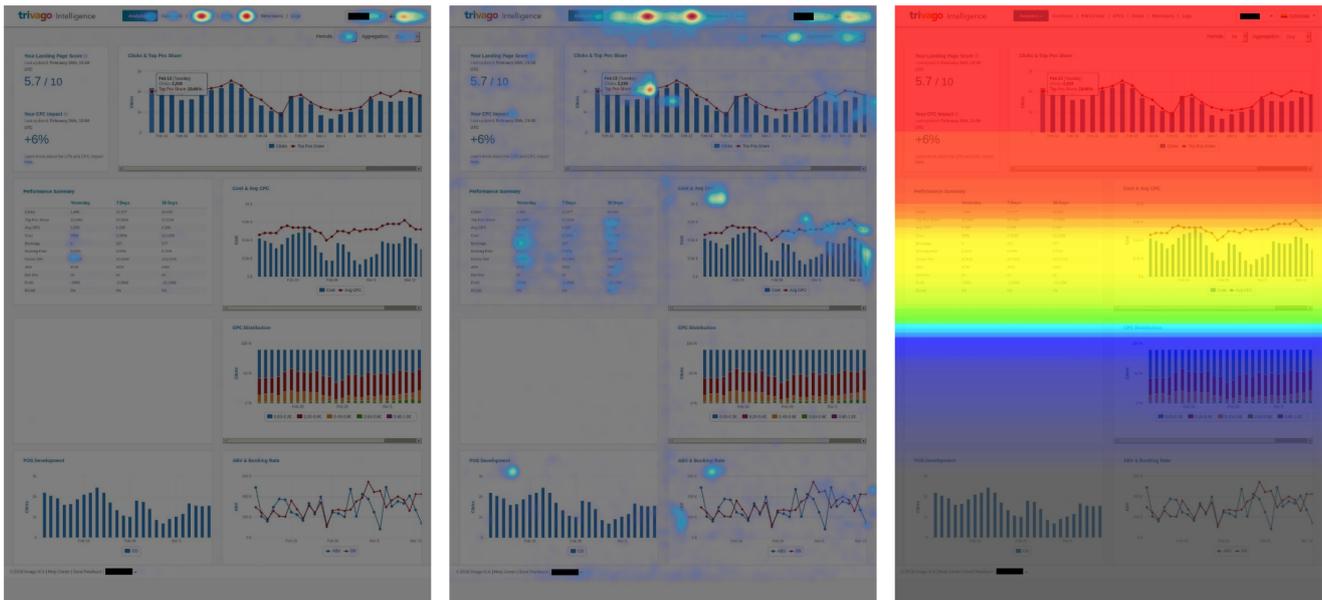


Figure 3: Dashboard page Click, Move and Scroll heat map

And finally, Depth test tells us that less than 50% of the users check CPC Allocation and CPC Distribution graphs and less than 17% of the users check POS Development and ABV (Average Booking Value) & Booking Rate graphs. Do we need all of these graphs in the UI? Or do we need to rearrange the order of the graphs if some of them are more important from the product perspective?

5.2 Create a campaign

Create a campaign is a page where the users fill out the form to create an Automated Bidding campaign. The process includes entering the name for the campaign, selecting the market(s) (where the users want to have that campaign live), setting the target CPA and clicking on the “Create” button. Click, Move and Scroll heat maps from this page are shown in Figure 4.

Over the time that the users’ behavior has been tracked, this heat map recorded 952 clicks and 298 page views. Observations are as follows.

If we test this heat map on Engagement, we can notice that the engagement level is very different than in the case of Dashboard. Engagement level can be defined as the number of clicks over the number of page views. In the case of Create a campaign page it is $952 / 298 = 3.195$, but for the Dashboard it was $2065 / 2000 = 1.033$, which means that each visitor of Create a campaign page makes around 3 clicks on average, while on Dashboard that number is only 1. This may be the normal behavior if we take into consideration that Create a campaign is a form while Dashboard displays graphs and infographics. If we take a closer look into the Create a campaign form, there’s a significant drop in the users’ engagement level

between the beginning of the form and the end. It is important to know that one filled field enables the following one. So users are required to firstly fill the name of the campaign, then the markets and finally the target CPA value. After that they are able to press the Create button. Unfortunately, the heat map did not record the number of clicks for setting the target CPA value, but if we compare the rest of the form elements, the results are as following:

1. Name for the campaign: 203 clicks or 21.32%
2. Markets: 189 clicks or 19.85%
3. Create a campaign button: 80 clicks or 8.40%

From the beginning of the form to create a campaign until the end there is a drop of 60.59% in engagement. It is difficult to understand just from the heat map, what happens in the process and why do the users quit filling the form. Since it is important to understand it, that issue could be examined through a well designed survey for example.

From the Click and Move heat maps, we can recognize the F-pattern of users’ behavior which is the most common pattern and it is normal that the forms follow this kind of pattern.

5.3 Campaigns

Campaigns page is a place where the partners monitor and manage their campaigns. Campaigns are displayed in a grid with the columns that hold information about the name of the campaign, status, date of creation, launch date, target CPA and markets. Users can perform several actions with the grid. They can filter the campaigns (by status, by market and by name), sort the campaigns (by every column), edit each of the campaigns (change name or target CPA) and they can pause, reactivate and cancel the campaigns. Campaigns can have one

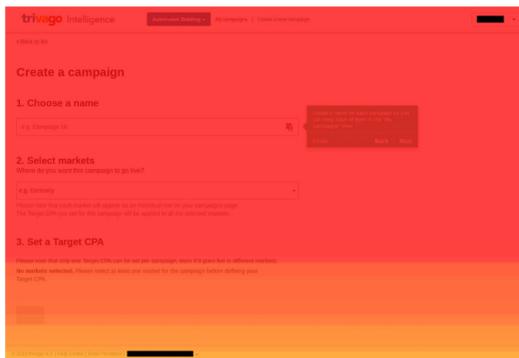
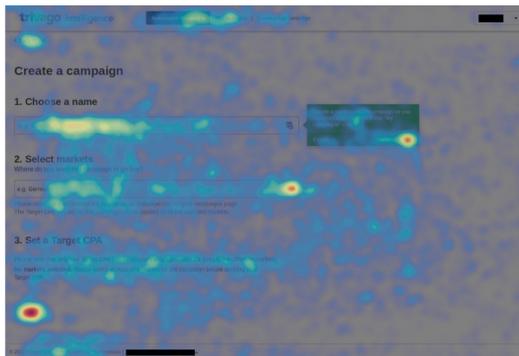


Figure 4: Create a campaign Click, Move and Scroll heat map

Figure 5: Campaigns page Click, Move and Scroll heat map

of the following statuses: Pending, Initiated, Scheduled, Live, Paused, Canceled and In review. Status names are pretty self-explanatory and for the purposes of this work it is not necessary to dig deeper into the meaning of each of them. Next to the grid there's a date range picker which is used to filter the campaigns by launch date. Click, Move and Scroll heat maps from this page are shown in Figure 5.

Over the time that the users' behavior has been tracked, this heat map recorded 2051 clicks and 1832 page views. Observations are as follows.

Engagement level from this heat map is $2051 / 1832 = 1.12$, which may not be considered as a decent result taking into the consideration all the actions the users can perform with the grid. So it is very important to determine whether the engagement level is as expected and how to improve it. Users filter the campaigns mostly by status (101 clicks) then by market (60 clicks) and then by name (40 clicks). Moreover, those

filters are ordered on the UI according to these results. Therefore, for the users, the most important information is the status of the campaign, then the market and the name. Users change the campaigns in the following order: Pause (41 clicks), Cancel (30 clicks), Reactivate (22 clicks). These numbers don't differ a lot like previous ones, but still it is noticeable that, through the UI, users have paused the campaigns the most, and reactivated them the least. Additionally, these buttons are not ordered on the UI according to the number of times they have been used. Another thing that we can notice from the heat map is that none of the users (0%) used the calendar to filter the campaigns by the launch date. So, for the future design it would be recommendable to replace the calendar with another element that will be more useful for the users.

Regarding the Header test, out of 2051 total clicks, 859 of them or 41.88% are clicks on the navigation bar to access another part of the platform. So, the question is whether the

content of this page is the one that users are expecting and is it relevant enough for them. Another thing that can be noticed is that if the users, for example, want to visit Hotels page from the Campaigns they need to do a total of 2 clicks to reach that page instead of going there directly. The problem is with the design of the navigation bar, which obligates the users to go first to the Dashboard and then they are able to redirect to Hotels page. This is not the best approach since Hotels page doesn't require Dashboard to load or any data from it to be able to load itself. So it is really necessary to provide the users the quickest way possible to information that they need. Otherwise, it could increase their level of frustration.

6 User Actions analysis

The focus of this section is to define the list of user actions, explain the approach how they can be tracked using the logs and use that approach to actually arrive to some results which could potentially bring valuable info for the UX and trivago Intelligence overall. So the main goal is to track how the users are using the platform, gather and collect that data, analyze it and find possible ways of improvement in the user experience perspective. Those improvements could in the end deliver benefits to the whole project.

Objective for defining the user actions is Automated Bidding by target feature since it is one of the newest features and one of the most important aspects of trivago Intelligence which makes it a good candidate to serve as a model to track user actions for the other functionalities in the future as well. One of the goals with analyzing this feature is to understand users' common patterns of usage and based on that knowledge advise the partners on how to optimize their campaigns (the life-cycle of their campaigns).

Previously, it has been discussed that certain, already defined, user actions could be used, but they are too general, not specific enough for the particular case of trivago Intelligence and not data driven nor user centered. Because of that, HEART framework and Goals-Signals-Metrics process were consulted in order to get metrics that have more actionable results. User actions are all supposed to be related to the particular goal of the Automated Bidding by target or trivago Intelligence platform.

The list of user actions is presented in the Table 3 and it is a result of the brainstorming session with the whole team of trivago Intelligence with the use of methodologies already described in the previous sections. User actions are defined in a form of questions that we would like to know about the users' behavior with the feature. It's already been discussed that each user action is defined with goal, metric and HEART category. Since that information is too large to be presented here, only the titles of user actions will be displayed.

All these User Actions have different ways to be tracked, and here a few of the most important ones will be discussed in details. All the other information about the User Actions is available in Appendix B.

Let's dig deeper with the User Action number 1: How many times have the users accessed the Create a campaign page and created a campaign? The *goal* we are trying to achieve related with this User Action is to *involve partners as much possible in creating campaigns with Automated Bidding (by target) feature*. Exact *metric* for tracking this User Action is *number of created campaigns per number of times that the users have accessed the Create a campaign page*. Metrics are usually specified in a form of percentages because that is the most credible way to track the progress. If we would for example, track the number of created campaigns only, the progress maybe wouldn't be realistic. Let's say that there would be a small increase in the number of created campaigns over the time, but in the background there's an enormous increase in the number of hits to Create a campaign page. This would mean that the users are struggling with the process of creating the campaign. The situation is the same other way around, if we would only track the hits to Create a campaign page. We could have a big increase in the number of hits to this page, but if the number of created campaigns remains the same that doesn't mean that we are advancing. *HEART* categories related with this User Action are *Engagement and Adoption*. Engagement because we want to expand the usage of this feature, which means that we need to engage the users more with it. And Adoption since the feature was released on 14th of February 2018 and it is still quite new, so we need to have more and more new users which will consequently increase the number of created campaigns.

The results for this User Action are gathered using Google Analytics tool and MySQL database. Google Analytics provides information about the number of hits to Create a campaign page and the database holds the information about the number of created campaigns. The results are split on a monthly basis so we can track the progress better:

- February: 361 hits, 65 campaigns created, efficiency 18.01%.
- March: 188 hits, 57 campaigns created, efficiency 30.32%.
- April: 125 hits, 83 campaigns created, efficiency 66.40%.
- May: 102 hits, 67 campaigns created, efficiency 65.69%.

According to this data, we can confirm that we have progressed since the release of the feature. The metric was showing only 18.01% efficiency in the first month, while in the last month we have had 65.69%. Also, it is noticeable how in the first month we have had a lot of hits, probably because the users were curious to check the new feature, but only few of them were courageous enough to actually create a campaign. Over the time the number of hits was not that high but the number of created campaigns has remained more or less the same. So the challenge now is to work more on the users' engagement with the feature and having more campaigns started on trivago. Also, regarding the Adoption, we need to attract more users to try this feature which is related with User Action number 10 (How many partners have created at least one cam-

User Action

1.	How many times have the users accessed the Create a campaign page and created a campaign?
2.	How many campaigns that were created through Create a campaign page went live?
3.	How much time do the users need to create a campaign?
4.	How successful are the users in creating the campaigns?
5.	How long are the campaigns live?
6.	At which part of Create a campaign form the most users give up?
7.	How many users are using the guidelines for campaigns?
8.	Do users make meaningful transitions for campaigns?
9.	How frequently the users change (increase / decrease) CPA target of the campaigns?
10.	How many partners have created at least one campaign?
11.	At what time in the day the users mainly create campaigns or make changes?
12.	What is the ratio between the usage of the campaigns and standard bidding?
13.	What is the revenue ratio between campaigns and standard bidding?
14.	What is the most used sorting criteria on Campaigns page?
15.	How many users use the calendar to filter the campaigns?
16.	What is the most common way of filtering the campaigns?
17.	How many times have the users applied the suggested CPA target value (20%)?
18.	What is the ratio between the market that has the largest amount of live campaigns and the market from which the most travelers search on trivago?

Table 3: User Actions list

paign?). According to that User Action, since the release until June we have had 70 partners out of 574 active ones (12.20%) who have created at least one campaign. There's a lot of room to improve this statistics. For example, this number could be increased with cross product promotion, where this new feature will be promoted within other trivago products but also within other trivago Intelligence features. Also, by frequently adding new improvements to the feature, it is possible to engage the existing users more and attract the new ones likewise.

Let's take a look at User Action number 5: How long are the campaigns live? The *goal* with this User Action is for *the campaigns to have a long lasting and healthy lifespan*. The *metric* for tracking this is *the number of days that the campaigns are live per number of campaigns*. HEART category related with the User Action is *Retention* because we are trying to have the users keep their campaigns live for as long as they are performing well. The cause for the results of this User Action could be the UI ease of use of the feature or low/high campaign performance. By checking the logs only, it is difficult to understand what is the main reason for the certain result. However, the team should always aim for making the improvements. The results for this User Action are extracted from the MySQL database:

- Total number of days of live campaigns: 9364.6986.
- Total number of created campaigns: 272.
- Average: 34.43 days.

These results are selected for the period from the release until 20th May. So the average time that the campaign is live is a bit over the 34 days. This User Action was measured at one more occasion on 26th of April when the average was 29.07 days. Therefore, we can conclude that the progress is

continuous and that the campaigns on average last longer than in the previous months. However, there's always room for improvement. In the case of Retention, we could, for example, provide the users with the occasional reports regarding the performance of their campaigns created through the Automated Bidding (by target) feature. This report would, at the lowest level, remind the partners that we are doing work for them. Also, that will help them recognize the trends in their performance as well as the ROI (Return On Investment).

Previous paragraphs demonstrate how the analysis of the User Actions should be carried out. Those examples represent an illustration on how all 18 User Actions are analyzed. But the most important thing is to track them continuously so that we can record the progress and make improvements and fixes accordingly.

7 Conclusion

This research has been done in order to collect the complete knowledge about the attitude of the users towards trivago Intelligence platform. Those users are the ones that are using this product on a daily basis and it is extremely important for them to know that our aspiration is to make their experience with it as pleasant as possible, but it is also important for us as well since that directly affects the success of the product. Having the complete knowledge enables us to make smart moves for the benefit of both the users and the product. It also gives us the possibility to be ahead of the time and always know our next step to improvement.

The help of HEART framework and Goals-Signals-Metrics process in this research is unmeasurable. Thanks to the flexi-

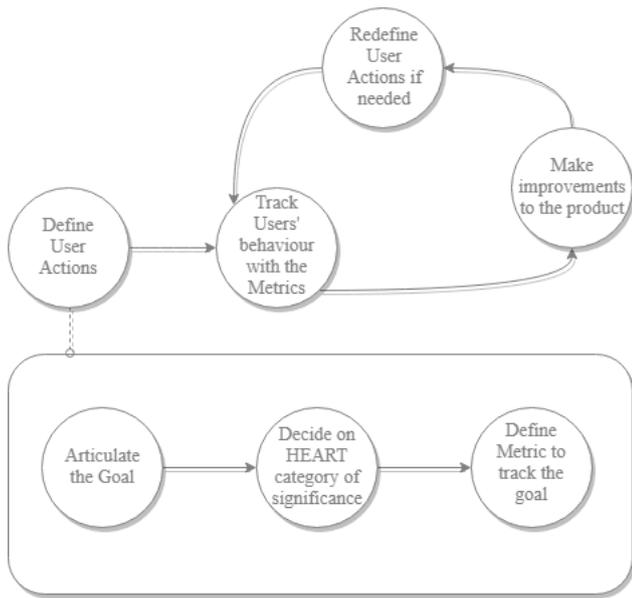


Figure 6: Process of user behavior tracking on a large scale

bility of this approach we were able to do the adjustments of this methodology to our case and obtain extremely valuable results. These results helped us make decisions that are both user-centered and data-driven. This framework and process have also pushed us as a team to be focused on the aspects of importance for the product and the things that bring value.

When comparing user testing sessions and this approach, it is important to emphasize that they should be done in parallel, in a way that one process complements the other and vice versa. Since the results and insights from those two approaches differ, combining two of them enables many opportunities for the progress. One of the advantages that this research brings is that the users whose behavior has been observed are 100% in their real environment and it is the actual image of their interaction with the product. On the other side, with user testing sessions, the users are aware about the testing session and that affects their natural behavior while using the product. However, unlike tracking the logs, these sessions provide information about users' satisfaction with the product, happiness, perceived ease of use, look and feel, etc.

Regarding the future ideas for this project, one thing that would bring additional value to it is to develop a software solution that would gather all relevant data from different resources (server logs, database, Kibana, etc.) about the users' activity and visualize that information in a form of dashboard with all defined User Actions. So the team will have everything that they need to know about the users' behavior at one centralized place and that information would be shown in a real time. Also, the team would be able to select different time periods for tracked User Actions and with that feature it will be possible to measure the progress over the time and compare the previous data.

To sum up, to process of tracking the activity of users and

their attitude towards the product is a continuous process. As shown in the Figure 6, the first step in this process is to define the user actions. User actions are built with the help of Goals-Signals-Metrics process and HEART framework, by articulating the goal of the product or feature, deciding on the HEART category of significance and defining the metric to track the goal. After constructing the user actions, the repeated set of activities starts. These three activities take place one after another: tracking the users' behavior by using the specified metrics, making improvements to the product and redefining the user actions if needed (when including additional features or redesigning the existing ones). These actions continuously repeat which ensures the constant progress and growth.

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Appendix A Heat map evaluation

This appendix contains a short evaluation of the remaining 6 trivago Intelligence pages that were included into the analysis with Hotjar tool. Heat maps are shown in the Figure 7. Heat maps for Dashboard, Create a campaign and Campaigns page have already been discussed in details.

Appendix A.1 Account page

The Account page shows an overview of all trivago POS and the statuses of the respective partner on the platform. Activations and deactivations of platform can be requested here, inventory information can be downloaded. Clicks recorded: 1499. Page views recorded: 1000.

Engagement Test: Out of 1499 clicks recorded, 489 or 32.62% are downloads of the inventory information. *Users should be provided with an easy way to download their inventory information and it could be the main purpose of Account tab.*

Depth Test: Less than 50% of users scroll to Southern Europe info and less than 25% scroll to Eastern Europe. *It's obvious that users check the page mainly for inventory information instead of checking the POS, so the main focus should be on inventory information. To engage the users more, POS should be displayed in one fold.*

Appendix A.2 Knowledge page

The Knowledge page provides regular updates on all new and exciting things at trivago as well as insightful analysis, detailed information and general trivago data. Clicks recorded: 1088. Page views recorded: 1086.

Engagement Test: Engagement level $1088 / 1086 = 1.002$. *Users visit this page only to go to another one. What is the purpose of this page?* Users go to: Academy (316 clicks), Help (95 clicks) and News (54 clicks). *Give priority to Academy out of three. Or give more importance to the other two to engage users more with them as well.*

Header Test: Number of clicks on drop-down menu button is 345 or 31.71% which can happen in two cases: (1) Users have just arrived to Knowledge page and they already want to leave (they didn't want to get here in the first place, or the information they were looking for wasn't the one displayed) and (2) Users have already visited News/Help/Academy tabs and now they are doing an extra click visiting Dashboard even though they could go directly using the drop-down menu button. *We should avoid that the users click more than it's actually required to achieve what they need.*

Appendix A.3 Pending changes page

Pending changes tab is a part of Logs page which enables you to review all bid changes you have made on trivago Intelligence. Pending changes view helps to review all the hotel-

locale combinations with pending bids to be sent live. Clicks recorded: 842. Page views recorded: 470.

Engagement Test: Users' choice when it comes to sorting the columns in the grid: New CPC (147 clicks), Current CPC (16 clicks), Hotel name (5 clicks), Partner reference (5 clicks), POS (1 click), Item ID (1 click), User (1 click). *For the users, the most useful column for sorting the data is New CPC.*

Header Test: In the navigation bar, users heavily go from this page to Hotels page (96 clicks) - compared to other pages (<14 clicks). *Put main focus on Hotels tab. Also there's an obvious correlation between these two pages. Users should be able to easily access the information and switch between the views.* Let's say that the users want to navigate from the Campaigns page to Pending changes page. In that case they need minimum of 3 clicks and wait until Dashboard and Logs load even though that's not necessary for Pending changes. *We should avoid that the users click more than it's actually required and wait more than it's needed.*

Appendix A.4 Hotels page

On Hotels page users can analyze traffic and performance data on a hotel level and also change bids for hotels. Detailed information is shown by clicking on the hotel name. Clicks recorded: 39168. Page views recorded: 10000.

Engagement Test: Users often select all the hotels displayed (1947 clicks). *Provide actions for the users that involve manipulation on the whole set of data (hotels).* Export is used more than import (738 clicks over 293 clicks). Users mainly filter by Hotel name (792 clicks) and Partner reference (690 clicks). Unlike in the Campaigns page, users find calendar pretty useful when displaying the desired data (4899 clicks or 12.51%).

Appendix A.5 CPCs page

On CPCs page users can see detailed traffic and performance data on CPC level. Clicks recorded: 16157. Page views recorded: 10000.

Engagement Test: Export feature is used a lot (1930 clicks or 11.95%). Comparing the level of engagement with Hotels page: (1) Hotels: $39168 / 10000 = 3.92$ and (2) CPCs: $16157 / 10000 = 1.62$. From this tab, users navigate the most to Hotels tab (1885 clicks or 11.67%).

Appendix A.6 Point of sale page

Point of Sale page provides detailed daily traffic and performance data on a Point of Sale basis (markets). Clicks recorded: 19953. Page views recorded: 10000.

Engagement Test: Export feature is used a lot (1150 clicks or 5.77%). Users switch a lot between the point of sales (3701 clicks or 18.55%) which is expected considering the content of this page. From this tab, users navigate the most to Hotels page: Hotels (823 clicks), CPCs (313 clicks), Dashboard (275 clicks), Somewhere else (122 clicks), Point of Sale (109

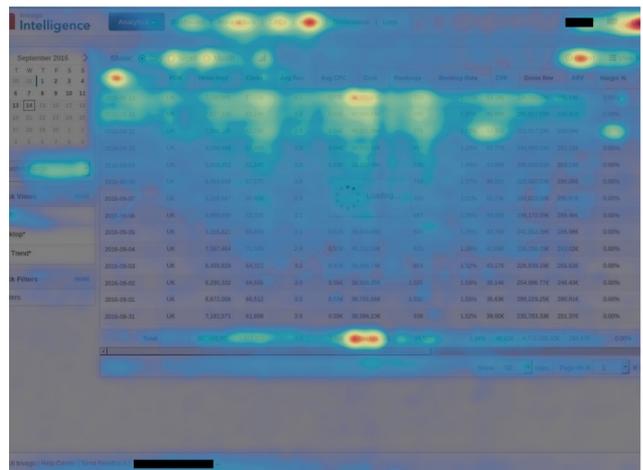
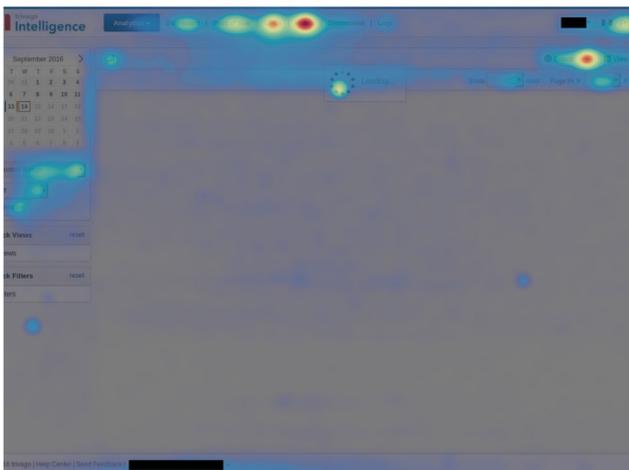
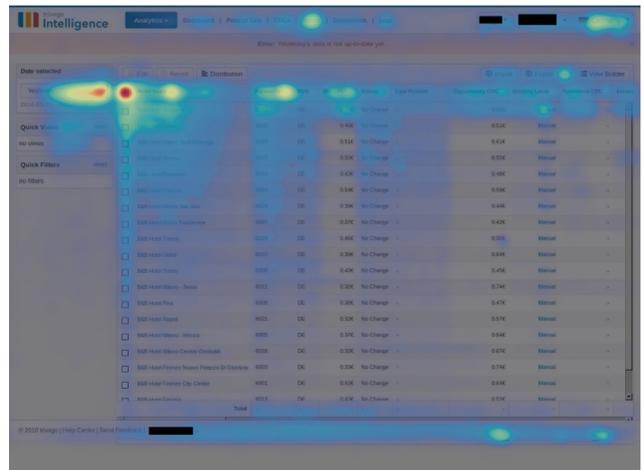
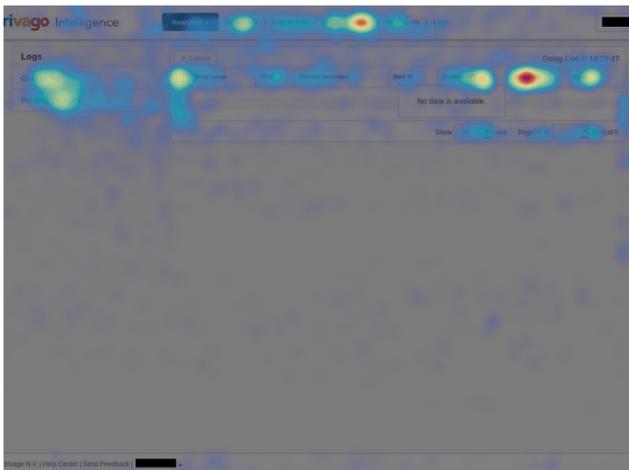
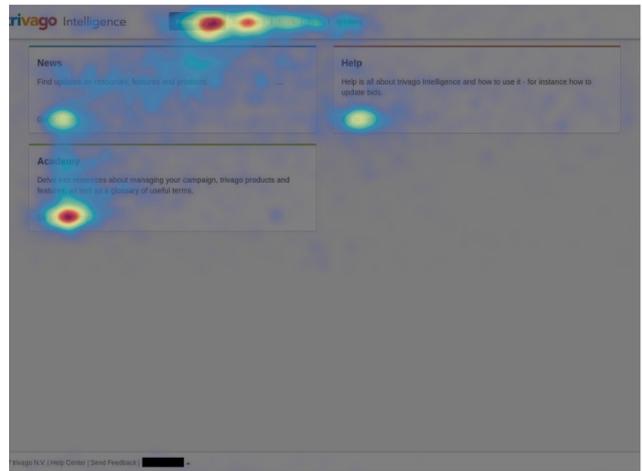
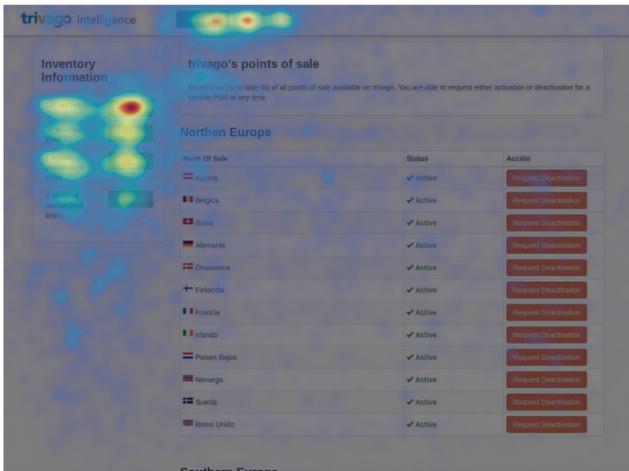


Figure 7: Heat maps from top to bottom, left to right: Account, Knowledge, Pending changes, Hotels, CPCs, POS

clicks), Logs (58 clicks) and Dimensions (47 clicks). Users' preferred choice in sorting the rows is by Date (393 clicks). Users go for Custom Date Range from selector bar more than Date Range picker: Custom Date Range (679 clicks), Date Range picker (4 clicks).

Information Test: Users are especially interested in the Cost column and total of Cost in the grid. *This values could be more highlighted in a new design.*

Appendix B User actions

This appendix contains a short analysis of the remaining 16 User Actions. User Actions number 1 and 5 have already been discussed in details.

User Action number 2: *How many campaigns that were created through Create a campaign page went live?* Goal: *The process of Automated Bidding (by target) should have a high success rate.* HEART category: *Task success.* Metric: *Number of campaigns that went live per number of created campaigns.* Data is taken from MySQL database and it is tracked since 14th February 2018. February: 49 campaigns went live out of 65 in total = 75.38%, March: 53 out of 57 = 92.98%, April: 79 out of 83 = 95.18% and May: 65 out of 67 = 97.01%.

User Action number 3: *How much time do the users need to create a campaign?* Goal: *The process of creating campaigns should be as smooth as possible.* HEART category: *Task success.* Metric: *Average time that the users spend on creating the campaign.* Data is taken from Google Analytics and it is tracked since 14th February 2018. February: 51 seconds, March: 1 minute 9 seconds, April: 1 minute 22 seconds, May: 52 seconds.

User Action number 4: *How successful are the users in creating the campaigns?* Goal: *The process of creating the campaigns should not have a high error rate.* HEART category: *Task success.* Metric: *Number of displayed error messages per number of created campaigns.* Data is taken from Kibana and it is tracked in a period of 30 days before 20th of May 2018. Results from Kibana show that 0 exceptions were thrown while creating the campaign.

User Action number 6: *At which part of Create a campaign form the most users give up?* Goal: *The UI for creating the campaigns should be intuitive and not confusing for the users.* HEART category: *Task success.* Metric: *Number of users to leave the AB feature at a specific point of their journey.* Data is taken from Hotjar and it is tracked in a period from 16th February 2018 until the page reached 298 views. Number of clicks on each part of Create a campaign form: Campaign name (203 clicks), Select markets (189 clicks) and Apply button (80 clicks).

User Action number 7: *How many users are using the guidelines for campaigns?* Goal: *The users should understand how the campaigns in Automated Bidding work.* HEART category: *Adoption.* Metric: *Number of users that check relevant information per total amount of users.* Data

is taken from Kibana and Google Analytics and it is tracked in a period of 30 days before 20th of May 2018. Number of hits to Campaigns page: 815. Number of hits to Create a campaign page: 144. Number of hits from Automated Bidding knowledge page to Campaigns page: 2 (2 out of 815 = 0.25%). Number of hits from Campaign Optimization knowledge page to Campaigns page: 0 (0 out of 815 = 0%). Number of hits from Campaigns page to Knowledge page: 29 (29 out of 815 = 3.56%). Number of hits from Create a campaign page to Knowledge page: 0 (0 out of 144 = 0%).

User Action number 8: *Do users make meaningful transitions for campaigns?* Goal: *The users should be able to understand the life-cycle of the campaign.* HEART category: *Task success.* Metric: *Number of transitions that happen the most.* Data is taken from MySQL database and it is tracked since 14th February 2018. Number of transitions from Live to Live (when users edit the campaigns): 345. Number of transitions from Scheduled to Live: 295. Number of transitions from Pending to Initiated: 272. Number of transitions from Initiated to Scheduled: 171. Number of transitions from In review to Scheduled: 110. Total number of all the other transitions: 309.

User Action number 9: *How frequently the users change (increase / decrease) CPA target of the campaigns?* Goal: *The platform should allow users to reach their goals with campaigns in a best way possible.* HEART category: *Engagement.* Metric: *Number of CPA changes / increases / decreases per campaign.* Data is taken from MySQL database and it is tracked since 14th February 2018. Number of campaigns: 272. Number of CPA changes: 223 (0.82 CPA changes per campaign). Number of CPA increases: 137 (137 out of 223 = 61.43%). Number of CPA decreases: 86 (86 out of 223 = 38.57%).

User Action number 10: *How many partners have created at least one campaign?* Goal: *There should be as many partners as possible involved in this feature.* HEART category: *Adoption.* Metric: *Number of partners that have created a campaign per total number of partners.* Data is taken from MySQL database and it is tracked since 14th February 2018. Total number of active partners: 574. Number of partners that have created a campaign: 70 (70 out of 574 = 12.20%).

User Action number 11: *At what time in the day the users mainly create campaigns or make changes?* Goal: *Understand how the users use the feature.* HEART category: *Engagement.* Metric: *Number of created campaigns or changes per specific hour in the day.* Data is taken from MySQL database and it is tracked since 14th February 2018. Number of created campaigns between 9h and 10h: 51. Number of created campaigns between 10h and 11h: 49. Number of created campaigns between 8h and 9h: 32. Number of created campaign between 12h and 13h: 26. All the other campaigns (114 of them) have been created at other periods in the day. Users mostly cancel the campaigns between 10h and 11h: 26 times. Users mostly pause the campaigns between 10h and 11h: 5 times. Users mostly edit the campaigns between 10h

and 11h: 36 times. Campaigns mostly go live between 17h and 18h: 26 times.

User Action number 12: *What is the ratio between the usage of the campaigns and standard bidding?* Goal: *Understand the user's preferences between the two.* HEART category: *Engagement.* Metric: *Compare the level of engagement between standard bid changes and campaign changes.* Data is taken from MySQL database and it is tracked in the month of May. Level of engagement for standard bidding: 67219230. Level of engagement for campaigns: 467. This difference is significant because standard bidding is for every single hotel while campaigns include the whole inventory of hotels.

User Action number 13: *What is the revenue ratio between campaigns and standard bidding?* Goal: *Get the knowledge about where the most of the revenue for partners comes from.* HEART category: *Engagement.* Metric: *Compare the revenue from standard bidding (per partner) with the revenue from campaigns (per partner).* Data for this metric is a bit difficult to extract due to its huge size. One easier thing that can be done is to compare the revenue for each partner, for each market and for each day when the partner had live campaign and when did not.

User Action number 14: *What is the most used sorting criteria on Campaigns page?* Goal: *Users should be provided with the easiest way possible to sort their campaigns.* HEART category: *Engagement.* Metrics: *Compare the number of times that the users have used each of the sorting criteria.* Data is taken from Kibana and it is tracked during a period of 30 days before 20th of May 2018. Number of times that the users have sorted by: Status (1), Name (0), Creation date (976 - because it is default sorting criteria), Scheduled date (0), Target CPA (21) and Market (0).

User Action number 15: *How many users use the calendar to filter the campaigns?* Goal: *Understand the usage of the calendar with campaigns.* HEART category: *Engagement.* Metric: *Number of times that the users have used calendar to filter the campaigns.* Data is taken from Hotjar and it is tracked in a period from 16th February 2018 until the page reached 1832 views. Number of clicks on calendar: 0. Data is also taken from Kibana and it is tracked in a different period

of 30 days before 20th of May 2018. Number of hits to filter the campaigns with calendar: 11.

User Action number 16: *What is the most common way of filtering the campaigns?* Goal: *Understand how the users are using filters with campaigns.* HEART category: *Engagement.* Metric: *Compare the number of times that the users have filtered the campaigns for each of the filtering options (Status, Market, Name).* Data is taken from Hotjar and it is tracked in a period from 16th February 2018 until the page reached 1832 views. Number of clicks to filter by: Status (101), Market (60) and Name (40). Data is also taken from Kibana and it is tracked in a different period of 30 days before 20th of May 2018. Number of hits to filter by: Status (29), Market (4) and Name (24).

User Action number 17: *How many times have the users applied the suggested CPA target value (20%)?* Goal: *The users should be provided with the best suggested CPA value for them.* HEART metric: *Engagement.* Metric: *Number of times that the users have applied suggest target value per number of all created campaigns.* Data is taken from MySQL database and it is tracked since 14th February 2018. Number of created campaigns: 272. Number of created campaigns with CPA value of 20%: 18 (18 out of 272 = 6.62%). Number of created campaigns with CPA value higher than 20%: 7 (7 out of 272 = 2.57%). Number of created campaigns with CPA value lower than 20%: 247 (247 out of 272 = 90.81%). Average CPA target value: 11.5%.

User Action number 18: *What is the ratio between the market that has the largest amount of live campaigns and the market from which the most travelers search on trivago?* Goal: *The goal is to guide the partners to create campaigns for POS that could bring the most benefits.* HEART category: *Engagement.* Metric: *Compare the markets that have the largest amount of live campaigns and the market from which the most travelers search on trivago.* Data for this metric is a bit difficult to extract due to its huge size. One easier thing that can be done is to check for each partner, for each market and for each day whether they had a live campaign or not and number of clicks received from that market on that day.