Proceedings of the Federated Conference on Computer Science and Information Systems pp. 1389–1396
DOI: 10.15439/2016F314
ACSIS, Vol. 8. ISSN 2300-5963

Searching for information and making purchase decisions in b2b online stores. The case of the technical articles wholesale

Łukasz Wiechetek
Maria Curie-Skłodowska University,
Plac Marii Curie-Skłodowskiej 5
20-031 Lublin, Poland.
Email: lukasz.wiechetek@umcs.lublin.pl

Mieczysław Pawłowski
Onninen Sp. z o.o. Email:
mpawlowski@onninen.com

***Abstract*—This paper aims to extend current research in the area of on-line business-to-business clients preferences. A quantitative research in a form of transaction log analysis (TLA) performed by the authors allow to conclude that search log and shop basket logs are sources of viable information about business customers. Transaction log analysis allows to identify different customer groups, such as searchers and buyers. It also allows for better customization of cloud of tags, so that the results are better tailored to customers' preferences. It turns out that a large list of products (result of search process) is not a deterrent to purchasing on-line. However, in order to facilitate the purchasing process b2b platform should offer additional filtering mechanisms.**

The main results of the research could be used by managers of professional e-commerce b2b platforms to better understand customers' needs and develop strategies to build long lasting partnerships.

Research limitations. The authors examined single b2b platform that may limit the findings generalizability, so the future research of other b2b platforms should be explored to validate the results.

Our future research should be performed to obtain the interplay between quantitative and qualitative methods of b2b clients' analysis and online shopping. It will allow for better understanding of customers' engagement and clients' unique organizational culture that may have an impact on purchasing decisions and building long time relationship.

I. Introduction

To avoid many pitfalls b2b companies should systematically analyze clients' decision making processes and improve supplier-client relationship. The Gallup research shows that in many cases b2b companies don't know the business clients opinions and needs, therefore they hardly need the feedback from the customers in order to sustain and develop business relationships [3]. The source of that feedback can be data stored in the Internet, social media platforms, that can be automatically summarized by IT systems [25, 26]. Data can be also collected by b2b platforms in a form of transaction logs (TL). Transaction logs are collected automatically and can be generated by applications, operating systems, network devices and other programmable hardware. Transaction log analysis (TLA) can be a good starting point for better understanding the purchasing preferences of business customers.

A. Collecting the data about b2b customers

E-commerce is rapidly developing phenomenon. Using information systems (IS) allows for gathering a lot of data about customers' behavior. Many companies believe that more data give better customer insights, however Gallup stated that it is not always true in b2b relations [1]. It is difficult to build lasting partnerships offering only good product or service price. This price related relationship will continue until the client finds a cheaper supplier.

In order to improve relations with customers Gallup advises to take the following steps [3]:

- Asses the company's knowledge about the business clients.
- Analyze the customer engagement drivers.
- Take the ownership of the relationship.

The above steps lead to better understanding the customer engagement and determine the strengths and weaknesses of the relationship. The weak points should be quickly identified and corrected and the strengths properly maintained. Taking the ownership of the relationship needs dialog with customer and continuous questioning about what was done well, in what areas the relation could be improved, what was missed, etc. The change should be sustainable.

As Gallup research shows fully engaged customers buy more and more often. The organic growth of the b2b business needs the understanding of business clients' needs. Some customer characteristics could be derived from the transition log analysis (TLA). Transaction logs are files that contain data collected automatically by b2b platforms. These files can consist of data about customers' search preferences: search phases, search time, session duration; buying preferences: price, discount, payment method; transportation preferences: duration, cost, volume, and many more. Therefore, the analysis of these files can be a good starting

point for exploring needs of business customers. To better understand these needs we should distinguish data stored in logs, generated by bots from the traffic generated by business users [27]. Well-identified needs are the foundation for further good relationships with customers.

The main drivers for purchasing decisions in b2b market are functionality, utility of the product and information about vendor. However in some cases just as important are some factors related to business customer personality [8]. Sometimes business clients act as common consumers and have human qualities. Therefore in order gain more profound knowledge about preferences of b2b clients pure quantitative research like transaction log analysis or knowledge extraction from the professional e-mails [28] should be complemented with psychological analysis. Chlupsa, Döhl, Lean and Hanoch claim that decision making processes are influenced by implicit motives [9]. In order to obtain a complete data describing customers some additional qualitative research like in-depth interviews, observations, and focus groups should be performed.

B. B2b customers purchasing decisions

When customer wants to buy a product he has to go through buying decision process. Psychologists have developed many models describing this process [11] most of them goes across the stages from the need to the purchase decisions. For example Engel's, Blackwell's, Kollat's model consists of five stages: need recognition, search for information, alternatives comparison, purchase decision and post-purchase behavior.

Business e-commerce customers need some tools preferably in the form of b2b platform that will allow them to convert needs into purchase. Therefore b2b platform should offer not only the mechanisms for searching the right product but also give the possibility for product comparison and finally offer a simple mechanism for filtering and purchasing. Furthermore, the additional mechanisms should collect information about the course of the purchasing process and also store the purchase history. This functionality results in higher hardware requirements but allows for better fitting the IT system to the needs of the business consumer and build customer loyalty.

IT solutions are not sufficient condition for the success. Khan, Naumann and Williams [12] examined factors that drive customer satisfaction and repurchase intentions. They explored Japanese business-to-business service customers. According to their findings personal interactions have great impact on repurchase intentions. The researchers observed that in Japanese context, product perception is less important than personal contact. They claim that personal business relationships are very important.

Belonax, Newell, Plank [13] investigated buyer perception of trust and expertise of the salesperson. They claim that this perception was higher in less important purchases than extremely important purchases. They also confirmed positive relationship between trust and expertise. Perception of trust and expertise is positively affected by the frequency of purchase contacts.

Cano, Boles and Bean [14] examined the communication media preferences in business-to-business transactions. They concluded that in most cases buyers and sellers prefer face-to-face or telephone communication rather than other types of communication tools. The communication ways vary throughout process purchase. For the efficiency of the sales process salesman must understand buyer's communication needs and adapt to this type of communication. Finally researchers conclude that communication process should be managed in order to be cost efficient in short time but also build stable long-run relationships.

There can be concluded that the purchase act in business to business environment is preceded by a number of preparatory steps. The buyer has to trust the seller and believe in his expertise. Good communication is crucial for building the trust. The communication preferred by b2b customers should be face-to-face but in many cases, through the development of technology it can be successfully supported by b2b platforms.

C. Building relationships with b2b clients with IT

Trusting and more satisfied clients are more likely to continue cooperation. Attracting and keeping customers can be achieved no only through functionality, utility of the product and information about vendor but also by offering additional services i.e. shipping cost and duration, payment form and conditions. Mingming and Parlar [10] used leader-follower game to check whether buyer is willing to increase the purchase value to get free shipping.

B2b platform can be also the tool for building customer loyalty. The structural equation modeling was used by Hsu, Wang and Chih [5] to explore how web platform characteristics influence customer loyalty and positive opinions. It was found that web site characteristics has a positive influence on relationships. Performed research showed that web site attributes can be good predictors for customer's loyalty, high-quality e-commerce platform results in more satisfied user.

Sila [6] collected surveys form 275 North American companies using b2b electronic commerce and found that the biggest contributor to b2b usage is scalability.

Taehee, Jonghoon, Junho, Sang-goo showed that the quality of b2b platform can be improved by using ontology-based product recommender system instead of systems based on the text-retrieval technique [7]. They addressed the results ranking problem by modeling the product ontology as a Bayesian belief network.

As we can see, there are many ways to build relationship with customer e.g. price, quality, delivery terms. B2b platforms can be an important part of maintaining

relationships with business customers. They play the role of an organization business card but in some sense also a kind of expert system. Moreover, the data recorded by the platform in the form of transaction logs can be a source of valuable information about customers' purchase preferences and can be used for increasing the efficiency of trade.

D. Shopping basket analysis

B2b platform can be used as a tool for collecting data about customers, tool for building relations with customer or image building tool. An interesting data for the analysis that can be collected by the b2b platform are the shopping baskets. Analysis of the shopping cart can provide a valuable information about the needs and behavior of on-line and off-line consumers. We can find many researches in the area of: what (and when) is being purchased [15][19], shopping basket size and value analysis [16], effect of sales promotions on shopping basket [17][18], the cart filling time [20], the influence of smart shopping card on shopping behavior [21], or determinants of consumers' online shopping cart abandonment [22][23][24].

Mallapragada, Chandukala and Qing [15] investigated the impact of what product and where being shopped. They examined 773,262 browsing sessions resulting in 9,664 transactions and noticed that website communication tools are positively correlated with basket value. They confirmed also that number of products available in the on-line store is positively associated with duration of the visit and the value of the basket.

Anesbury, Nenycz-Thiel, Dawes and Kennedy [20] examined in details behavior of 40 shoppers by recording (screen recording) online shopping trip of new, inexperienced grocery customers. They concluded that shopping process is quite fast. The 12 item shopping took less than 10 minutes. Clients mostly have chosen items from the first results page. Customers used rather default display options presented on the on-line store. Finally researches stated that in terms of time and efforts grocery on-line clients are quite similar to off-line shoppers.

List of the determinants of consumers' online shopping cart abandonment was presented by Kukar-Kinney and Close [22]. They confirmed that categories of cart abandonment determinants should include entertainment value (using web page only for information purpose), concern about costs, waiting for better price, privacy and security concerns. They concluded that customers leave the basket not only because of dissatisfaction with the product. They often use on-line platform just for tracking prices. The basket leaving does not necessarily mean abandoning the purchase. Some clients are going to decide to buy selected products in the near future, e.g. waiting for right time or maybe better price.

Mentioned researches were mainly related to retail customers. The above cases confirm that the shopping cart analysis provides valuable information that can be used to build clients loyalty and improve platform conversion rate.

In this article we want to present the shopping cart analysis of the customers of the technical articles wholesale. In order to describe searching process and better understand purchase decisions of b2b clients.

II. Methodology and Research Model

A. Research questions

The main research questions are:

- What are the main characteristics of the search phrase?
- How many items are returned in a single search procedure?
- What kind of users buy products using the business-to-business platform?
- Do b2b clients use during search procedure the advanced manual filtering mechanism to complete the purchase?
- What is the average size of the list returned by the query? This may describe both the ability to find the right product by the customer and product range offered by the platform.
- What is the optimal size of results list allowing to finalize the purchase? It seems that too small or big size of the results list is not conducive to adding items to the shopping cart.
- How many shopping baskets were filled by single user during the examined period?

B. Explored data

The Authors' explored log files generated by users of the online technical articles wholesale. The use case diagram of explored b2b platform is presented on Fig. 1

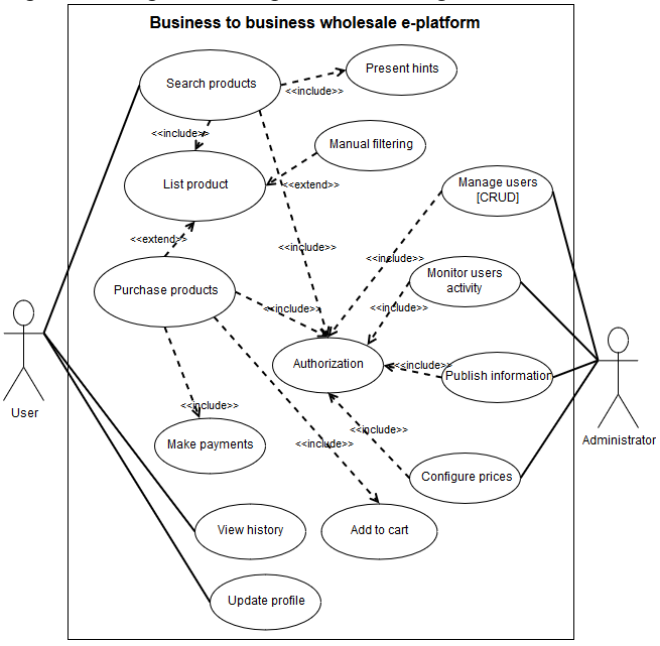

Fig. 1 The use case diagram of explored b2b platform

The explored b2b platform is technical articles wholesale. It has two groups of actors: business users and administrators. Registered business customers can use the platform to search for the products, view products characteristic, make a purchase, make a payment or view purchase history. Administrators can create and manage users' accounts, monitor users' activity, configure prices or promotions and finally add news.

The sample screens of searching mechanism of investigated b2b platform were shown on Fig. 2 and Fig. 3.

Fig. 2 Search inbox and prompt screen

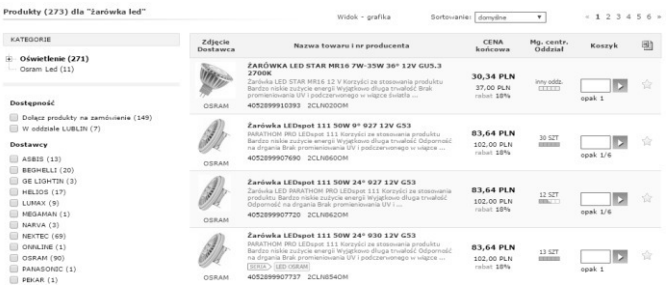

Fig. 3 Product list filters

We explored 596130 logs generated between September 1st 2015 and October 31st 2015. The logs were generated by 4824 b2b customers.

A log file collected by the platform contained information about search phrase, search date and time, customer ID, number of products found (Fig. 4).

```
Phrase;DateAndTime;CustomerID;NoOfRes
22x3/4 mufa ;2015-9-1 06:10:39;0093689001;3
kolano 22x3/4 ;2015-9-1 06:10:56;0093689001;12
mufa 22  ;2015-9-1 06:11:15;0093689001;28
filtr 3/4 płuk;2015-9-1 06:11:35;0093689001;3
forum   ;2015-9-1 06:12:13;0096764001;15
króciec 3/4 ;2015-9-1 06:12:31;0093689001;10
```

Fig. 4 Part of an analyzed log file

C. Research procedure

The research procedure was presented on Fig. 5. We divided the procedure into the following stages: data collection, data selection, data completion, basket linking, quantitative data analysis and conclusions.

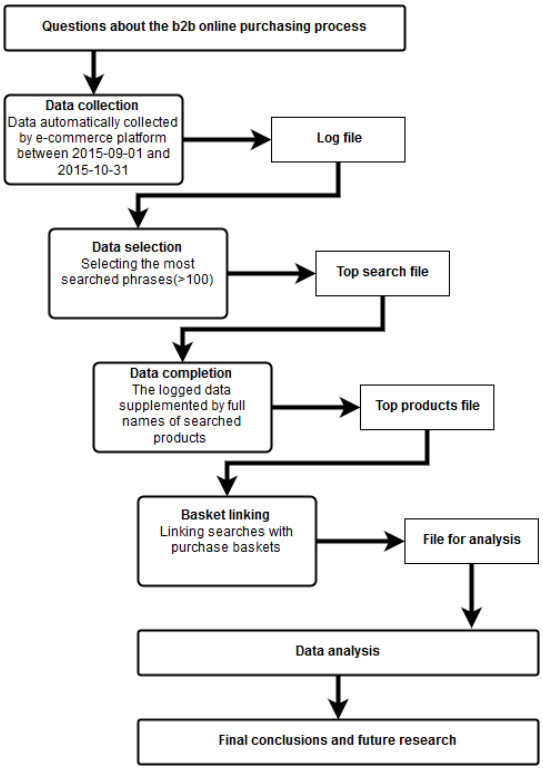

Fig. 5 The research procedure

- The mechanisms implemented on the b2b platform allowed for the collection of transaction logs without the need to turning on the debug mode.
- The automatically generated log file was limited to the most popular phrases. We selected the phrases that were searched more than 100 times in the period of two months. As the result we obtained the list of 367 the most popular phrases (Table 1).
- The list of the most popular search phrases has been supplemented with the list of full products names that were returned by searching mechanism. We used SQL command `[select product from product_list where product_name like "*searched_phrase*"]` This extension was performed only for the 367 most popular search phrases.
- Knowing the indexes of searched products we linked them with shopping basket logs stored in the system. The obtained file became the input for further quantitative analysis.

III. Data Analysis

The qualitative analysis of the incidence of search phrases showed that the most frequently occurring phrases are: pipe, pump, LED, boiler, valve, heater, sink. Mainly pure text phrases (3-11 characters) that included general name of searched object or the manufacturer name. The "word cloud" of the most popular search phrases used by b2b customers was presented on Fig. 6.

Fig. 6 The most frequent search phases (Polish spelling)

The number of products returned by search mechanism for less popular phrases (100-500 searches) is 10-100. For the more frequently used search phrases, the number of returned products is from 100 to 1000. We can say that these are the most popular group of products but also their recognition in the form of phrases, it is very inconvenient for the user. The search phrase that returns 1000 items creates about 20 result pages. Therefore to find the right product user have to use the additional filtering mechanism. In the explored case, clients used additional filtering mechanism which is reflected in a large number of baskets containing these products (Fig. 7).

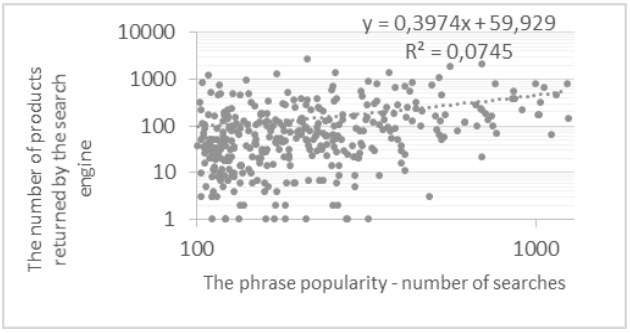

Fig. 7 Phrases popularity vs. the number of products returned by the search engine

In the second study we analyzed how the number of products in search results affected adding them into the shopping baskets. Some search processes returned a lot of products (>1000 items that is >20 pages). That should not foster adding products to the shopping carts. This seems to be problematic for the customer because there are too many items to analyze manually. However, it turned out that these common phrases were source of many purchase decisions. The most shopping carts consisted of items that were chosen from the lists of more or less 250 products (about 5 pages).

From the Fig. 8 we can conclude that the optimum number of products fostering the purchase act is from 30 to 150 items (1 to 3 pages). A larger number of results gives a minimal purchase increase till the point where we have again an increase in the number of items in a baskets. The second area of purchase increase is observed in the range from 600 to 800 returned items. However we assume that it is due to product attributes but not due to the user's convenience. We can say that this kind of inconvenience does not prevent the user from buying. Users seem to continue buying process using manual filters. The question for the future analysis is what kind of additional filtering has been applied to finalize the purchasing process? Currently, the platform does not register information about usage of manual filter.

TABLE I.
THE NUMBER OF PRODUCTS RETURNED FOR A PARTICULAR SEARCH PHRASES

Number of items	Phrase count
1-10	56
11-20	25
21-30	31
31-40	32
41-50	18
51-60	18
61-70	15
71-80	19
81-90	8
91-100	13
101-110	6
111-120	10
121-2720	7 - 1
Total	367 phrases

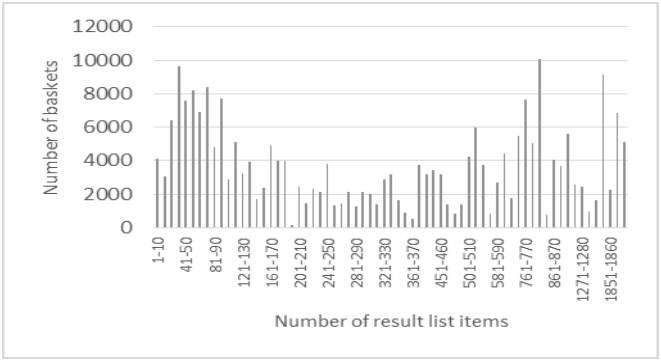

Fig. 8 The most frequent search phases

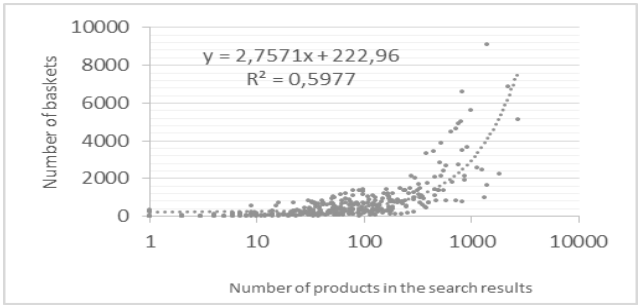

Fig. 9 Search results vs the number of baskets

In the next study we tried to find how the search results are distributed among the population of users. Fig. 10 shows that the majority of users receive less than 200 products as the search results (1-4 pages). That amount of results is possible to read and familiarize with the offer. Larger lists of products was obtained by much smaller group of users.

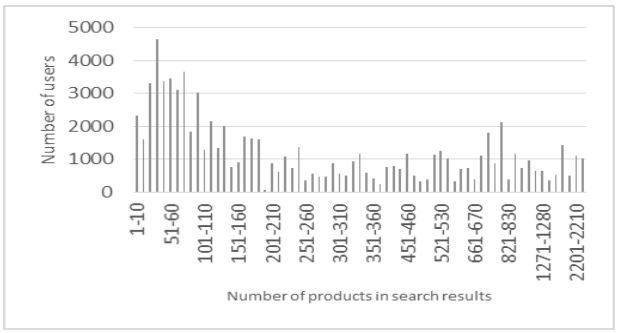

Fig. 10 The number of users obtaining a given number of products as a search results

We also examined how many baskets per customer was created using the same search phrases (Fig 11).

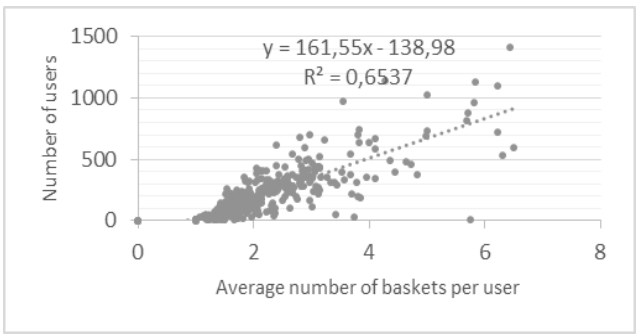

Fig. 11 The average number of baskets per user

As it was shown on Fig. 11, it turns out that during the two-month period it was only from 1 to 4 baskets. As for the b2b shopping it is not a staggering number.

IV. Conclusion

The performed research gave an answer to many questions connected with b2b clients purchasing process. However, were also the source of many new questions. The conducted analysis shows that:

- Transaction logs are source of viable information about customers' behavior and functioning of the b2b platforms. They can be used to investigate customers' purchase decisions and improve the efficiency of b2b tools.
- The examined platform users, specialists in electrics, hydraulics, ventilation used mostly short (from 3 to 11 characters, 1-3 words) text search phrases like pipe, valve, LED, pump, boiler, which as a result gave many pages of items. Thus, the effective platform should include easy-to-use tools that allow for selecting one particular item from an extensive list.
- The performed research was complicated by a set of search phrases resulting in a large number of products found. It turns out that large result lists does not stop customers from finalizing the purchase. However, we weren't able examine how business clients passed from the results list to selecting one specific item. We assume that they used additional manual filtering mechanism rather than reading page after page.
- Our analysis allowed to discover three groups of customers: buyers (few searches and a lot of items in cart), searchers (a lot of searches and few items in cart) and regular ones (few searches and few items in cart).
- The search phrase used by the customer indicates the search engine what subset of offered products should appear on the screen. The user can view presented list and decide whether to make a purchase. The search phrase belongs to customer every-day language and it is not precise. We can say that it is a client's way of naming the class of products. Frequently used short, text phrases gives from 1 to 2720 results. But the most popular phrases returns less than 120 items (3 pages) (Fig. 7, Table 1). In our opinion it is acceptable result for the next manual analysis. The question is the fit and the usefulness of returned results. The conclusion is that most of phrases returns reasonable number of product, so it shouldn't result in inconvenience of shopping and stopping the customer from buying. However we must clearly state the assumption that examined search process was performed with the intention of purchase and there were no obstacles for an effective purchase.
- Fig. 10. shows that users got mostly 1 to 4 results pages. So they were able to read and analyze presented items and finalize the purchasing process. The b2b clients used the same search

phrases only to complete from 1 to 4 shopping baskets.

- The optimal number of products in search results list allowing to finalize the purchase is from 30 to 150 items (1 to 4 pages). However the users with the score of 20 results pages also weren't discouraged from making purchases.
- Search mechanism "clouds of tags" should be reconfigured in order to return less than 200 items (1-4 pages) as a response to the commonly used search phrases.
- If search phrase gives more than 1000 items, client should be supported with additional filtering mechanism or advanced search mechanism allowing for more precise searching.
- The additional extended tests should be performed in order to determine if, in fact, a large number of products in the results discourages customers or makes it difficult to buy the right product (lack of purchases). To perform this research we should use search phrases of similar popularity that gives different number of products found.

V. Future Research

As The Gallup research indicated to build better b2b strategy the companies should combine quantitative (automatically collected) data with a qualitative "small-data" approach [1]. In the future studies we want to obtain interplay between quantitative and qualitative methods so we intend to examine small groups of b2b platform users using in-depth semi-structured interviews and focus groups to measure customers' engagement, and know better client's unique organizational culture. The interesting material for deeper analysis could be obtained also by recording (screen recording) the on-line shopping process [20]. The authors examined single b2b platform that may limit the findings generalizability so in the future research other b2b platforms should be explored to validate the results [2].

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