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USER EXPERIENCE EVALUATION ASPECTS OF LITHUANIAN NATIONAL MUSEUMS WEBSITES

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Abstract

Purpose. The focus of this article is to explore the differences in task completion time between National museum websites when user is searching for important information to him and after taking measures and analysis of the results to produce conclusions and recommendations on optimization and improving museum websites interfaces.

Design/methodology/approach. The research was done with all four Lithuanian national museum websites: National Museum of Lithuania, Lithuanian Art Museum, M. K. Čiurlionis National Museum of Art and National Museum – Palace of the Grand Dukes of Lithuania. User's behavior on searching most important for them information in websites was measured with eye tracking equipment and users gaze plots and heat maps were analyzed. The data collection was made by setting a temporally mobile eye tracking laboratory inside museum near the entrance into exhibitions. 110 respondents were used, the overall Lithuanian structure of male/woman and group of ages was maintained.

Findings. The analysis of gazing plots and heat maps showed that clear space around the menus matters: users can find information significantly faster. Also adding the third level in the website and placing important information there makes double search time for user. Overall best results was on Palace of the Grand Dukes of Lithuania website: the design and clear structure are important for the time visitors have to spend on museum website in searching important information.

Research limitations. The scope of this research is the Lithuanian National museum websites. Further research can assess to other countries museum's websites.

Practical implications. The research results may help on improving Lithuanian National museum websites and contribute to the new knowledge about designing successful interfaces for museum websites. Also the results could be used and in broader field on improving interfaces and information representation for websites in general.

Originality/Value. It was first time in the museum research in Lithuania when the eye tracking technology and equipment were used. The analysis results may contribute to the new knowledge about designing successful interfaces for museum websites.

Research type: research paper.

Keywords. Lithuanian National museums websites, eye-tracking, user's behavior, reading paths, information finding time.

1. Introduction

The research results presented in this paper is funded by Research Council of Lithuania under project *Research on increasing the attractively and optimizing virtual access of Lithuanian national museums* (LitMus-Web).

Museums are important part of cultural and creativity industries. The part of these industries in the economy of modern countries are growing in the past years: more jobs in these fields appears in recent years, more revenue are obtained, and bigger part of GDP pie is taken (Rifkin, 2003). Nowadays museums are not limited to traditional functions - to collect, preserve, restore, research, and exhibit and promote the material and spiritual cultural values and natural objects. Term *New Museology* reveals the changing functions of the modern museum. The focus goes from museum objects and collections to visitors and associated social communities. According to *New Museology* representatives, all museum dedicated methodologies and concepts must start with identification of user needs (van Mensch, 1992).

Information and communication technologies are changing and our society. These changes are influencing and museums. We can observe how museums are transforming into organized virtual systems on the internet. Museums are searching ways for society participation into their activities. The need to attract more online visitors occurs, so museums trying to use various communication channels on the internet. One of the most used channel is communicating via official museum websites. Here museum employees are facing with some challenges: the lack of knowledge and abilities for full exploitation the potential of communication possibilities via website. When creating own websites some of museums are trying to use as guidelines MINERVA *Cultural Website Quality Principles* (2005) prepared in 2005. These principles describes recommendations for good quality cultural websites. The problem is that these principles are very broad and not adopted to cultural, social and political requirements of specific countries. There are some requirements for websites in Lithuania formulated by government and public sector institutions also (Directory of European and national rules on Web Applications. Lithuania, 2008). But these requirements also are very broad and adopted to almost all industry fields, but are not adopted to specific museum needs. We believe that deep understanding of specific user needs and expectation are crucial on formulating specific requirements for good quality museum websites.

There are a lot of eye tracking studies based on gathering eye movement data while participants were engaged in typical information search tasks on web pages were performed in recent years. Goldberg at al. (2002) conducted an eye tracking study and evaluated specific design features for a prototype web portal application. Findings emphasized the need to place critical portlets on the left and top of the web portal area. Josephson and Holmes (2002) in their study recorded eye-movement measures while subjects repeatedly viewed three different kinds of internet pages (portal, advertising and news story page). Findings showed that some viewers' eye movements may follow a habitually preferred path (scanpath) across the visual display. Granka at al. (2004) using eye-tracking investigated how users browse the presented abstracts and how they select links for further exploration. The results were focused on the amount of time spent viewing the presented abstracts. Russell (2005) in this study discusses the contributions of eye-tracking data to traditional usability test measures for first-time usage of websites. He

concludes that the eye-tracking data revealed which aspects of the website received more visual attention and in what order they were viewed by users. Nielsen (2006) research eye tracking visualizations show that users often read web pages in an F-shaped pattern: two horizontal stripes followed by a vertical stripe. Shrestha and Lenz (2007) study show that users follow a fairly uniform scan path when browsing through pictures, and a more random path while specifically searching through them. Thomas S. Tullis (2007) was seeking differences in how different participant age groups scan webpages. He found that on the average, the older adults are spending 40-50 percent more time looking at the content of the pages and at the navigation areas than did the younger adults. Ehmke and Wilson (2007) conducted user testing of two websites and extracted a set of diverse usability problems from the data. These problems were analysed and some were correlated with users' eye-tracking patterns. Soussan Djamasbi at al. (2010) were tracking Generation Y age group participants' eye movement while browsing pages that were most and least liked by previous study. The results suggest that participants of that age group may prefer pages that include a main large image, images of celebrities, little text, and a search feature.

However, not so many researches were done with museum online web sites. Eye tracking technology are quite often used for physical exhibitions analysis and not so often for online websites evaluation. Milekic (2010) did few theoretical researches on designing websites for museums. Some other researchers (De Caro, Di Blas, Spagnolo, 2010) was trying to identify the main aims of museum website's, such as supporting a variety of communication goals (providing practical information, offering an quick understanding of the collections ideas), supporting a pleasant and exiting exploration, allowing the user to quick locate a specific of content and so on. Hanson (2010) in her paper examines components of information search by younger and older adults using the British Museum website. Eghbal- Abdullah at al. (2011) conducted empirical investigation to test the hypotheses linkage between cognitive styles and user interface (as new medium to allow museum collections to be exhibited and promoted more effectively) dimensions. Their results suggests cognitive styles do influence user interface dimensions. Eghbal-Azar and Widlok (2012) demonstrates the potentials and limitations of mobile eye tracking in visitor studies and other social science research in the context of a comparative study of two exhibitions at two museums in Germany. Deuschel at al. (2014) in their paper describes a novel approach to satisfy the needs of museum's website visitors with a unique experience that cannot be reproduced in the museum itself. The proposed approach claims to fill the gap between current digital museums and the needs of the digital museums' visitors. The importance of eye tracking technology in user experience field understand and such companies like *Google*, using eye tracking as a qualitative supplement to think aloud studies or running controlled experiments where eye tracking is the main source of data on improving user interface quality.

There are no data about eye tracker based researches with museum websites done in Lithuania. The analysis results may contribute to the new knowledge about designing successful interfaces for museum websites. Also the results could be used and in broader field on improving interfaces and information representation for websites in general.

The aim of this paper is to find the differences in task completion time between National museum websites when user is searching for important information to him. Some research tasks was formulated:

- To measure user behavior in websites, analyze and determine the browsing speed and ways to the most important spots of interest and most important information for users (on the basis of data of user most visited website parts and expectations gathered earlier in this research).
- To find out which National museums of Lithuania website requires most and least time spend to find the information user needs.
- To produce recommendations on optimization and improving museum websites interfaces, hereby making museums more attractive to visitors and improving the competitiveness of the museums.

In order to measure user's behavior eye tracking hardware and software was used on implementing tasks mentioned above. This equipment allows to precisely determine areas of interest on the website together with entry points, reading paths, time spend, etc. Based on these measures the analysis was done, conclusions and recommendations for museum webpages optimization to increase a user experience was formulated.

2. Methodology

It was first time in the museum research in Lithuania when the eye tracking technology and equipment were used. Eye tracking equipment and technology makes it possible to find out websites visitors' basic focus points, entry points and reading paths, time spent, fundamental interests, and so on.

The research was done with all four Lithuanian national museum websites: *National Museum of Lithuania* (NML, www.lnm.lt), *Lithuanian Art Museum* (LAM, www.ldm.lt), *M. K. Čiurlionis National Museum of Art* (ČNMA, www.ciurlionis.lt) and *National Museum – Palace of the Grand Dukes of Lithuania* (PGDL, www.valdovurumai.lt). Three museums (NML, LAM, ČNMA) each have lot of departments spread all over the country, but the websites of each department are under the parent museum website. So three departments of each these museums was used in experiment (in order to find differences between being on the top, middle or bottom of departments list) – one from the top of the list (N1, D1, C1), second from the middle (N2, D2, C2), and third from the bottom (N3, D3, C3). PGDL has no departments so their website structure are simpler and just the main museum was used in experiment (V).

The following abbreviations used in this paper:

N1 – *The Old Arsenal* (department of NML, http://www.lnm.lt/ekspoziciniai-padaliniai/senasis-arsenalas),

N2 – *Kazys Varnelis House-Museum* (department of NML, http://www.lnm.lt/ekspoziciniai-padaliniai/kazio-varnelio-namai-muziejus),

N3 – *Jonas Šliūpas Memorial Homestead* (department of NML, http://www.lnm.lt/ekspoziciniai-padaliniai/jono-sliupo-memorialine-sodyba),

D1 – *Museum of Applied Art* (department of LAM, http://www.ldm.lt/TDM/Index.htm),

D2 – *Pranas Domšaitis Gallery* (department of LAM, http://www.ldm.lt/PDG/Index.htm),

D3 – *Museum of Miniature Arts* (department of LAM, http://www.ldm.lt/JPS/Index.htm),

C1 – *M. Žilinskas Art Gallery* (department of ČNMA, http://www.ciurlionis.lt/zilinsko),

C2 – *Ceramics Museum* (department of ČNMA, http://www.ciurlionis.lt/keramikos),

C3 – *V. K. Jonynas Gallery* (department of ČNMA, http://www.ciurlionis.lt/jonyno),

V – *Palace of the Grand Dukes of Lithuania* (PGDL, http://www.valdovurumai.lt).

The data collection was made by setting a temporally mobile eye tracking laboratory inside museum near the entrance into exhibitions. 110 respondents were used, the overall Lithuanian structure of male/woman and group of ages was maintained. Respondents was placed in front of laptop with eye tracking equipment (*Tobii X2-30 Eye Tracker*) mounted and eye tracking software (*Tobii Studio 3.2*) installed. Second monitor was connected and used for live preview of respondent's actions. Participants were seated approximately 60 cm away from the computer monitor. After calibration, before going to the main tasks respondents was asked to enter their sex and age. Then small exercise was provided, making respondent comfortable with the system. Each respondent was given three tasks: to find the working hours, to find the entrance ticket price and to find information about the exhibitions. Tasks were selected according another research on the same Project on most important information for museum websites visitors. All tasks were done on all four national museums websites starting the task from homepage.

System configuration. The system was configured to use *Tobii* recommended *I-VT filter*. Fixations (fixations are stops during which the brain starts to process the visual information received from the eyes; fast jumps from one fixation to the other are saccades) was defined as having fixated in a given area for at least 60 ms (shorter fixations was discarded). The length of a fixation is usually an indication of information processing or cognitive activities. Regressive saccades and the saccade pattern can reveal confusion and problems understanding. Vision is largely suppressed during the movement. The end point of saccade cannot be changed during the movement. Velocity calculator window length was set to 20 ms, gap fill-in length to 75 ms. Adjacent fixations was set to merge if maximum time between fixations do not exceeds 75 ms and angle between fixations is less than 0,5 degree.

Eye tracking metrics. In order to find out the browsing speed and ways to the most important information for users on National museum websites, few eye tracking metrics were measured. First is **time to first fixation.** It shows the time for a participant to first fixation on a specific area of interest (AOI). Time to first fixation is linear variable, counted in milliseconds. Taken on its own, this metric doesn't reveal much. However, when compared to other areas of interest, time to first fixation can show which elements of the page are drawing a user's attention in the context of the task they are asked to perform. Time to first fixation was used to measure task completion time: from the beginning of test to the moment user gaze enters AOI (he finds required information). Findings could show that some elements of the page completely unrelated to completing a task are competing with those that are related to the task. The number of fixations a participant has on a pre-defined AOI was measured as **fixation count**. All webpages areas were defined as AOIs. **Mouse click count** are not primary eye tracking measure, therefore it could be done along the others measurements. This metric is primarily helpful when looking at the paths that users take from a single decision point within an interface. Our tasks for users was to find a specific piece of information. So mouse click count could provide information where do users click first and it comes to answers into question if users interact with faceted navigation, which elements of that navigation do they click on most?

Gaze plots (representation of user's eye movement across the screen, fixation by fixation; the size of the gaze plot dot relates to how long a user has fixated on that specific spot) and **heat maps** (representation of the different areas of the screen where the user has spent the most time looking; green color represents the least time focused on an area and red – the most time) was generated from measurements and analyzed.

3. Findings

All museums websites have no working hours, ticket price and exhibition information placed on their home pages. So, first user must find the button or hyperlink to the specific page (or few linked pages) which finally links to information user need. Time needed to find the requested information was measured and analyzed: total search time was counted from the beginning of the test and until the information was found – first fixation in AOI (working hours, ticket prices, and information about exhibitions).

3.1. Average results for searching working hours

The best **average total search time** of searching for working hours (Fig. 1) was on D2 (31 sec) and V (38 sec). N2, N1 got into middle range (45-46 sec) and D1, C1, C3, D3, N3 got into bottom range with 55-72 seconds timing. The worst result has C2 – average 83 seconds to find working hours.

Average number of fixations on searching for searching working hours (Fig. 1) also could be divided into few ranges. D2, V, N1, N2, N3 falls into first wide range with 83-128 fixations count. D1, D3, C3, C1 falls into second with 159-169 fixations. Most fixations recorded on C2 website – 199.

The measurements of **average mouse clicks** showed (Fig. 1) that at least average clicks for finding working hours needed on D2 (1,2 clicks) website. V, N2, N1, D1, D3, C1 needed 1,9-3,6 clicks. Finally N3 (4,5) and C2 (6,2) showed very bad results using 4-5 times more (to compare with C2) clicks to complete the same task.

One mouse click at least is required on all websites to find working hours (there are no working hours information on home page). PGDL has special link to the page with working hour's ant ticket prices, the rest three museums despite of having a complex webpage structure due a lot of departments, still have one mouse click access to working hours of all departments.

Figure 1. *Average results for searching working hours*

N3 has less fixations recorded to compare with another sites (C1, C3, D1, D3) with similar searching time and average mouse clicks count. One of the reasons of such results could be that it were less visual information to process on N3 web page.

It is interesting why LAM department D2 has much better results than other LAM departments. The gaze plots analysis showed that users spend a lot of time looking at the main menus (positioned on the left or top on the web sites), but seems it is not ease to find the right item in the menu. Department D1 is even placed almost on the top of departments list, but the results was worse than department D2 which is in the middle of the list. While NML's last department in the list (N3) showed worse results between other departments (N1 and N2). And ČNMA museum had even different situation – the best results with C1 department (on the top of the list), while C2 (middle position in the list) had worst results between all museum departments. Seems it is connected with visual designing of department's lists. LAM and NML have quite clear lists with the lot of space around, while ČNMA list is closely surrounded by other information.

PGDL (V) in average showed good results to compare with others, but the analysis of user's gaze plots discovered that there still could be better solutions on placing most important information for users. Most of the users are trying to find most important information for them on the main menus (left or top menus). One typical example: it took 95 seconds and 5 mouse clicks for user (man, age group 25-34 years) to find the exit from home page to the ticket price page. The user was searching this information on the top menu and in the middle part of the page, but he didn't noticed hyperlink "Opening hours and visiting prices" (Fig. 2, bottom left, in the red rectangle). After all he found another way by selecting "Excursions" from the top menu.

Figure 2. *Gaze plot of user's way to find working hours information (fastest exit – on the bottom left, marked by authors with red rectangle)*

3.2. Average results for searching ticket prices

Mouse clicks count can provide useful information about how much efforts user have to use to reach the goal – the information he is seeking. One mouse click at least is required on all websites (except NML with departments N1, N2, N3; this website requires at least 2 mouse clicks to access ticket price information) to find ticket prices if starting from home page.

The best **average total search time of searching for ticket prices** (Fig. 3) was on C1, D1 and D2 (37-40 sec). N1, V, C3 got into middle range (51-55 sec) and N3, C2 got into bottom range with 67-75 seconds timing. The worst result has N2 (88 sec) and D3 (96 sec).

Average number of fixations on searching for searching ticket prices (Fig. 3) could be divided into a few ranges. D1, C1, D2 falls into first wide range with 86-98 fixations count. N1, V, C3, N3 falls into second with 123-147 fixations. And most fixations recorded (174-227) on third range – C2, N2, D3.

Average mouse clicks count showed (Fig. 3) that at least average mouse clicks for finding ticket prices needed on D1 (1,5 clicks) website. C1, D2, N1, C2, V, C3, N3, D3 needed 2,7-3,9 clicks. N2 (6,2) showed very bad results using 4 times more (to compare with D1) clicks to complete the same task.

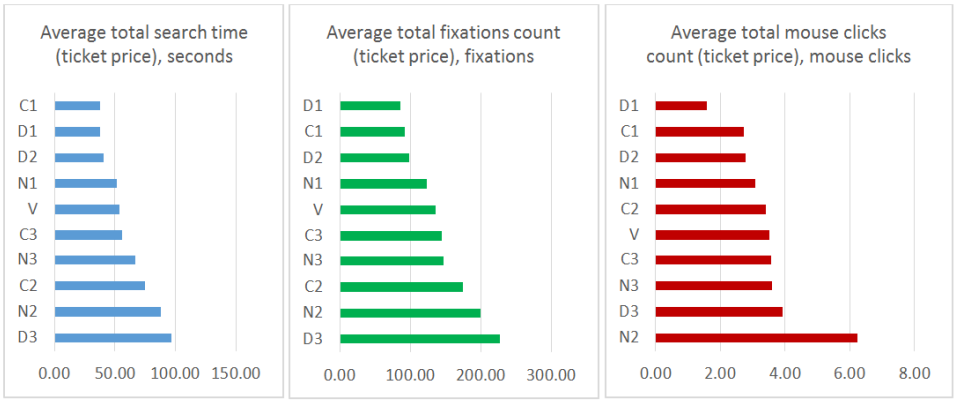

Figure 3. *Average results for searching ticket prices*

There is no visible differences when comparing searching time results with fixations counted on searching ticket price task. Significant difference could be noticed on average mouse clicks count: finding ticket price on website N2 took 50 per cent more clicks to compare with D3, while average searching time of N2 website is even shorten then D3. The reason might be more difficult structure of NML website – at least 2 clicks to access ticket prices (while all other museums requires only one click). Otherwise, finding a ticket price on N1 and N1 department showed no significant difference on mouse clicks count to compare with other museums.

On searching ticket prices the results between departments are different. Best results has departments placed on the top of the list (C1, D1, N1). Departments with lower position on the list has

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different results: NML and ČMNA worst results got on N2 and C2 (both are in the middle on the list) departments, LAM – D3 (bottom of the list).

Despite of showing best average results C1 also got the case of worst time: it took 73 seconds to find the exit from home page to ticket price information (Fig. 4). During that time on home page the respondent (female, age group 25-34 years) had 67 fixations and used 7 mouse clicks. Most of his time she spend on trying *Search* field, unfortunately it didn't helped.

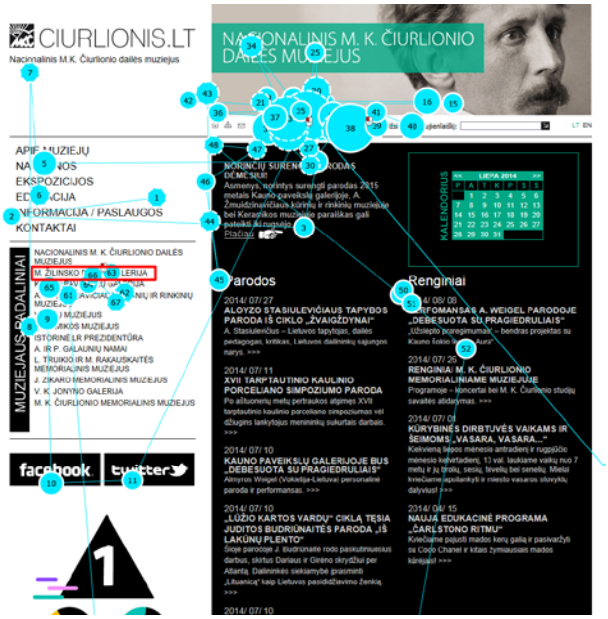

Figure 4. *Gaze plot of worst result in time on searching ticket price on C1 (middle left menu, marked by authors with red rectangle)*

3.3. Average results for searching information about the exhibitions

Access to information about the exhibitions is different on museums websites: NML departments needs at least 2 clicks to get this information, PGDL and ČNMA requires one and LAM requires no mouse clicks, because information about exhibitions is partly presented on home page. The measures showed that such placing of information on different webpage levels requires significantly different access time, fixation and mouse clicks count.

The **average total search time of searching for information about the exhibitions** (Fig. 5) could be divided into two ranges: narrow range of D1, D3, C3, V and C1 with 21-25 seconds timing and more wide range of D2, N3, C2, N2, N1 with slower results (35-52 sec).

The **average total fixation count of searching for information about the exhibitions** (Fig. 5) could be divided into few ranges: D1, D3, V, C3 and C1 with 43-62 seconds timing, second range of N3, D2, C2, N1 with slower results (91-116 sec) and most fixations was recorded on N2 website (136).

The measurements of **average mouse clicks** showed (Fig. 5) that at least average mouse clicks for finding information about the exhibitions needed on D3 (0,9 clicks) website. C3, V, C1, D2, D1 falls into second range (1,2-1,7 clicks). Worst results were on C2, N2, N3, N1 (3,4-3,6 clicks) websites in searching information about the exhibitions.

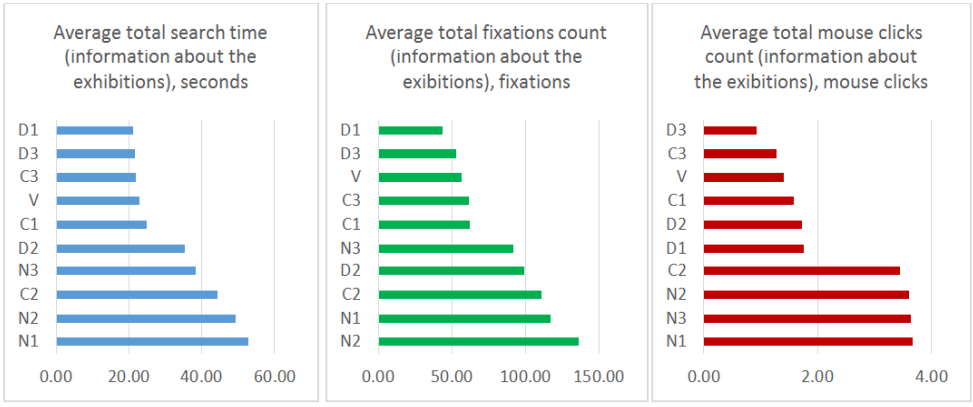

Figure 5. *Average results for searching information about the exhibitions*

Notable difference is website N2 – it has more fixations then other similar websites (N1, C2) with approximately the same searching time and average mouse clicks count.

The measures showed that placing an information on different web page levels requires not only more mouse clicks to find that information, but and different access time. In most cases one additional level in web site structure doubles the searching time. In the charts (Fig. 5) you can see that NML departments with additional deeper information about exhibitions placing level (and mouse click) showed much worse results then other museum's departments: in average it took 47 seconds instead of 25 seconds.

Department C3 showed quite good average results on searching information about the exhibitions, but still some users faced some difficulties. For example, it took 49 seconds and 3 mouse clicks to find exit to exhibition information on ČNMA (item 3 on the left menu). He spend most of this time on searching in all other places except the left menu (Fig. 6). Analysis of this one and other users gaze plots discovered that this left menu on ČNMA website is hardly visible and needs improvements, probably more clear space around. The analysis of gaze plots showed that museums with menus having more clear space around showed better results on the speed of finding information.

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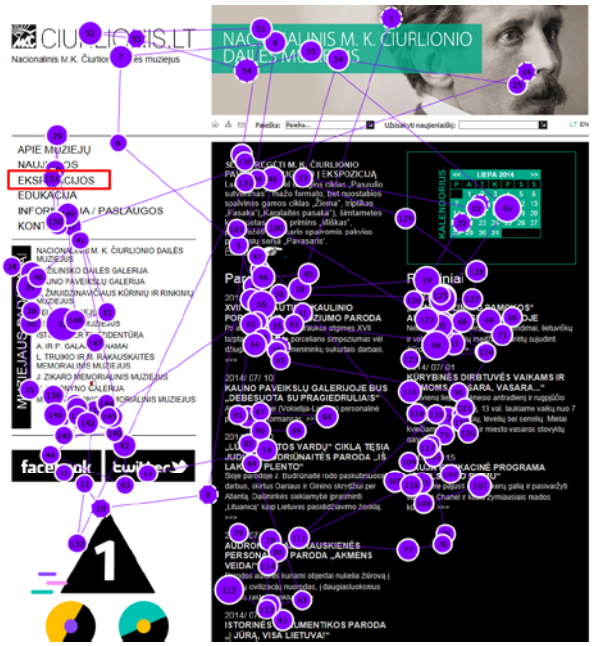

Figure 6. *Gaze plot of user's way to third item ("Exhibitions") of the left menu (top left, marked by authors with red rectangle)*

3.4. Average tasks comparison results

The **average completion time** of each task also could be calculated (Fig. 7). The results showed that information about the exhibitions was found much faster (in average 33 sec) and the average time of finding working hours (56 sec) and ticket prices (60 sec) was close and slower almost twice.

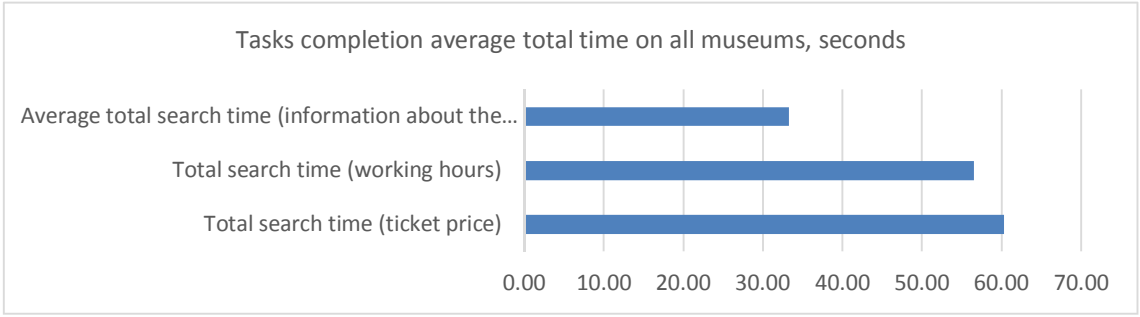

Figure 7. *Tasks completion average total time on all museums*

The average fixations count to complete each task also recorded and calculated (Fig. 8). To find an information about the exhibitions in average took less fixations (83), finding working hours (139) and ticket price (143) needed more fixations.

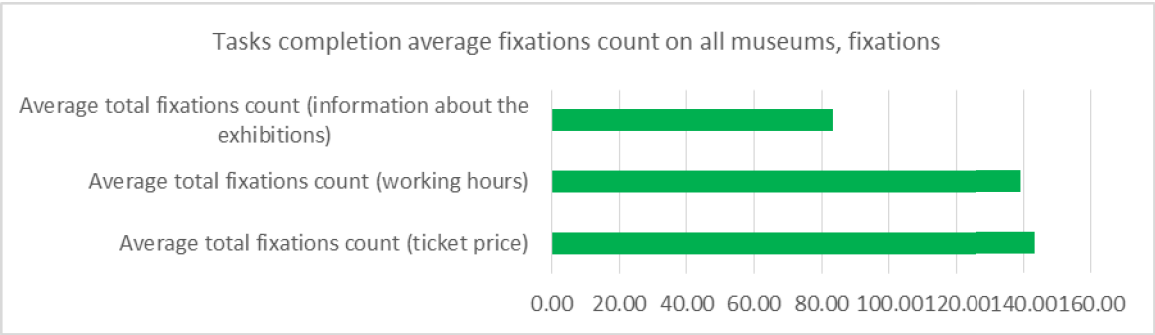

Figure 8. *Tasks completion average fixations count on all museums*

To find an information about the exhibitions in average took less mouse clicks (2,3) then to find working hours (3,1) and ticket price (3,4) (Fig. 9).

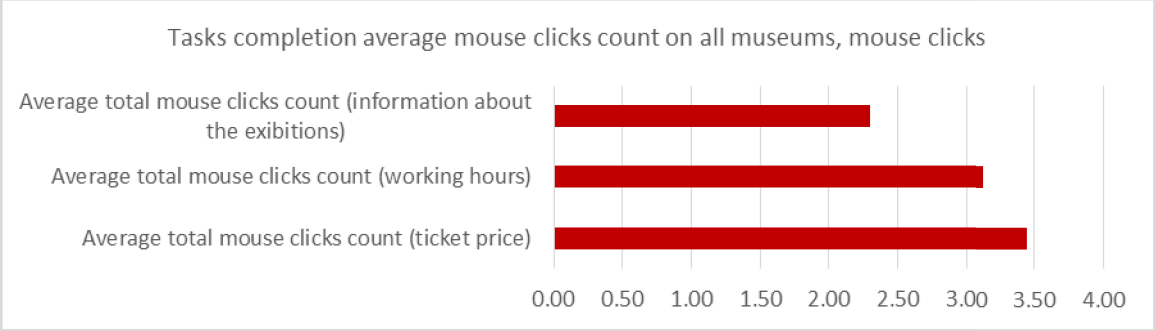

Figure 9. *Tasks completion average mouse clicks count on all museums*

The average of all tasks results on all museums shows that the easiest task was to find information about the exhibitions. It might be explained by the task nature itself: it was enough to find and click required link and the task was completed. In other tasks just clicking a button or link was not enough: user had to seek required information on the page he opened with the mouse click. And the most difficult was to find ticket prices (the same results in all measures: searching time, fixations count and mouse clicks count; prices search results mostly affected by NML website, which placed prices on third level in website structure), however finding working hours had very similar results.

3.5. Average museum department's results for all tasks

The results showed that best **average total search time** (Fig. 10) of all tasks was on D2, D1, V and C1 websites (35-41 seconds). Other two websites falls into middle (C3, N1) range (46-50 sec) and another three (N3, N2, D3) into bottom range (59-61 sec). The most time to complete the task took for C2 (67 sec) website – almost double the time if compare to fastest website (D2, 35 sec).

Average number of fixations on completing all tasks in all museums also was counted (Fig. 10). The results could be divided into three ranges: at least fixations were needed on D2, D1, V websites (93-96

fixations), into middle range falls C1, N1, N3, C3 (108-122 fixations), third range has D3 and N2 (147-151 fixations) and the worst result was on C2 website with 161 fixation.

Number of **average mouse clicks** user had to do to complete the task shows clearness of website navigation system – less clicks usually is better (Fig. 10). The measurements showed that at least average clicks for all tasks needed on to D2 (1,9 clicks) and D1 (2,0) websites. V, C1, D3 needed 2,3-2,5 clicks, C3 and N1 falls 2,8-3,0 clicks range and N3, N2, C2 have worst results 3,9-4,3 clicks to complete the tasks.

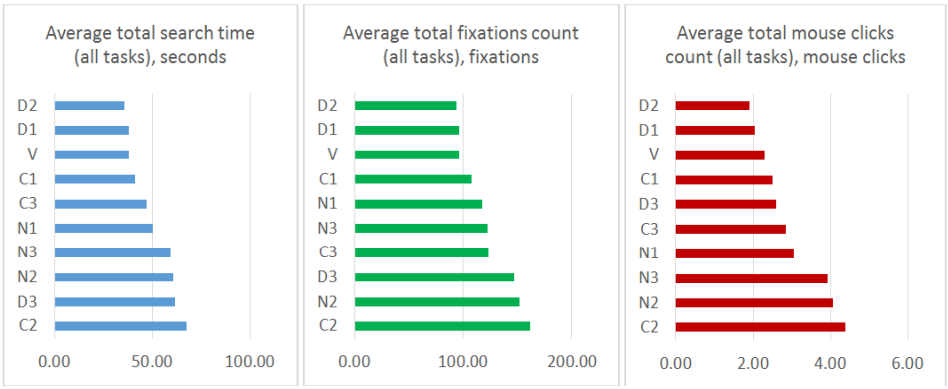

Figure 10. *Average museum department's results for all tasks*

Almost all total fixation count results shows the same results as total search time and total mouse clicks, except N3, which got into longest searching time range, but fall into middle range of fixations count.

The results of all tasks between departments are contradictory: on the cases of ČNMA and NML best results has departments with position on the top and then on the bottom in the list. On the case of LAM results are opposite: best results has department from the middle of the list (D2 – and the best results between all museum departments), but the top department in the list (D1) was very close, while the bottom department (D3) had bad results.

3.6. Average overall museum results

Summary of average **total search time** for all tasks and all departments also could be done (Fig. 11). The results shows that best task completion time was on PGDL website (38 sec) with no departments inside the institution. LAM website showed second time (45 seconds), ČNMA (51) was third and NML was the last with worst searching time (56). These three museums websites structures represents their departments: first thing the user need to do is to find department's subpage and then continue with the task.

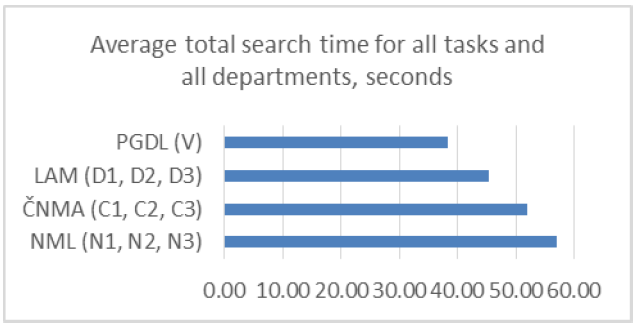

Figure 11. *Average total search time for all tasks and all departments*

The results of average **total fixation count** for all tasks and all departments showing (Fig. 12) that NML (with N1, N2, N3 departments) has the same amount of fixations (130) as ČNMA, but total average searching time between NML and ČNMA websites has percentage difference of 9%.

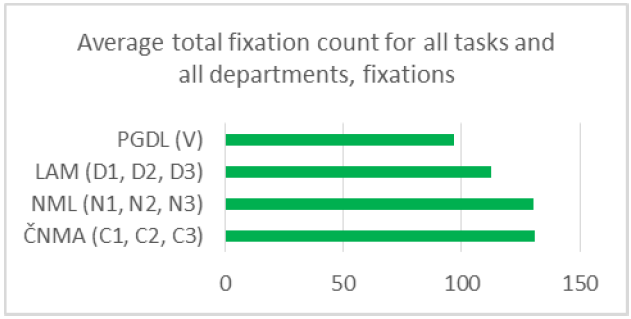

Figure 12. *Average total fixation count for all tasks and all departments*

The measures of average **total mouse clicks count** for all tasks and all departments showed (Fig. 13) best results on LAM (2,1 clicks) and PGDL (2,3) websites. ČNMA (3,2) and NML (3,6) had much worse results.

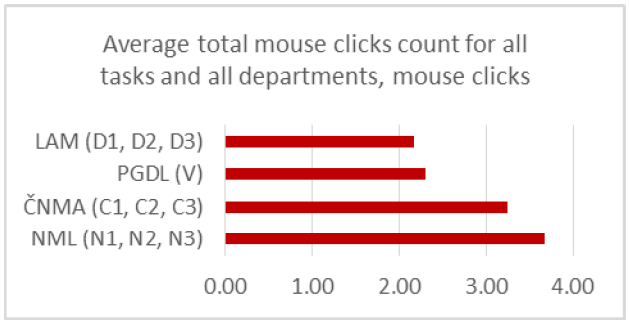

Figure 13. *Average total mouse clicks count for all tasks and all departments*