YÖNETİM BİLİŞİM SİSTEMLERİ DERGİSİ

http://dergipark.gov.tr/ybs

Yayın Geliş Tarihi : 09.01.2021
Yayına Kabul Tarihi : 01.05.2021
Online Yayın Tarihi : 07.07.2021

Cilt:7, **Sayı:**1, **Yıl:**2021, **Sayfa:**61-78
e-ISSN: 2630-550X
Araştırma Makalesi/Research Article

COMPUTER AIDED DESIGN PROGRAM 'ÇIZEN' AND USER INTERACTION AND EFFICIENCY ANALYSIS; DEVELOPMENT OF INTELLIGENT INTERFACE SUGGESTIONS

Önder Erkarslan[1], Gül Çiçek Zengin Bintaş[2]

[1]Endüstriyel Tasarım, Mimarlık Fakültesi, İzmir Yüksek Teknoloji Enstitüsü, İzmir, Türkiye

[2]Endüstriyel Tasarım, Mimarlık Fakültesi, İzmir Yüksek Teknoloji Enstitüsü, İzmir, Türkiye

ABSTRACT

The study aimed to design a simple and intelligent interface by clearly determining the needs and expectations of sheet metal designers and the user's program experience. Within the scope of objective, user experience surveys were conducted with the participation of 14 users. The users were asked pre-configured and open-ended questions, and by giving the users specific tasks, the focus points in the program were revealed with heat maps through the Eye Tracker device. After the pre-test studies and obtaining eye-tracking data, the final-test phase was initiated; having received general opinions on the program, System Usability and Nonverbal Pictorial Scale research was conducted. The results were interpreted, evaluated, and suggestions were developed under three main headings: productivity, simplicity/functionality, and interface.

Keywords: computer aided design (CAD); sheet metal die design, user experience; eye tracking; interface design

BİLGİSAYAR DESTEKLİ TASARIM PROGRAMI "ÇİZEN" VE KULLANICI ETKİLEŞİMİ VE VERİMLİLİK ANALİZİ; AKILLI ARAYÜZ ÖNERİLERİNİN GELİŞTİRİLMESİ

ÖZET

Çalışma, sac metal tasarımcılarının ihtiyaç ve beklentilerini ve kullanıcının program deneyimini net bir şekilde belirleyerek basit ve akıllı bir arayüz tasarlamayı amaçladı. Hedef kapsamında 14 kullanıcının katılımıyla kullanıcı deneyimi anketleri yapılmıştır. Kullanıcılara önceden yapılandırılmış ve açık uçlu sorular sorulmuş ve Eye Tracker cihazı üzerinden kullanıcılara özel görevler verilerek programdaki odak noktaları ısı haritaları ile ortaya çıkarılmıştır. Ön test çalışmaları ve göz izleme verilerinin alınmasının ardından son test aşamasına geçildi; program hakkında genel görüşler alındıktan sonra Sistem Kullanılabilirliği ve Sözsüz Resimli Ölçek araştırması yapılmıştır. Sonuçlar yorumlanmış, değerlendirilmiş ve öneriler üç ana başlık altında geliştirilmiştir: verimlilik, basitlik/işlevsellik ve arayüz.

Anahtar Kelimeler: Bilgisayar destekli tasarım; kalıp tasarımı; kullanıcı deneyimi; göz izleme; arayüz tasarımı.

INTRODUCTION

The design industry could be regarded as the basis of the economy considering the growth of global manufacturing competition in almost all national economies around the world. The design sector has seen a massive surge in modernization in technology and computer-aided design, allowing the manufacturing sector to adapt to the industry's ever-changing needs.Given the importance of mass production in the manufacturing sector and the challenges that companies face in order to remain competitive, it is easier to comprehend the significance of sheet metal forming production in technology and the economy.For example, the production of an automobile requires an estimated 300-350 parts and approximately 1200 sheet metal formings. Depending on the dimensions and properties of the part, the design of a sheet metal forming can take anywhere from 30 to 400 hours.Sheet metal forming design and manufacturing was a highly detailed, precise, technically crafted process which requires computer modeling with advanced technology and heavy industrial machines. It was viewed as a high-cost service all around the world because it had a direct effect on the final product.

Product design was the first stage of sheet metal forming production. The final product was designed to the desired specifications and dimensions using 3D CAD applications. Product margins and final 3D drawings were created. With the help of 3D Cad data, the base sample/prototype was prepared and presented to the manufacturer for inspection before the production of the sheet metal forming. The manufacturer gives the approval when it is ready for mass production by detecting the missing points and conveying the necessary additional requests. Along with Industry 4.0, there were several requirements and expectations in the sheet metal forming design and production sector. These were shorter product launch times, lower cost and higher quality production, innovative, flexible, modular, intelligent production that allows the reuse of materials and equipment (Bintas, Öz, 2016; Bintas, Öz 2017). The importance of new and innovative product design is increasing day by day in international market conditions. In this context, competition was no longer experienced in the final product, but in the process leading to the final product. When the design process is completed in a correct manner, smart design applications such as CIZEN help companies to enhance their brand image and secure their position in the industry. These applications, which gather all the parameters related to sheet metal forming design under a single roof, eliminate all unexpected problems and contribute to the finalization of designs in a relatively shorter time (Bintas, 2011). According to the data received from the National Union of Turkey (UKUB), there are 5,000 sheet metal forming manufacturers and roughly 100,000 employees in Turkey. The metal sheet metal forming sector accounts for 35% of this total (1,750 companies and 35,000 employees).It was stated by UKUB that this number did not include design offices. In addition to these companies, dozens of designers work in the sheet metal forming design departments in the main and automotive sub-industries. The biggest challenge faced by these designers was to use the information available to predict the future. The precision of the estimation was achieved in the degree of accuracy (Bayazit, 1994).

There were various studies in the literature that show a variety of approaches to improving sheet metal forming design and manufacturing process and to reduce costs (Singh, 1996). Lee and his friends (1997) had appointed various assembly relationships to a base sheet metal forming set, and assigned these relationships to certain parameters. With this method, they were able to update the pattern and adapt it to new situations. They had also incorporated the information of the standard elements into the prepared parameters, which allowed them to form a material list in a speedy manner. With this computer aided parametric design technique, they created sheet metal forming design modules. Myung and Han (2001) had assembled the machine elements with the database they prepared. To do this, they used the expert system approach technique. Duffey and Sun (2003) used computer programming to design progressive patterns. With a user interface prepared by Kumar and Singh (2007), a skeleton was created to help draw programmatic patterns in the AUTOCAD environment. Chu and his friends (2004) were able to make the necessary element picture ready for design with a user interface before the sheet metal forming design of the automobile tire was prepared. By Lin and his friends (2008), the rules were assigned to the drawing sheet metal forming set prepared in this study, so that the sheet metal forming could be adapted to new situations. This set, which was prepared in the "Pro/E" solid model design program, took the information about the press and other sheet metal forming design information from the parameters which were a feature of the CAD program. This technique was a computer aided parametric design approach. Kim and his friends (2007) with an interface had been able to prepare to control a small and simple cutting pattern. In this study, Basic Visual Basic 6.0 programming language was used. With this study, the sheet metal forming set was standardized. Pattern information was entered into the Access Ms Access database.

The simplicity of the sheet metal forming was the most important factor in the effectiveness of the study. They used a parametric design approach in their study. Skarka (2006) used the "Knowledge" module, a special extension of the CATIA program. This module allowed for writing rules for the desired transactions. The study was an example of the development of solid model programs. The system approach was a technical expert. Bintas and et al (2011) wrote macros and obtained parametric intelligent design libraries by using the Knowledge CA module, which was a special extension of the CATIA program. This module involves the use of eye tracking, which was a technique whereby an individual's eye movements were measured so that the researchers were able to observe where a person was looking at a given time and sequence (Poole and Ball, 2005). Eye-tracking research has been increasingly used to supplement usability tests in both commercial and academic practice (Ehmke and Wilson, 2007). Eye tracking alone can not be considered a complete engineering approach, but it can make a significant contribution to usability assessment. A summary of 21 usability studies incorporating eyetracking was presented by Jacob and Karn (Jacob and Karn, 2003). However, there were very few publications available in the literature that discuss the use of eye tracking and its possible advantages. In the study done by Doğan and et al, the parameters of yacht hull design were examined with an eye tracking device and visual evaluations were made. As a result of these evaluations, several findings were reported in order to improve the quality of the relationship between the parameters (Doğan and et all, 2018).

The use of Computer Aided Design program in Turkey is behind by an estimated 20 years compared to the member states of the European Union. The absence of a domestic and national program, the lack of attention to the recent developments in technology combined with the high licensing fees have prevented the use of CAD programs from spreading. Due to the high license fees, unlicensed use of CAD programs is still a common occurence even today. To adjust Turkish industry to the international standards and improve the competitiveness of their products, the government began the process of nationalizing their work in 2010 and supported the development of CAD programs, especially due to the risks of information security in overseas programs. Among the developed programs, the CİZEN program became the first program to be commercialized. The CİZEN program is currently being developed for small industries (SME's). The goals of the program were:

- To replace Cizen Program with CATIA V5 in sheet metal forming design companies and other SME's.
- To create a program that is faster and more accurate than other programs.
- To sell 100 licences until 2018.

But long-term R & D work was required to achieve this. So Mubitek has been developing the program since 2010. After the program's first lunch (in 2014), Mubitek got so much feedback from users about the program. Many of the feedback contained problems with the program. Developing a software like this was a value added. Despite program issues, Mubitek received the Microsoft Innovation Special Award for the CZEN and Intelligent Design application programs in 2014, the Turkey Exporters Assembly Information Technology R & D 1st prize in 2015, and the Ministry of Industry's TUBITAK and TTGV Technology Awards Finalist in 2016.Productivity 2nd Prize and Automotive Project Market Honorable Mention. In 2019, it became the finalist of the Innovation League. However, the prevalence of the program could not be achieved. Building on this, it could be argued that it was necessary to develop the features and capabilities according to user opinions.

Our research was of great importance in order to ensure that the program, which was a high value-added and strategic product, could compete with the international examples. Furthermore, the conclusions of this thesis could be used to ensure information security, to reduce foreign exchange expenses and to improve user satisfaction.

The aim of this research was to contribute to increase efficiency in infrastructure and interface usage of the CİZEN program and to ensure its prevalence in sheet metal forming design. Determination of the needs and expectations of sheet metal forming designers and the efficiency analysis of CİZEN would play a critical role in the development of a simple interface model with high competitiveness features. Overall, this study would contribute to the technical infrastructure, CAD literature and, lastly, it would provide insights to supply innovative designs with increased commercial and R & D gains both on a country and company basis. The research questions of this study were grouped under three main headings: (i) productivity, (ii) simplicity and functionality, (iii) interface. The respective questions of each category were organized as follows:

(i) Productivity

- Compared to other CAD programs (CATIA V5), how efficient was CİZEN on a command basis (edit toolbar, file menu, product menu, Part Menu, Sketch Menu)?
- How efficient was CİZEN's sheet metal forming design compared to other CAD programs?

(ii) Simplicity and functionality

- What were the most commonly used and needed commands in sheet metal forming design?
- Were the CİZEN's commands sufficient to design the sample model identified in the research? If not, what commands should be added/edited?

(iii) Interface

- Were the instructions in the interface sufficient? If not, what were the recommendations?
- Did the designs of the icons used in the design of the example model reflect the command functions?

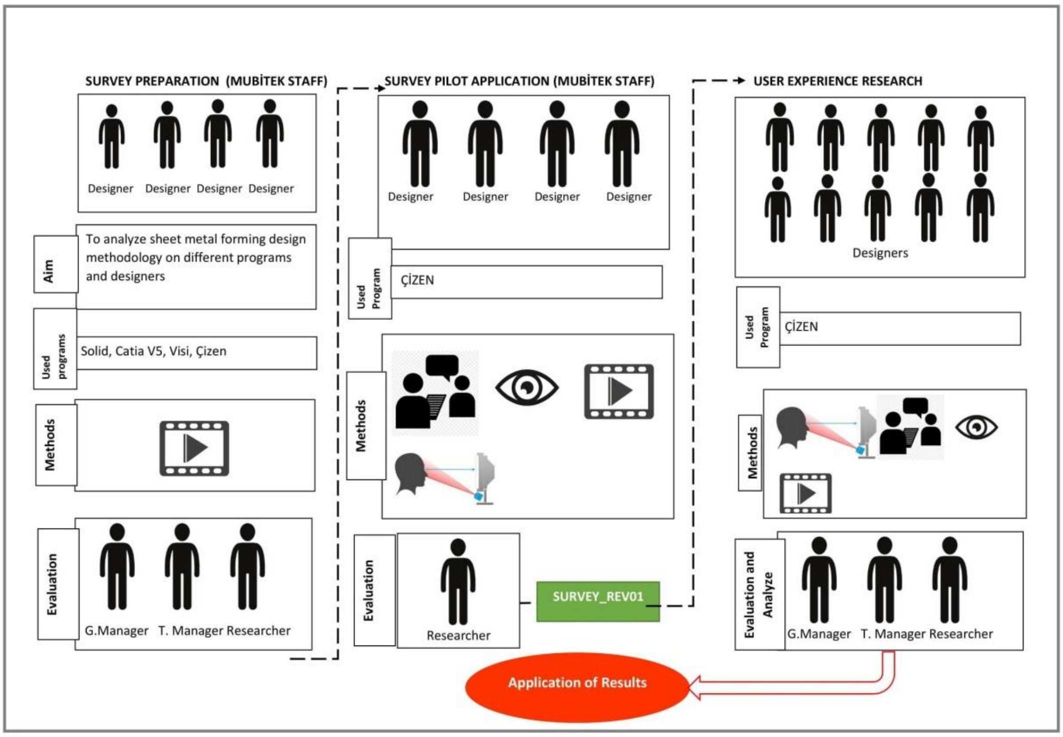
METHOD

The study was divided into three sections.For the efficiency analysis, CATIA V5 was preferred for the efficiency analysis due to its similarity to the CİZEN program and the sector in which it was used. As CATIA V6 was not yet widely used, Version 5 had been analyzed and the results were presented in tables. Within the scope of the analysis, the commands of Edit Toolbar, File Menu, Product Menu, Part Menu and Sketch Menu which are available in both programs were compared. Secondly, the most common commands in sheet metal forming design and the design logic of sheet metal forming designers were determined in order to provide simplification and intelligent systems for sheet metal forming design in the CİZEN interface. Mold design has been made in Catia V5, VisiCAD, SolidWorks and Cizen programs to reveal sheet metal forming design methodologies in different programs. These programs were used in sheet metal forming design in the sector. Each stage of the designs was videotaped and analyzed, and the logic and capability of sheet metal forming design of the programs were demonstrated. As a result of the data obtained, question headlines were created for the smart interface application and users were asked open-ended questions in the pre-test questionnaire. The purpose of the pre-test questionnaire was to collect demographic information as well as information about sheet metal forming design methodologies.The questionnaire was composed of 11 questions. The majority of participants were aged 30 and under with a diploma and a job experience of 3 years and under. Lastly, the analysis of CİZEN-User experience was conducted. In this phase, pre-structured open-ended questions were asked and 16 tasks were determined through a model drawing. After that, an application was made by using eye-tracking, stopwatch and usability test notes observation methods. With the eye-tracker device, interval duration, visit duration, visit count and click count metrics were measured.

In this context, the application was made through a drawing and a diameter. Following that, the thickness values of the model were asked to be connected to the parameter. Here, the average time period needed to complete the drawing was observed as well as the points where difficulty was experienced, and which command caused time loss. Following that, they were asked about interface orientations, the use of mause, the adequacy of 2-Dimensional (2D) and 3D commands, their thoughts on the content and formation of the model tree, the use of parametric modeling methods, and their thoughts on special 3D catalogs in the interface.Finally, suggestions and comments on the overall appearance, design and usability of the interface were requested. The following questions were asked in order to understand the sheet metal forming design logic: the process steps they followed while designing, the commands they used the most and the points they were forced to do, the revisions in the design changes and the points they needed these changes.

The research questions were designed as qualitative and quantitative research. Questions were focused on user explanations and program experiences. The reports obtained from the interviews constituted the main source data of the study. The research was conducted with a total of 15 users. First of all, the pilot application was made with 4 designers in the firm which develops CİZEN. With the pilot application, the effectiveness of the questions was tested and improved. In 83 case studies conducted by Nielsen Norman Group, which was the world leader in research based on user experience, it was seen that usability studies gave 5 users the most optimum results. However, in some studies, it was found that they achieved optimum results with 8 participants and with 12 participants (Nielsen, 1993, 1994, 2012). Therefore, 11 participants were included in the research. However, only 9 participants could be observed due to technical problems regarding the eye tracker recorder. During the research, the following design thinking methods were used: interviewing, contextual inquiry, buy a future, think aloud testing, critique, system usability scale, competitive product survey, persona, experience diagramming, affinity map, problem tree analysis, value priorization, and subject matter expert.The study lasted between 45 minutes and 1.5 hours. All studies were digitally recorded. The designers working for the companies that design and manufacture sheet metal formings in Bursa were chosen based on their willingness to volunteer. At the end of the study, a post-test questionnaire about the participants' perceptions was conducted. The Post-test, System Usability Scale was adopted by Brooke (1996).

Figure 1. User research plan



EFFICIENCY ANALYSIS

The general interface including Start Screen, Worksheet, Save, Sketch, Part and Product was compared with Catia V5. The programs had similar interfaces, but in the Catia program the caliper element was found to be more useful visually and functionally. There were no different interfaces for modules in Cizen. Solid and surface command were in the same interface. Contrastingly, in Catia V5 there were different interfaces for each model. Another difference between the interfaces was that in CİZEN, the feedback link was on the login screen, while in Catia, it could be found in all working places.

The opening worksheet was similar to CİZEN and Catia V5. But it was observed that the variety of components created in the Catia program was high and the interface design was more advanced. Redirects were found useful in both programs to save documents. A comparison was made between the programs for sketches and parts. Generally, both programs display a significant level of similarity except for the difference in the product tree. The Catia program had a relatively more flexible product tree, which makes it more useful in a way. While sketching in CİZEN, it was seen that commands were limited and offered less flexibility. Product menu was also compared between the two programs, and the interface designs were found to be similar. However, there were several structural differences with regards to the product tree. In CİZEN, the assigned parameters and the relationship between the parts could be found at the top of the product tree contrastingly to the Catia, which placed them at the end of the product tree. Also, in CİZEN, assembly commands seemed to be limited and more rigid. Catia V5 was found to have more command options and a wider array of capabilities than CİZEN. Although the design style and commands displayed a certain level of similarity, the interface usage and placement and capabilities presented a departure point.

The Open and Edit Toolbar Menu, which was used for opening new files and/or reopening existing files, shows that editing and exporting can be 50% faster and more efficient than the Catia program. Catia includes a wide range of modules because it was designed to be a general-purpose design program. This results in a considerable amount of time loss and ineffiency. Furthermore, when the results of the comparisons were examined, it was concluded that the level of difficulty experienced while using "assembly, import, export, part and returning part" were quite similar.

However, it was observed that Catia had a wider range of file types. *Product Menu* Assembly design could be made with an intuitive and flexible user interface with the help of the product menu. Catia had relatively more advanced features for some commands, such as measure commands. *Part Menu,* Part menu includes command groups in which part design could be viewed as a solid model. It could be done in 3D using a previously designed 2D model. Catia had some user-friendly functions such as hole, edge and champher command, which CİZEN lacks in comparison. *Sketch Menu,* there was no major difference observed between CİZEN and the Catia program with regards to the sketch menu. The most notable difference was that Catia offers more sketching alternatives compared to CİZEN. Also in the sketch, the relationship identification could be conducted in Catia with the help of a right-click window while CİZEN did not have this option, which constitutes a problem. In addition to this, CİZEN provides different commands for each relationship type, unlike Catia. This could be considered an advantage for the user.

PRE-TEST

The pre-test questionnaire was used to evaluate participants' previous utilization and involvement details in the CAD program. The questionnaire was composed of two parts. The first section included 6 questions about demographic information, and the second section included questions about sheet metal forming design methodology, for a total of 11 questions. The majority of the participants were aged 30 and under and were graduates with job experience limited to 3 years and under. In the second part of the pre-test, a mold design was designed by the pilot users with the help of several programs such as Visicad, Catia, Solidworks and CİZEN in order to formulate the 11 questions that were mentioned above. The findings of a report that came out of this design process were used to formulate the pre-test questions. At the end of this process, it was concluded that all programs had their unique advantages and this finding was also included in the report. In the second part of the pre-test, the previously designed mold design with different programs such as Visicad, Catia, Solidworks and CİZEN were used in order to compare the respective process of each program. 11 questions were prepared to ask the participants to investigate sheet metal forming design methods.

EYE TRACKING ANALYSIS

A total of 16 tasks were assigned to each participant to complete on the CAD interface. However, for pilot participants, eye tracking recording was not used due to the costly process. Only the task completion time was recorded and observations in the Usability Test Notes Form were documented. The pilot application was designed in both the CİZEN program and the CATIA program in the study (Figure.3). The average task time in the CATIA program was 6,12 minutes, while it was 12,50 minutes in the CZEN program. This signifies approximately a 50% difference in design time, which could be considered a major contrast. But it should be mentioned that, due to the differences between CİZEN and the Catia program in doing design Task 4, 8, 12, 14 and 16, which were only possible for CİZEN, these tasks could not be incorporated into the analysis of the Catia program.

Originally, the number of participants was 10, but during the research one more participant was included, which could be seen in Figure 3.

Recording 2 was a trial test, so it was not included in the assignment. While using the program, some participants changed the interface menu locations. 7 participants used the top menu, 3 participants used the right menu, 1 participant used both methods (Recording 13). However, one of the 7 participants that used the top menu could not be included in the assessment due to unforeseen problems while using the program (Recording 14). Similarly, the participant that used both methods was not included in the assessment in order to prevent possible confusions. Therefore, 9 participants in total were included in the analysis.

Figure 2. Model sample designed for tasks

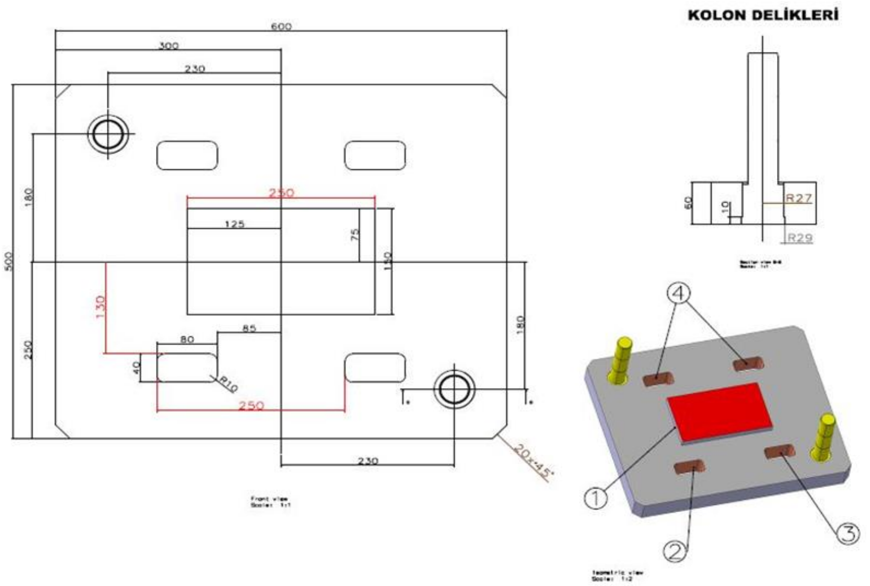
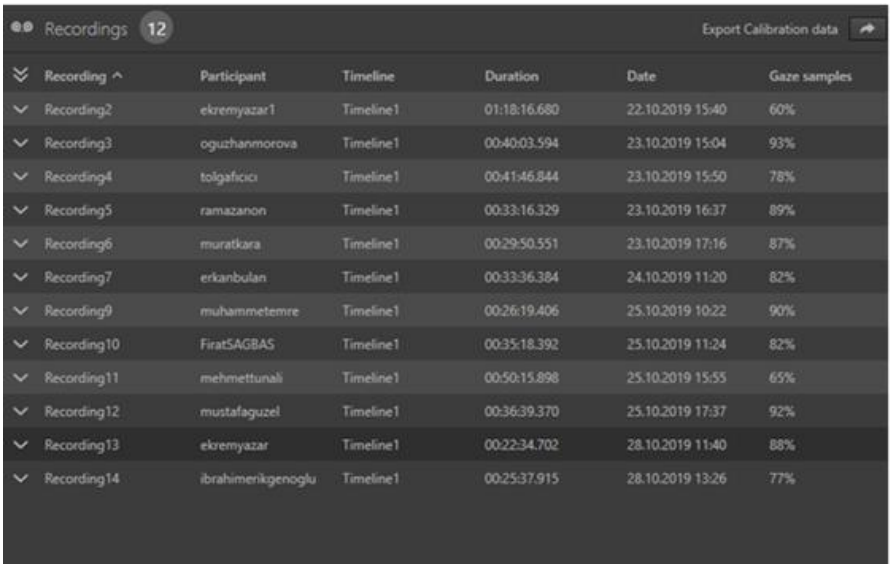


Figure 3. Photos from research with eye tracker device

Figure 4. Eye tracking recording screenshot


Recordings 12 Export Calibration data

Recording	Participant	Timeline	Duration	Date	Gaze samples
Recording2	ekremyazar1	Timeline1	01:18:16.680	22.10.2019 15:40	60%
Recording3	oguzhanmorova	Timeline1	00:40:03.594	23.10.2019 15:04	93%
Recording4	tolgaficici	Timeline1	00:41:46.844	23.10.2019 15:50	78%
Recording5	ramazanon	Timeline1	00:33:16.329	23.10.2019 16:37	89%
Recording6	muratkara	Timeline1	00:29:50.551	23.10.2019 17:16	87%
Recording7	erkanbulan	Timeline1	00:33:36.384	24.10.2019 11:20	82%
Recording9	muhammetemre	Timeline1	00:26:19.406	25.10.2019 10:22	90%
Recording10	FiratSAGBAS	Timeline1	00:35:18.392	25.10.2019 11:24	82%
Recording11	mehmettunali	Timeline1	00:50:15.898	25.10.2019 15:55	65%
Recording12	mustafaguzel	Timeline1	00:36:39.370	25.10.2019 17:37	92%
Recording13	ekremyazar	Timeline1	00:22:34.702	28.10.2019 11:40	88%
Recording14	ibrahimerikgenoglu	Timeline1	00:25:37.915	28.10.2019 13:26	77%

Pilot participant task completion average time was measured as 12,17 minutes and the average task completion time of participants was measured as 33,92 minutes. The figures of task results in the form of gazeplot and heatmap can be found below. Gaze could be described as an eye tracking metric, usually the sum of fixation durations within a prescribed area. It could also be called "dwell1," fixation cluster ", or" fixation cycle". In gazeplot, they were measured in the form of saccades.

Heatmap was an eye-tracking data visualization method which represents the values of a variable as colors, where the amount of "heat" was proportional to the level of the represented variable (Bojko, 2013). The main measurements used in eye tracking research were fixations and "saccades", which were quick eye movements occcuring between fixations. More fixations on a particular area indicate that it was more noticeable, or more important, to the viewer than other areas.

Figure 5. Task 1 gazeplot

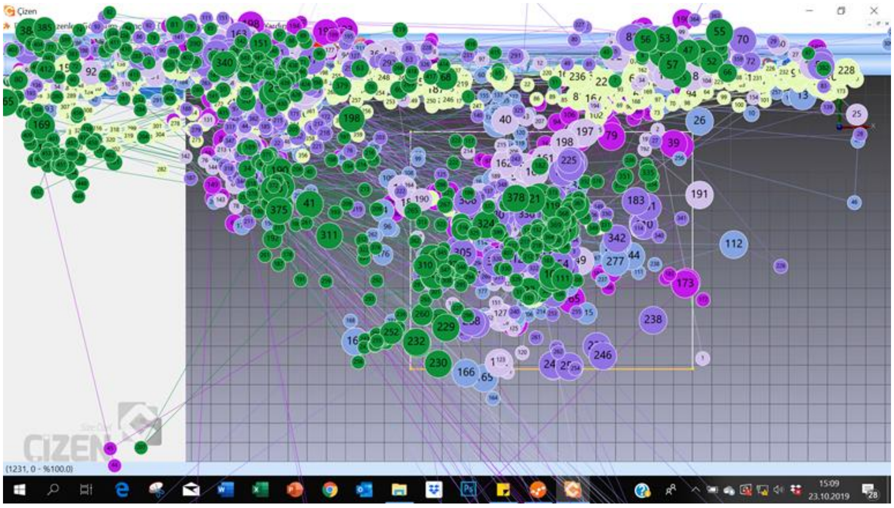
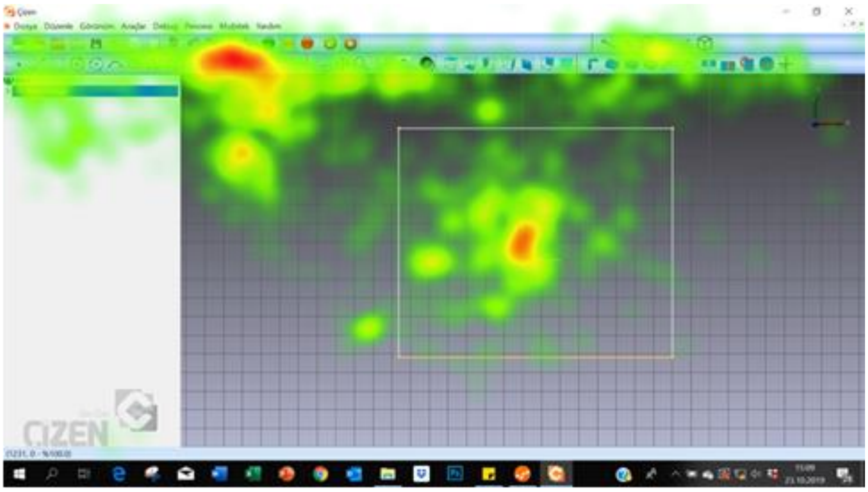


Figure 6. Task 1 Heatmap



More saccades indicate more searching. Larger saccades indicate more meaningful cues, as attention is drawn from a distance (Poole and Ball, 2005). Between Figure 5 and Figure 6 indicate the top menu users. The colours in the gazeplot represent different participants. In this eye tracking research, tap and right menu use should be taken into account in order to observe the time spent searching for the commands as well as to detect their location from the participant's point of view. The focus points in the center of the program screen show how participants design the tasks.

There were several issues that should be taken into consideration regarding the task. As mentioned before, there were 16 tasks. However, while analyzing, we realized that some were divided in themselves. For example, task 1 includes 4 sub-tasks, task 4 includes 4 sub-tasks, tasks 5, 12, 13 and 15 include 2 sub-task. As a result of this, the number of tasks that were analyzed was not 16, but 23. Furthermore, some users had personalized the interface in a way that the menu is divided into 2 parts: the top menu and the right-menu, which meant that 46 analyses were made in total. However, due to the limitations of capturing eye-movements and heat maps of Task 11 and 16, there were only 42 results of this part of the analysis. In this research, the eye-movements and heat maps were limited to Task 1 only.

The Click count metric indicates the number of clicks on the menu, which implies a possible problem in a case where many clicks were made on the menu. When the tasks were examined in detail, it was observed that the click count ranged between 1 to 29. More than 5 clicks were considered not acceptable. The Visit count metric shows the number of visits to the menu. A large number of visits imply a difficulty experienced when finding the intended target, the participant was looking for. When all tasks were examined in detail, it was found that the visit count ranged from 1 to 51. It was concluded that more than 4 visit counts were not acceptable. The visit duration metric displays the menu's fixing time. The less fixation signifies that the participant had found the task easier. When examined, it was detected that visit duration ranged from 0,08 to 102,21 seconds. It was determined that visits lasting more than four days were not acceptable. Interval duration shows the time in which users completed their tasks. When analyzed, it was seen that the interval duration ranged from 1.790,55 to 3.015,90 seconds. As it could be seen below, the interval duration results were not successful. So, it could be stated that there was a usability problem in CİZEN.

Table 1. Participants' task completion time and comparison with pilot participants

Tasks	Pilot participant	Pilot participant	Participant
	CATIA	CİZEN	CİZEN
TASK 1	0,31	0,65	4,68
TASK 2	0,59	1,05	1,25

TASK 3	0,11	0,36	1,79
TASK 4	0,37	1,00	2,18
TASK 5	0,46	1,71	2,31
TASK 6	0,32	0,33	2,23
TASK 7	0,11	0,17	1,2
TASK 8	0,08	0,29	3,3
TASK 9	1,33	2,02	2,19
TASK 10	0,34	0,78	2,11
TASK 11	0,50	0,14	0,47*
TASK 12	0,92	2,12	5,72
TASK 13	0,26	0,51	1,27
TASK 14	0,20	0,62	1,73
TASK 15	0,23	0,40	1,08
TASK 16		0,02	0,41*
TOTAL TIME	6,12 Minutes	12,17 Minutes	33,92 Minutes **

* In these tasks there were no gazeplots and heatmaps.
* * Result of 11 participants' tasks. If we only consider the 9 participants for whom we are analyzing eye tracking data, the total time result is 36,34 seconds.
As could be seen in Table 1, there was a usability problem with all the tasks without Task 2. Task 2 is related to parametric design.

POST-TEST

In the post test, 6 open-ended questions were asked, using 1 multiple choice question and applied System Usability Scale and Nonverbal Pictoral Scale. In the test, all answers were analyzed and interface-technical infrastructure and icon-command suggestions and problems were categorized using Affinity Mapping Methods. After categorizing with an affinity map, a value based prioritization with technical staff working in the firm which develops CİZEN was done. During the meeting, all suggestions were examined and scored based on their importance, value, and feasibility. From all the participants, System Usability Scale answers were taken (Table 2.). After the calculation of all answers, it was found that the lowest score was 47,5 points and the highest score was 92,5 points. Building on the general view in the literature, the standard average of SUS score was concluded to be 68. If the product reaches less than that, it has to change the product usability (Alathas, 2018).

Table 2. SUS score interpretation

Sus Score	Grade	Adjective Rating
>80,3	A	Excellent
68-80.3	B	Good
68	C	Okay

51-68	D	Poor
<51	F	Awful

Table 3. shows the participants and pilot application SUS score results. The average result of participants was **68,4 points (Okay).** The average of pilot participants was 80,6 (Good) points. After taking the average, the result was found as 74,51 points (good).

Table 3. The participants and pilot participants SUS score

Participan**t**	SUS Score	Pilot Participant	SUS Score
p1	60	p1	80
p2	87,5	p2	82,5
p3	92,5	p3	70
p4	85	p4	90
p5	82,5		
p6	47,5		
p7	47,5		
p8	55		
p9	52,5		
p10	62,5		
p11	80		
TOTAL	**68,4**		

Regardless of the interface design, the architecture of the game/program/software, the process flow, should be planned simultaneously with the user. However, the interface design was usually put at the end of these stages (Keş and Kara, 2015). This might not be the right approach due to the possibility of facing usability problems later in the future. For this reason, in this research, we see that there was a usability problem. The use of eye tracking tools adds different aspects to the usability studies by providing objective and quantitative evidence to investigate participants' cognitive processes. Therefore, this study uses objective and quantitative methods. Furthermore, usability research had certain benefits such as increased productivity, increased sales and revenues, decreased training and support costs, reduced development time and costs, reduced maintenance costs and increased customer satisfaction. (Bojko, 2013)

The following sections of this paper will present an evaluation of the results to ensure the availability of the program and improve the smart and lean interface, under three main headings: productivity, simplicity/functionality, and interface. Prior to that, general perspectives on the research findings will be provided, as shown in Table 4. and the problems experienced by the participants will be explained, which is shown in Table 5.

Table 4. General views of researcher about research and results

In the General Research	*****I wanted to choose a model to use a lot of menus in CİZEN program. For analyzing, I set 16 tasks in the model. But 16 tasks forced participants.

Process	*****In the analyzing stage, 16 tasks were divided into tasks. Eventually, there were 23 tasks to analyze. For 9 participants to analyze 23 tasks would take so much time. So we tried to put forward the most important results. *****During the performing of some tasks, problems occurred due to CİZEN Program software infrastructure and affected completion of tasks.
In the Process of Performing Tasks	* Starting to record eye tracking, problems occurred due to the Tobii X2 Pro device I didn't know why. Therefore, for some participants we couldn't take a recording. So we tried new participants. *Some of the participants we selected were not willing to participate, so, we gave them Sodexo Gift Check to thank. * In the trial application, the participant did the tasks reading his own. But it took a lot of time and caused data loss on the eye tracking device. So we read the tasks to other participants. * We wanted to start to design without giving information about the CİZEN Program. Because the program was Turkish, we believed participants could. But in most of the tasks, participants had difficulty understanding the general logic of the program. I thought it would be better if we introduced the program before application. * During the application we had found that the translation in some menus from English to Turkish was incorrect. This made it difficult for participants to understand. * We found that participants using Catia were more successful in using the CİZEN Program. * The task completion time difference between pilot and research participants was extremely large. Pilot participants completed in 12,17 minutes. But research participants completed 33,92 minutes. There was almost 3 times the difference. I thought this result showed us there was a usability program in the CİZEN program. We could normally accept the difference as a result of not introducing the program earlier. But this difference was still so high. * We also compared the CİZEN Program with Catia with pilot participants. The company which developed Cizen wanted to use the CİZEN Program instead of Catia in the sheet metal forming sector. At this stage, it did not seem possible. Because the task completion time was 12,17 minutes in CİZEN and 6,12 minutes in Catia. There was a two-hour time difference.
In the Post-Test and Interview Process	* Although the results of analysis were not good, overall views were positive because of national and domestic programs. * For example, the System Usability Scale result was 68,4. This was an acceptable result. Also, the Nonverbal Pictorial Scale result was fine. I thought the program could be successful if the development process continues. * Of course, many suggestions and criticism came from the participants. I examined it in detail and got the opinions of software developers and designers working for the company which develops Cizen. After that, I took out the suggestions that could be done.

In Table 5, participants experienced difficulty on almost all tasks. However, on certain tasks, all participants experienced difficulty, such as task 1, task 6 and task 13. Furthermore, while using Catia, almost all participants had chosen the method of clicking the "number" to correct false measures. However, in CİZEN, measurements were given by clicking the "line", which might pose an issue in terms of effectiveness due to mouse insensitivity and imprecision. So, it could be concluded that giving measurement operation must be changed in CİZEN.

Table 5. Participants-based problems in the tasks observed by researcher

Participants	Comments
Participant 1	Task 1- Forced to exit from sketch Task 2 – Forced to put parameter relationship Task 4-Forced to find Simmetry Icon Task 8 – Forced to do user pattern Task 12- I did not find the standart part because of the menu name (menu name is mubitek) Task 16-Forced to find “feedback menu”
Participant 2	Task 1- Forced to give measure Task 6- Forced to do Rectangular Pattern Operation Task 13- Give Colour Operation Task 16-Forced to find “feedback menu”
Participant 3	Task 1- Forced to exit from sketch Task 7-Confused Mirror and Pattern Operation Task 12-Did not do Assembly Operation Task 13-Confused Give Colour Operation
Participant 4	Task 3- Forced to do Pad Operation Task 4- Forced to exit from sketch Task 6- Forced to do Rectangular Pattern Operation Task 13-Confused Give Colour Operation Task 14-Find “Yardım Menu”, under all the menus Task 16-Forced to find “feedback menu”
Participant 5	Task 4- Forced to do Add Operation Task 6- Forced to do Rectangular Pattern Operation Task 7-Confused Mirror and Pattern Operation Task 8-Forced to do Remove Operation Task 13-Confused Give Colour Operation Task 16-Forced to find “feedback menu”
Participant 6	Task 1-Forced to do Sketch Operation Task 4- Forced to do Add Operation Task 6- Forced to do Rectangular Pattern Operation Task 12-Forced to do Assembly Operation

	Task 13-Confused Give Colour Operation Task 14-Forced to find "Support menu" Task 16-Forced to find "feedback menu"
Participant 7	Task 1- Forced to give measure Task 3- Forced to find Pad Operation Task 6- Forced to do Rectangular Pattern Operation Task 14-Forced to find "Support menu" Task 16-Forced to find "feedback menu
Participant 8	Task 1-Forced to do Sketch Operation Task 3- Forced to do Pad Operation Task 4- Forced to do Add Operation Task 6- Did not do Rectangular Pattern Operation Task 8-Forced to do Remove Operation Task 15- Looking for "Screenshot" under view menu Task 16-Forced to find "feedback menu"
Participant 9	Task 6- Forced to do Rectangular Pattern Operation Task 12-Forced to do Assembly Operation Task 13-Confused Give Colour Operation Task 15- Looking for "Screenshot" under view menü Task 16-Forced to find "feedback menu"
Participant 10*	Task 1-Forced to do Sketch Operation Task 4- Forced to do Add Operation Task 12-I did not find the standart part because of menu name (menu name was mubitek) Task 13-Confused Give Colour Operation Task 15- Forced to find "Screenshot" Task 16-Forced to find "feedback menu"
Participant 11*	Task 1- Forced to exit from sketch Task 9-Forced to find Gradual Hole Operation Task 16-Forced to find "feedback menu"

*The reason I mentioned earlier, participant 10 and participant 11 were not included eye tracking analysis.

When all analyses were completed, the results were evaluated by the Technical Manager (Mechanical Engineer and designer) and Software Manager (Computer Engineer). After evaluation, the results were summarized under 3 main headings which offered suggestions in order to improve the program. If the findings of these three main headings were taken into consideration by the software developer company which develops CİZEN, there would be a considerable improvement of the program which would increase its chances of being successful. For now, it could be argued that there was a clear usability problem in CİZEN.

Table 6. Evaluation result

Productivity	*Mirror Command axis should be picked as part of the surface *Mouse usage should be customizable to the user *The page number in the Help File should be written *A guide should be added how to use the parameter operation *Measurement change operation should be done automatically *Commands in the toolbars should be arranged according to frequency of use *With double click on the icon, command repetition should be done *Right-Click window should be created for constraints *Copy-paste command should be created *Undo-Redo operation bug should be fixed *In concentricity operation, surface should be picked
Simplicity/ Functionalty	* To add description window for Zoom-in Zoom-out command * The previous entered measurement values in the Hole Command should remain in the command window * New geometric shapes should be added in 2D operation * In the product tree, you can easily see which parameter was assigned in the parameter operation * The commands to give color and assign color should be combined.*Move command should be developed * Publication property should be added * All the changes in design should be done not only on the product tree but also on design. * Commands group should be hidden and displayed at any time * Solid and surface commands should be in a separate interface
Interface	* During the opening CİZEN Program, which version of the program could be written * Remove the CİZEN Logo from the product tree * Feedback menu should be added * All descriptions of Windows related commands should be updated * The name of the toolbar Mubitek, which was related to the standard part library, should be changed. * The names of toolbars translated into Turkish should be reviewed, some of them should be changed. * The interface colour should be customizable.

	* The background color should be different depending on which command was active. * Preview window should be added for commands * Most icon images should be changed. * On the part axis, x-y-z direction information should be written * There should be a user guide in HTML format. * Toolbars should be named

CONCLUSION

Sheet metal forming design is one of the most important issues in terms of time and cost savings in the automotive industry. Failure or delay in sheet metal design steps has a negative impact on the cost and delivery time of a new product. Quality, time and error-free design was possible with the help of CAD Programs. Nowadays, as a result of the rapid progress of technology, technical infrastructure and features of CAD programs are developed and user-oriented interfaces are beginning to emerge. All of the CAD programs that are currently used in Turkey are foreign products. Lack of a domestic program and high licensing fees push the sector to unlicensed use of these programs. The CİZEN program, which has been developing, could be considered a gain for the design sector due to its Turkish language support and its potential to ensure global competition. It would be easy to expand the program to small enterprises since these small businesses experience financial problems and the Turkish language support would offer significant relief. However, as a result of the negative feedback coming from the users of the program, the need for user-oriented research on the interface emerged. Within this scope, firstly, the future vision of CAD Technologies was investigated. Evaluation of CİZEN program efficiency and the design methodologies of different designers were extracted and program interface research with task based was conducted.

As a result of the research, it was seen that CAD technology was more oriented towards cloud based operation and licensing fees were transferred to the leasing model. Furthermore, a sheet metal forming design program was already offered for sale in Turkey. It is reported that the authorized distributor will start advertising activities in the year 2020. When the CİZEN program was compared with Catia V5, it was observed that the CİZEN program was performed with fewer steps for some commands. About 120 commands and features were compared in 5 sections. However, although CİZEN performed some operations/commands with fewer steps, it was observed that the task completion time was 2 times longer than Catia V5. In this study, a diemold was also designed with 4 CAD programs. These programs were Solidworks, Visicad, Catia V5 and CİZEN. The design was examined under 11 headings. As a result, it was concluded that Catia V5 and CİZEN have similar design methodologies. The Solidworks program was found to be insufficient in progressive sheet metal forming design.

In the user experience research, a basic sheet metal forming was designed by potential CİZEN program users. As a result of this design, it has been determined that there was approximately 3 times the difference between the pilot participants and research participants in the completion time of the tasks. In addition, in the majority of tasks, research participants had experienced a loss of time, searched the relevant command for a long time, made too many clicks on the commands and found it difficult to understand the design steps. The results were evaluated, and in order to create a smart, lean interface, 11 tasks were identified under Productivity, 11 tasks under Simplicity/Functionality, and 13 tasks under Interface. Although System Usability Scale and Nonverbal Pictorial Scale results were "Okay", the issues that were identified demonstrated that there was a usability problem in the CİZEN Program. If the evaluation results were applied to the CİZEN program, the usability would increase and the program could achieve the goals described in the Background Section. The results of this study can also be implemented by third parties too.

REFERENCES

Bayazıt, N. (1997). Endüstri Ürünleri ve Mimarlıkta Tasarlama Metodlarına Giriş, 1. Basım, Ekim, İstanbul.

Bintas, M. (2011). TMMOB Makine Mühendisleri Odası, 12. Otomotiv ve Üretim Teknolojileri Sempozyumu Sonuç Bildirgesi, 13-14 May, 308-313.

Bintas, M., Oztürk, A., Gungor, C., Tutay, A., Bilgili A., Kurt, M., Ergun, S., Kayıtken, T., & Gercek, E. (2011). *Development of Computer Aided Die Design Software and Die Design Process Modeling*, 6th International Conference and Exhibition on Design and Production of Machines and Dies/Molds, 23-26June 2011, Atılım University, Ankara, 285-290.

Bintas, M., Öz, C. (2016). Tasarım 4.0, *CADCAMCAE Dünyası Dergisi*, Sayı:46, 21-23.

Bintas, M., Öz, C. (2017). Tasarım 4.0 Bölüm 2, *CADCAMCAE Dünyası Dergisi*, Sayı:47, 2017, 30-33.

Bojko, A. (2013). *Eye Tracking the User Experience a Practical Guide to Research*, Rosenfeld Media, LLC, USA.

Brooke, J. (1996). *SUS: A quick and dirty" usability scale*. In P. W. Jordan, B. Thomas, Francis.

Chu, C.H., M.C. Song. (2004). *Computer Aided Parametric Design for 3D Tire Mold Production. Computers in Industry*, Department of Industrial Engineering and Engineering Management, National Tsing Hua University, Taiwan, 11-25.

Doğan, K. M., Suzuki, H., Günpınar, E. (2018). *Eye Tracking for Screening Design Parameters in Adjective based Design of Yacht Hull*, The University of Tokyo, Graduate Scholl of Engineering, Bunkyo, Hongo, Chome 3-1, 113-8654, Tokyo Japan.

Duffey, M.R., Q. Sun. (2003). Knowledge-Based Design of Progressive Stamping Dies. Department of Mechanical Engineering University of Massachusetts at Amherst, MA 01003, USA. 221-227.

Ehmke, C., Wilson, S. (2007). *Identifying Web Usability Problems from Eye-Tracking Data*, British HCI Group Annual Conference, University of Lancaster, UK, 119–128.

Jacob, R. J., Karn, K. S. (2003). Eye Tracking in Human –Computer Interaction and Usability Research: Ready to Deliver the Promises.

Jun C. and et all. (2013). Geometric Compensation for Automotive Stamping Die Design Integrating Structure Deflection and Blank Thinning, *The International Journal of Advanced Manufacturing Technology*, *66*, DOI 10.1007/s00170-012- 4422-7, 1449-1456.

Keş, Y., Kara, M. (2015). Mobil Oyun Geliştirme Sürecinde Arayüz Tasarımı, *Yıldız Journal of Art and Design*, (2)2, 18-26.

Kim, C.W. and et all. (2007). An Automated Design System of Press Die Components Using 3D CAD Library, Professor. School of Mechanical Engineering, Konkuk University, Korea. Part II, 961–974.

Kumar, S., Singh, R. (2007). An Intelligent System for Automatic Modeling of Progressive Die. *Journal of Materials Processing Technology*, 194:176-183.

Lee, R.S., Hsu, Q.C. Su, S.L. (1997). Development of a Parametric Computer-Aided Die Design System for Cold Forging. *Journal of Materials Processing Technology*, 91: 80-89.

Lin, B.T., Hsu, S.H. (2008). Automated Design System for Drawing Dies, *Expert Systems with Applications*, 34(3),1586–1598.

Myung, S., Han, S. 2001. Knowledge-Based Parametric Design of Mechanical Products Based on Configuration Design Method, *Expert Systems with Applications*, 99-107.

Nielsen, J. (1994). Estimating the Number of Subjects Needed for a Thinking Aloud Test. *International Journal of Human-Computer Studies*, 41(3), 385-397. Retrieved. http://www.sciencedirect.com/science/article/pii/S1071581984710652. (Accessed 20 September 2019)

Nielsen, J., Landauer, T. K. (1993). A Mathematical Model of the Finding of Usability Problems. In Proceedings of the INTERACT '93 and CHI '93 Conference on Human Factors in Computing Systems (CHI '93), 206-213. Retrieved. http://doi.acm.org/10.1145/169059.169166. (Accessed 20 September 2019).

Nielsen (2012). How Many Test Users in a Usability Study? Retrieved. https://www.nngroup.com/articles/how-many-test-users/. (Accessed 19 May 2019)

Poole, Alex and Ball J. Linden, Eye Tracking in Human-Computer Interaction and Usability Research: Current Status and Future Prospects, Psychology Department, Lancaster University, UK. Retrieved. https://pdfs.semanticscholar.org/92bc/546258e9b6560cea225ca9f6745fa636ae6a.pdf. (Accessed 14 May 2019).

Singh, N. (1996). System Approach to Computer-Integrated Design and Manufacturing, John Wiley Sons, USA.

Skarka, W. (2006). Application of MOKA Methodology in Generative Model Creation Using CATIA. *Engineering Applications of Artificial Intelligence*, 20(5), 677-690.