

The Interactional Effects of Page Layout, User Workload, and Lists in Improving the Single Usability Metric

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Abstract

With the rise of the digital age, people are increasingly exposed to the visual environment such as online websites that commonly contain usability issues. This study established a framework for improving the usability of an online birth certificate application website as measured through the Single Usability Metric (SUM), with completion rate, error rate, satisfaction, and task times as usability metrics. This is done by incorporating the concepts and guidelines provided by the design factors such as page layout, user's workload, and lists. Usability testing was conducted to gather quantitative information for measuring the usability metrics, which were standardized to obtain the SUM of the current design. The design factors were then analyzed and improvements were applied to develop a new design. A follow-up usability testing for the new design was conducted and results showed that the SUM increased from 1-sigma to 3-sigma level. The framework consisting of the design factors on web design development is deemed effective in improving the usability of a website.

Keywords

Usability, Web design, Single usability metric, Usability design, Online application

1. Background of the Study

The advent of the internet caused a massive disruption to business models and processes across different industries. Along with this is the emergence of the digital platforms that impacts the Industrial Engineering role in technology-based ecosystems with implications in the society and the economy (Zutshi and Grilo 2019). This increasing prominence of virtual surroundings poses a complex adaptive challenge to the users as they navigate online. Stokols (2018) explained that the influence of cyber sphere is evident in the design of work environments and understanding how people respond to and modify their surroundings requires explicit consideration.

With the digital age, manual tasks are transitioned into online applications, which require cognitive demands. This study looked at the considerations in website design to improve its usability. Several studies provide guidelines and recommendations to improve the user experience in websites. Quinones and Rusu (2017) conducted an exhaustive review of 73 studies related to usability heuristics for specific domains and methodologies of papers published from 2006 to 2016. However, according to Alonso-Virgos et al. (2019) despite this a lot of websites still have big usability problems. They analysed the degree of compliance to the usability guidelines by web developers to determine which usability recommendations are often forgotten and which are important to the minds of the web developers. Most of the usability problems can actually be addressed by the guidelines found in literature.

This research examined an E-government website (Philippine birth certificate online application) as the experimental stimuli. Based on initial user testing and user feedback, it was found out that the website contains many usability issues particularly on navigation, complexity, and clarity of the information being processed. The users generally struggled on using the website because of the difficulties in understanding the functions within the website since the ambiguous design deters the user's supposedly smooth operation. The website is system-centered rather than user-centered, which motivated the study to enhance its usability. To improve its usability, a framework of design factors were established and studied to identify specific usability problems found in the website. The

selection of design factors was based on the observations and results of the initial usability testing, user feedback, and extensive review of related literature. The three design factors identified were page layout, user workload, and lists. Understanding the roles of these design factors contribute to building an improved version of the website.

2. Conceptual Framework

The research framework (as shown on Figure 1) of the study is developed through the concepts and guidelines from the literature to improve web design. The involvement of users during the initial usability testing was also useful in gaining valuable insights about the usability design issues. Incorporating the design factors is aimed at improving the usability of the website as measured through the Single Usability Metric (SUM). Each design factor consists of sub-design factors that indicate the specifics on how a certain factor can be improved. The following sections present the design factors and how they can be utilized to improve usability based on the conceptual logic and evidence from previous studies. The hypotheses of the study were then developed.

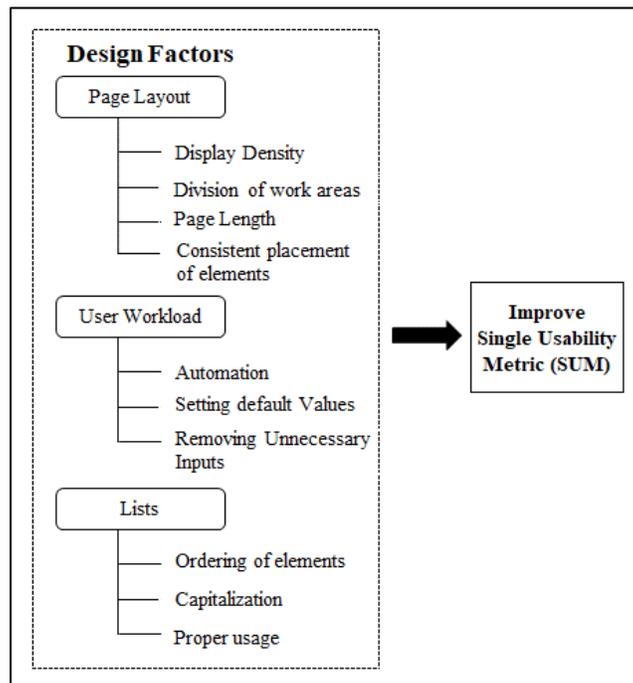


Figure 1. Conceptual framework of the study

2.1 Page Layout

Display density

Appropriate layout can increase usability (Vila and Kuster 2011). One of the common concerns in websites is the amount of clutter on the pages. The content on a website must be presented concisely as uncluttered layout enhances user engagement (Garett et al. 2016). Too crowded page with a huge amount of items of information affects the facilitation of finding the target information of the use (Rosel and Purinton 2004). According to Johnson (2014), too much text in a user interface loses poor readers while alienating the good readers, requiring readers to read more text than necessary which results into an intimidating amount of work. Likewise, Koo and Ju (2010) concluded that most users prefer a straightforward web design. For instance, text instructions can be shortened or removed with no loss of clarity. The goal to reduce display density is to minimize the need for reading. Furthermore, a study by Halverson and Hornof (2004) showed that visual search in sparse groups is faster, likely missed less often, and searched earlier than when in dense groups.

Division of work areas

The location of the work sections is crucial for users to understand the purpose of each part. This affects the ease in navigation of the user. A study conducted by Polancos (2019) demonstrated that during navigation, the overall layout would influence the overall efficiency, effectiveness, and satisfaction of the users. Moreover, when a section is located on the side where advertisements are usually placed, it is perceived to be not part of the main working space and less important. Our peripheral vision is poor. The low acuity of our peripheral vision would explain why the parts of the page away from the fovea (center of our visual field) diminish their visibility (Johnson 2014). Resolution is low when the objects are within the peripheral vision. Proper grouping of information is also important to aid the user in organizing the ideas. One of the strategies that could be used here is to arrange the elements in such a way that minimizes the frequent shift from using the keyboard and mouse, which could result in shorter task times.

Page length

When the screen size is not properly utilized, finding entry fields and buttons is a challenge. It is necessary for web pages to display all the information on a single screen and reduce scrolling within the page (Venkatesh et al. 2017, Torrente et al. 2012, Cox and Dale 2002, Gehrke and Tuban 1999). Further, Golombisky and Hagen (2017) discussed that web page's contents must be visible to any viewer with no scrolling required. Originally, the standard web page size was 640 x 480 pixels. However, as monitors became larger in the present, the screen size can be up to 1024 x 768 pixels.

Consistent placement of elements

In designing a website, the layout should enable the users develop a sense of familiarity. This is possible by placing the components of the website in a consistent location within and across pages (Lee and Kozar 2012, Lohse and Spiller 1999). Similarly, Wake (2016) stated that consistent placement of website elements ensures a better user experience.

2.2 User Workload

Automation

One of the design principles to cognitively engineer an interface is to automate unwanted workload. Tasks that can be eliminated by automation shall be done to free the user from some workload (Gerhardt-Powals 1996). For instance, the birth certificate website requires a zip code. If the user cannot recall, a hyperlink is available for the list of cities/provinces and their zip code. This process may be eliminated by automatically showing the respective zip code based on the province and city/municipality input of the user. Furthermore, Torrente et al. (2012) suggested that user-input fields must have available options to select rather than to type.

Setting Default Values

Another way of aiding the user in accomplishing the tasks faster and easier is to display default values for items with 'most likely' answers. For example, the country is set as 'Philippines' by default since most of the users would deliver within the country because the website is for Filipino birth certificate. In addition to this, the first entry field must be automatically activated letting the user type the necessary information without moving the cursor (Venkatesh 2017).

Removing Unnecessary Inputs

The amount of information asked from the user as input shall only consist of the essential ones to perform the function of the website. Flooding the user with information will require additional efforts that are non-value adding to the end goal. Thus, designers should try to minimize the amount of information entered by users (Leavitt and Shneiderman 2005).

2.3 Lists

Ordering of Elements

The arrangement of the elements in a list should facilitate successful user performance. The list of items must follow a coherent order (Torrente 2012). If there is no obvious order to apply, that is when they are arranged alphabetically or numerically. Research indicates that users tend to stop scanning a list as soon as they see something relevant (usually top three items), thus illustrating the reason to place important items at the beginning of lists (Leavitt and Shneiderman 2005).

Capitalization

According to Leavitt & Shneiderman (2005), only the first letter of the first word in the list should be capitalized. Since the current displays all the letters in each item on the list in capital letters, the new design applied this to all drop-down lists on the pages.

Proper Usage

Dropdown boxes should be avoided for data that is highly familiar to users such as the day, month, and year of birth (Li 2017). For this type of information, it would be easier for users to just type the information provided that the format is clearly indicated. This reduces the time that is needed for scrolling and searching. Also, an open list is preferable to use than a drop-down list to select one from many since the users are able to see all the items without scrolling. An exception here is when the number of items is extremely long (Leavitt and Shneiderman 2005). For this matter, the use of radio buttons instead of a drop-down list for “Sex” options is more appropriate. Radio buttons are used when users are asked to select one item only from a few mutually exclusive choices (Doan and Berryman 1999). Not requiring the users to click or scroll to see the options will reduce the time needed to perform the task.

2.4 Single Usability Metric

Several definitions and attributes on usability are established by literatures. It has multidimensional view and can be viewed in different aspects. The standard boards ISO 9241-11 (1998) and ANSI (2001) provided the common industry format for usability test reports, which refers usability to be “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.” Ajay (2010) and Dordevic (2007) provided an analytical review of usability definitions and their decomposition in various attributes for software. Their comparative analyses show that the three dimensions from the standard boards were included in the attributes that have the highest impact in the usability of software systems. The Single Usability Metric (SUM) represents these usability dimensions using standardization techniques in Six Sigma. It summarizes the quantitative and qualitative components of usability in a single score (Sauro & Kindlund, 2005). Effectiveness is measured in terms of completion and error rates, efficiency in terms of time on task, and satisfaction in terms of standardized satisfaction questionnaires (Figure 2).

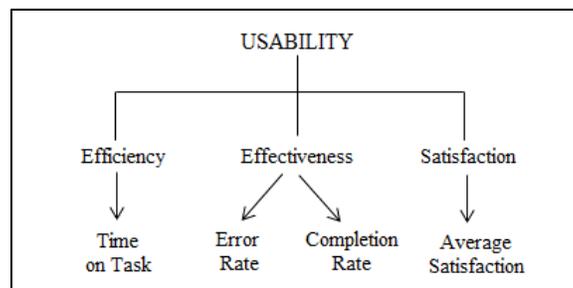


Figure 2. Quantitative model of usability by Sauro and Kindlund.

2.5 Hypothesis

H1: The overall page layout would influence the usability of the website. This is contributed by the display density, division of work areas, page length, and consistent placement of elements. The current design of the birth certificate website brings about annoyance and confusion to the user because of crowding and improper grouping and placement of the elements which disrupts the user’s flow.

H2: Reducing the amount of user workload would improve usability. This hypothesis suggests that automation, setting default values, and removing unnecessary workload will help the user achieve ease of use in operating the website. Some features within the current website can be performed by the system to aid the user in accomplishing the tasks.

H3: The use of lists would influence the usability of the website if the elements were ordered and capitalized properly and the type of list used is appropriate. On the current birth certificate website, the user encounters difficulty in finding an item in a list because of its arrangement, being overwhelmed by all capitalized elements, and spends more time than necessary because of inappropriate type of list used.

3. Methodology

To understand the effectiveness of the framework established, a case study on the Philippine online birth certificate application website was conducted. A birth certificate is a vital record used to authenticate one's identity and nationality (Philippine Statistics Authority 2012). Since birth certificate is a necessity for every living, the usability of the website is crucial. Citizens coming from different demographics like social status, education level, and age should use the website with ease. Usability testing for the current website design (referred to as Design 0) was performed to measure its usability through SUM. Respondents were given written instructions to do several tasks that utilize the birth certification application process. While performing the activities, their actions were documented using a screen recorder for accurate data collection. The list of tasks performed is given at Table 1.

Table 1. List of tasks performed

Task	Description
1	Start the document request process
2	Input contact and delivery information
3	Request for birth certificate document
4	Edit the birth certificate details
5	Change delivery address
6	Submit the document request

After using the website, the user is immediately asked to answer a questionnaire to get feedback on their satisfaction and comments to further improve the website's usability. This study used the After Scenario Questionnaire (ASQ) by Lewis (1991). The ASQ is commonly used in usability studies as research has supported that it has acceptable psychometric properties of reliability, sensitivity, and concurrent validity, and may be used with confidence in several usability studies. The data collected were then used to evaluate completion rate, error rate, satisfaction, and task times to compute for the SUM of the current design. Using the framework established in this study, a new design (Design 1) was created using Microsoft Excel Visual Basic. The same user testing method was done to get the SUM for the improved design. The SUM obtained was compared with current design to quantify usability improvement.

4. Results and Discussion

This section presents the assessment of the current design by computing its SUM from the usability metrics. SUM represents the usability dimensions using standardization techniques in Six Sigma. It summarizes the quantitative and qualitative components of usability in a single score (Sauro and Kindlund 2005). The design issues that were addressed in building an improved design were then presented and the SUM of the new design was assessed.

4.1 SUM Assessment of the Current Design

Completion Rate

The average task completion rate for Design 0 is at 73% with z-score equivalent of 0.6229. This is slightly lower than the 78% benchmark for software and websites (Sauro 2011). Overall, the modified Wald interval is 60.91% to 82.95% at a 95% confidence interval. This means that the observed completion rate on average will be within the interval 95% of the time.

Error Rate

The error rate per task is computed as a proportion of the number of errors over the error opportunities. Since all metrics must agree on reflecting an increase in usability, quality rate is obtained by subtracting the error rate from one. The average quality rate is at 91% with z-score equivalent of 1.3373.

Satisfaction

ASQ features three post-task questions with 7-point graphic scales. Prior usability research studies suggest that systems with “good usability” have a mean rating of 5.6 on a 7-point scale (Nielsen and Levy 1994). Thus, the value 5.6 is set to be the specification limit. The satisfaction metric resulted into z-score of -0.9026 with 18% equivalent.

Task Times

The maximum acceptable time or the specification limit is set using the bootstrap method (Sauro and Kindlund 2005), which resulted to a specification limit of 595 seconds. The overall average task time is at 464.76 seconds, which is lower than the specification limit. The z-score obtained is -0.6806 with a defective rate of 25%. Since the interest of SUM is the quality rate, the complement of these values is taken. Quality rate is at 75% with a z-value of 0.6806. The summary per task is shown on the table below.

Table 2. Completion rate, error rate, and time per task

Task	Completion Rate	Error Rate	Time (seconds)
1	100%	20%	23.48
2	70%	8%	94.95
3	40%	10%	213.51
4	60%	3%	46.47
5	70%	12%	81.12
6	100%	0%	5.23
	73%	9%	464.76

SUM of the Current Design

When the standardized score for each of the four metrics is obtained, the SUM is computed by getting the average of these four. The metrics are treated with equal weights. A sigma factor of 1.5 was then added to the SUM. This adjusts the SUM to account for a drift in the process over time. Based on results shown on Table 3, Design 0 is operating at 1 sigma.

Table 3. Process sigma for Design 0

Metric	Quality Level	z-score
Completion	73%	0.6229
Errors	91%	1.3373
Satisfaction	18%	-0.9026
Times	75%	0.6806
SUM		0.4345
Sigma Factor		1.5
Process Sigma		1.9345

4.2. Usability Design Issues

The following presents the usability design issues present on the current website and how these were addressed by applying the research framework. Figures 3-8 show the before and after design of the critical web pages.

Page Layout

- Too long text instructions were shortened with no loss of clarity.
- Obvious instructions that add to the visual density were removed. For example, every page has “Enter the required information below” instruction when it is obvious that the blank form needs to be filled.
- On the Contact and Delivery Information page, required input is divided into two clear groups: requester’s information and delivery address. Doing this layout change also avoided frequent shift from using the keyboard and mouse.

- With Design 1, the Contact and Delivery Information page can be accomplished without the need for scrolling.
- On the Requests Summary Page, “Edit” button for the requester’s information is difficult to locate because it is located in the peripherals.

User Workload

- The Requester’s Delivery Address would require a zip code. This process is eliminated by automatically showing the respective zip code.
- The Tax Identification Number (TIN) of the Requester is asked but is tagged as optional since it will not derail the accomplishment of the application. This unnecessary input is removed.
- For every page, the first entry field is automatically activated so that the user can type the necessary information without moving the cursor.
- The amount due is automatically computed after indicating the number of copies requested.
- A “No” is on default for the “Registered Late?” question since it is the most common answer.

Lists

- The items of the list on “Relationship to the Birth Certificate Owner” are unnecessarily arranged alphabetically. This makes it difficult for users to search for the commonly used items and the “Others” item must be placed at the end of the list.
- Since Design 0 displays all the letters in each item on the list in capital letters, the new design only capitalized the first letter of each word.
- The use of radio buttons instead of a drop-down list for “Sex” options is more appropriate.

Contact and Delivery Information

Enter your name and contact details.

Requester's Name: Last Name * First Name * Middle Initial

Delivery Address: Where will we deliver the document(s) to?

Country: PHILIPPINES

Deliver the document(s) to this embassy *

Complete Delivery Address

House/Apartment/Unit/Floor No., Building Name, Company Name (if office), Street Name *

Barangay/Subdivision/Village/District Name (also describe nearest landmark if possible) *

Barangay/Subdivision/Village/District Name (also describe nearest landmark if possible) *

Delivery Province * For delivery within Metro Manila, select METRO MANILA as Delivery Province.

Delivery City/Municipality *

ZIP Code * [Search Philippines ZIP Codes](#)

FEES

Document	Delivery Address	
	PHILIPPINES	OTHER COUNTRIES
Birth	PHP 330.00 per copy	USD 20.30 per copy
Marriage	PHP 330.00 per copy	USD 20.30 per copy
Death	PHP 330.00 per copy	USD 20.30 per copy
CENOMAR	PHP 430.00 per copy	USD 25.30 per copy

Telephone/Mobile No.: Country Code Area Code Telephone * Enter your valid telephone/mobile number to enable us to contact you regarding your request if necessary. Please enter numbers only.

Email Address: * Enter your valid email address. Payment and delivery notifications will be sent to you through email.

Tax Identification No.: Optional

By clicking the "Next" button you signify that you have read, understood, and agree to conform to and consent to be bound by the PSA S

Figure 3. Contact and Delivery Information page of Design 0.

Contact and Delivery Information

Requester's Information

* Last Name: * First Name: Middle Initial:

* Contact No:

* Email Address:

Delivery Address

* Street Address:

* Barangay:

* Province: For delivery within Metro Manila, select METRO MANILA as Delivery Province.

* City/Municipality:

Zip Code:

* Country: If you want to deliver to an embassy, select one:

By clicking the "Next" button you signify that you have read, understood, and agree to conform to and consent to be bound by the PSA Serbilis' Privacy Notice.

Figure 4. Contact and Delivery Information page of Design 1.

Requests Summary - JUAN A. DELA CRUZ

To add a request, click on a button below.

REQUESTS SUMMARY

Type	Name	Event Date	Event Place	Copies	Amount Due	View/Edit/Delete
BIRTH	DE LEON, GARRY HERRERA	11/08/1995	MORONG, RIZAL, PHILIPPINES	1	PHP 330.00	

To add another request, click on a button above.
To finalize your application, click on Submit.

Total No. of Copies Requested: 1

Total Amount Due: PHP 330.00

CONTACT AND DELIVERY INFORMATION

Requester's Name
DELA CRUZ, JUAN A.

Delivery Address
095 LAPU-LAPU STREET
SAN RIVAL, MORONG
RIZAL, PHILIPPINES 1960

Telephone/Mobile No.
09362866351

Email Address
JUANDELACRUZ@GMAIL.COM

Tax Identification No.

Figure 5. Requests Summary page of Design 0.

Add Request

Contact and Delivery Information

Requester's Name: **Juan A. Dela Cruz**

Contact Number: **09362866351**

Email Address: **juandelacruz@gmail.com**

Delivery Address: **095 Lapu-Lapu Street, San Rival
Morong, Rizal, Philippines 1960**

Requests Summary

Type	Name	Copies	Amount Due	Action
BIRTH	Garry Herrera De Leon	1	330	

Total No. of Copies Requested: 1
Total Amount Due: **Php 330**

FEES

Document	Amount
Birth	PHP 330.00 per copy
Marriage	
Death	
CENOMAR	PHP 430.00 per copy

Figure 6. Requests Summary page of Design 1.

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Figure 7. Add Request page of Design 0.

4.3. Assessment of the New Design

The SUM of the new design is computed to see improvements after incorporating changes based on the design factors considered. The quality level and z-score of the usability metrics are presented on Table 4.

Table 4. Process sigma for Design 1

Metric	Quality level	z-score
Completion	95.0%	1.6449
Errors	99.1%	2.3481
Satisfaction	99.8%	2.8169
Times	99.1%	2.3814
SUM		2.2978
Sigma Factor		1.5
Process Sigma		3.7978

The same procedure was done to standardize the usability metrics. There is an improvement in usability scores across all four usability metrics. There is an increase in quality rate from 73% to 95% for completion, from 91% to 99% for errors, and from 75% to 99% for the task times. The satisfaction scores of the users immensely increased from 18% to 99.76%. From 1 sigma, the new design development resulted to a process sigma of 3.

Figure 8. Add Request page of Design 1.

5. Conclusion

The framework consisting of the design factors on web design development are deemed effective in improving the SUM score of the website. Based on the usability tests conducted, all the three hypotheses were proved to be true. The SUM of the birth certificate application website increased from 1-sigma to 3-sigma level. Improving from 1 to 3-sigma would mean decreasing the percentage of defects by 62%. With a process sigma of 3, there will be 66,807 defects per million or 6.7% percentage defects. In general, a sigma level of at least three is desirable for organizations.

6. Recommendation

There are still opportunities to further improve the birth certificate website. It is recommended to develop design iterations until the target of six-sigma level is achieved. More research could be done to identify other improvement areas and consider other design factors not considered in this study. Moreover, the applications of the design factors to enhance other kinds of websites are recommended to further strengthen the evidence that support the results of this study.

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References

- Alonso-Virgós, L., Espada, J.P., and Crespo, R.G., Analyzing compliance and application of usability guidelines and recommendations by web developers, *Computer Standards & Interfaces*, vol. 64, pp. 117–132, 2019.
- ANSI, Common industry format for usability test reports (ANSI-NCITS 354-2001). Washington, DC: American National Standards Institute, 2001.
- Cox, J., and Dale, B.G., Key quality factors in web site design and use: An examination, *International Journal of Quality & Reliability Management*, vol. 19, no. 7, pp. 862–888, 2002.
- Doan, K., and Berryman, D., Design guidelines and UI standards for web based telco applications, 1999.
- Dordevic, N. D., Usability: Key characteristic of software quality. Military technical courier / Vojnotehnicki Glasnik, vol. 65, no. 2, pp. 513–529, 2017.
- Garett, R., Chiu, J., Zhang, L., and Young, S.D., A literature review: Website design and user engagement, *Online Journal of Communication and Media Technologies*, Available: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4974011/>, 2016.
- Gehrke, D. and Turban, E., Determinants of successful website design: Relative importance & recommendations for effectiveness, *Proceedings of the 32nd Hawaii International Conference on System Sciences*, pp. 1–8, 1999.
- Gerhardt-Powals, J., Cognitive engineering principles for enhancing human-computer performance, *International Journal of Human-Computer Interaction*, vol. 8, no. 2, pp. 189–211, 1996.
- Golombisky, K., and Hagen, R., White space is not your enemy: A beginner's guide to communicating visually through graphic, web & multimedia design. New York: A K Peters/CRC Press, 2017.
- Halverson, T., and Hornof, A.J., Local density guides visual search: Sparse groups are first and faster, *Proceedings of the 48th Meeting of the Human Factors and Ergonomics Society*, vol. 48, no. 16, pp. 1860–1864, 2004.
- ISO, *Ergonomic requirements for office work with visual display terminals (VDTs) – Part 11: Guidance on usability* (ISO 9241-11:1998(E)). Geneva, Switzerland, 1998.
- Johnson, J., *Designing with the Mind in Mind*. 2nd Edition, Elsevier Inc, USA, 2014.
- Koo, D.M., and Ju, S.H., The interactional effects of atmospheric and perceptual curiosity on emotions and online shopping intention, *Computers in Human Behavior*, vol. 26, no. 3, pp. 377–388, 2010.
- Leavitt, M.O., and Shneiderman, B., *Research-based web design and usability guidelines*, U.S. Government Printing Office, 2005.
- Lee, Y., and Kozar, K.A., Understanding of website usability: Specifying and measuring constructs and their relationships, *Decision Support Systems*, vol. 52, no. 2, pp. 450–463, 2012.
- Lewis, J.R., Psychometric evaluation of an after-scenario questionnaire for computer usability studies, *ACM SIGCHI Bull.*, vol. 23, no. 1, pp. 78–81, 1991.
- Li, A., Dropdowns: Design guidelines, *Nielsen Norman Group*, Available: <https://www.nngroup.com/articles/drop-down-menus/>, June 11, 2017.
- Lohse, G.L., and Spiller, P., Internet retail store design: How the user interface influences traffic and sales, *Journal of Computer-mediated Communication*, vol. 5, no. 21, 1999.
- Nielsen, J., and Levy, J., Measuring usability: Preference vs. performance, *Communications of the ACM* 37, vol. 37 no. 4, pp. 66-75, 1994.
- Philippine Statistics Authority, Birth certificate, Available: <https://psa.gov.ph/civilregistration/birth-certificate>, 2012.
- Polancos, R., A usability study of an enterprise resource planning system: A case study on SAP Business One, *Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018)*, vol. 7, pp. 1203-1223, January 2019.
- Quiñones, D., and Rusu, C., How to develop usability heuristics: A systematic literature review, *Computer*

- Standards & Interfaces*, March 2017, vol. 53, pp. 89–122, 2017.
- Rana, A., Analytical Roadmap to Usability Definitions and Decompositions. *International Journal of Engineering Science and Technology*. vol. 2, no. 9, pp. 4723-4729, September 2010.
- Rosen, D.E., and Purinton, E., Website design: Viewing the web as a cognitive landscape, *Journal of Business Research*, vol. 57, no. 7, pp. 787–794, 2004.
- Sauro, J., and Kindlund, E., A method to standardize usability metrics into a single score, *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 401-409, April 2005.
- Sauro, J., and Kindlund, E., How long should a task take? Identifying specification limits for task times in usability tests, *Proceeding of the Human Computer Interaction International Conference (HCII 2005)*, pp. 1-5, 2005.
- Sauro, J., What is a good task-completion rate?, Available: https://measuringu.com/task-completion/?fbclid=IwAR0jkz6v7fgENsIXknJbX_yqcX8ecQwKR1PJoxenYaRudmeaWz9BHH100T8, March 21, 2011.
- Stokols, D., *Social Ecology in the Digital Age: Solving Complex Problems in a Globalized World*, Academic Press, London, 2018.
- Torrente, M.C.S., Prieto, A.B.M., Gutiérrez, D.A., and De Sagastegui, M.E.A., Sirius: A heuristic-based framework for measuring web usability adapted to the type of website, *The Journal of Systems and Software*, vol. 86, no. 3, pp. 649–663, 2012.
- Venkatesh, V., Hoehle, H., and Aljafari, R., A usability study of the obamacare website: Evaluation and recommendations, *Government Information Quarterly*, vol. 34, no. 2, pp. 199–210, 2017.
- Vila, N., and Kuster, I., Consumer feelings and behaviours towards well designed websites, *Information and Management*, vol. 48, no. 4–5, pp. 166–177, 2011.
- Wake, L., Why is consistency important in web design?, *University of St Andrews*, Available: <https://digitalcommunications.wp.st-andrews.ac.uk/2016/04/07/why-is-consistency-important-in-web-design/>, April 17, 2016.
- Zutshi, A., and Grilo, A., Developing a digital platform architecture and analysing its impact on Industrial Engineering, *Computers & Industrial Engineering*, vol. 136, pp. 546–555, 2019.

Biographies

Gabriel John L. de Leon graduated BSc in Industrial Engineering at the University of the Philippines – Los Baños (UPLB) as the 2016 Outstanding Student Leadership Awardee recognized with academic excellence, leadership, and service awards. His student leadership prowess was exemplified by his notable projects as the President of the Philippine Institute of Industrial Engineers – National Student Chapter and UPLB College of Engineering and Agro-Industrial Technology Student Council Chairperson. He was a former Demand Management Planner at San Miguel Purefoods Company, Inc. and also taught Operations Research courses at UPLB. He is currently taking Master of Science in Industrial Engineering at the De La Salle University – Manila as a Department of Science and Technology (DOST) scholar.

Joana Patrice M. Gratuito is currently a graduate student in De La Salle University-Manila taking up Master of Science in Industrial Engineering. Prior to this, she obtained a Bachelor of Science degree in Industrial Engineering from Adamson University in the year 2018. She is a consistent top student of her batch and has been assigned to hold the position of Vice President for Internal Affairs at Philippine Institute of Industrial Engineers-Operations Research Society of the Philippines (PIIE-ORSP). Then, she gained her internship experience at Mondelēz Philippines Incorporated as a part of Continuous Improvement team. She ranked 15th place in the 10th Industrial Engineering Certification administered by Philippine Institute of Industrial Engineers (PIIE) through Industrial Engineering Certification Board (IECB).

Ronaldo V. Polanco is an Assistant Professor at De La Salle University - Industrial Engineering Department. He obtained his MSc in Industrial Engineering from DLSU as a Department of Science and Technology scholar and currently completing his Doctor of Philosophy in Industrial Engineering from the same university. He is also a Microsoft Certified Technology Specialist for Microsoft Dynamics AX Distribution and Trade 2012. He specializes in the area of project management, process management, and quality management system; technical expertise on enterprise resource planning system (Microsoft Dynamics and SAP R/3), information system, and web usability assessment. He has been in the academe for more than 10 years and presenting his researches to different international conferences. He has 10 years of experience in the telecommunication and retail sector. He continues to serve as consultant to different government and private companies in the Philippines.