The Impact of Command Buttons, Entry Fields, and Graphics on Single Usability Metric (SUM)

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Abstract

In recent years, the growth of Internet has reached many organizations. Web sites become an avenue for companies to widen their market and reduce facility cost. This calls for the need to develop websites that are more user-friendly, especially for government-operated sites where a large portion of the population is required to be a user. A case study on the Professional Regulation Commission: Licensure Examination and Registration Information System (PRC: LERIS) was conducted. The Single Usability Metric (SUM) was used to encapsulate the effectiveness, efficiency, and satisfaction score of the said web site. Primarily, this paper presents a framework containing design factors seeking to address different design issues. This paper aims to improve the SUM by implementing the improvements on the design factors. A new design was developed to compare the SUM with the existing website. The increase in the sigma level indicated the evidence of effectiveness of the proposed framework.

Keywords

Single usability metric, Usability testing, Web design, User registration

1. Background of the Study

It is undeniable that rapid development of the Internet has a significant effect on different organizations. In relation to this, companies of any size and type are using web sites for their transactions (Barnes and Vidgen 2000; Bell and Tang 1998). Web sites are great aid for companies to widen their market and minimize the facility cost. Consumers also benefit significantly in using such sites, as much as with organizations. It helps them access vast collections of information in the World Wide Web (Liddle et al. 2003). The emergent of digital age does not only transforms the way of doing business which includes web services but also the expectations of customers. Thus, it is important to continuously evaluate and improve such services. In relation to this, Wang and Senecal (2016) discussed that usability is an essential construct in assessing websites. Therefore, it is imperative for web designers to consider usability as an indicator for a successful design (Kaur, Kaur, and Kaur 2018). Having said that, this paper established design factors to be considered in designing a website. Agreeing to this, Guo et al. (2016) stated that website design has a significant influence to user satisfaction.

This paper conducted a usability testing on the registration process of certain website to uncover design issues. The website considered is government-operated to regulate professionals or individuals required of board examinations. There are several issues encountered by the users. Among these are undistinguishable buttons, ambiguous label's captions, confusing textbox positioning, and numerous graphics resulting to disorderly layout. The design factors are based on these issues which include (1) Command Buttons, (2) Entry Fields, and (3) Graphics. Through literature review of these factors, the framework of this study was developed.

The system studied is a website of Professional Regulation Commission (PRC) to accommodate the board examinees, board passers, and all individuals required of any board exam. LERIS stands for Licensure Examination and Registration Information System which is an improvement of the former PRC website. PRC: LERIS is a website comprising of various online service such as Exam Application, Initial Registration, Renewal of License, and

Verification. The process of user registration is crucial for a government-operated website because every user's identity must be verified.

2. Conceptual Framework

In improving the current system, different design factors were established. The enhancement on the design factors aims to improve the efficiency, effectiveness, and satisfaction score of the website which will result to a higher SUM. This can be seen in the conceptual framework presented in Figure 1.

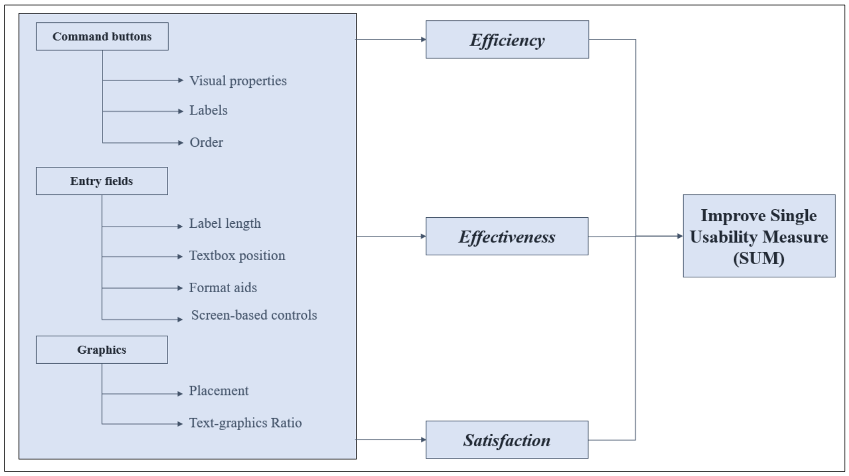

Figure 1. Conceptual framework of the study

2.1. Command Buttons

Visual Properties (Affordance)

The buttons should look like buttons that are clickable. One way to do this is to show the dimensionality of the object. There are a variety of familiar designs and the clearest among them is a "filled button with shadows" (Babich 2018). Also, the amount of whitespace around the label helps in perceiving the object to be clickable.

Labels

The label of a button should clearly and concisely indicate what it does. It should describe its action to avoid misleading. Effective use of short phrases better conveys the action and removes doubt of users.

Order

The literature on order of buttons such as "Previous and Next" varies and no clear agreement is posed to whether which must come first. This study considers the guideline of Babich (2018), which states that it is logical that a button that moves the user forward should be on the right while the button that moves user backwards should be placed on the left.

2.2. Entry Fields

Entry fields include labels and textboxes that are used to complete a form by entering a text input into the textboxes. The entry fields are expected to have labels which will not cause confusion to users (Polancos 2019). Also, it must provide a clear distinction between the required and optional fields.

Labels Length

Labels are informative descriptions of the data required in the text box, which help users understand the entry that should be made. Ideally, these must be short because extensively long captions distracts and tires users (Alonso-Virgós et al. 2019).

Textbox Position

When a single label is associated with a single text box, it is strongly recommended that labels will appear on the left of the text box, rather than above the text box (Schumacher Jr. 1996). This reduces the visual clutter and eases the user to associated labels with the respective textboxes. With this, Design 1 positioned the labels on the left of the textbox.

Format Aids

Several parts of the pages also incorporate format aids to specify the desired response. However, this also adds to the visual clutter and must be used sparingly (Schumacher Jr. 1996). Visual aids that can be removed while not derailing the achievement of the task must be removed.

Screen-Based Controls

Users must be able to distinguish the required and optional data fields. This is usually done by the aid of an asterisk (*). However, it adds confusion if not properly located. The asterisks used on the current design do not clearly indicate which field they are referring to because of the location (in between textboxes) and inconsistency.

2.3. Graphics

Placement

The usage of graphics must not occupy the main space on the screen where visibility of important information is lost (Condos et al. 2002). This could be distractive and eat up the attention of the user. Experienced users will tend to ignore graphics that they consider to be advertisement.

According to Leavitt and Shneiderman (2005), web designers should not make images look like banner advertisements or gratuitous decorations that users will miss even though the graphic is larger than most graphics on the page. The use of images should be done if it is critical to the success of the website

Ratio

The appropriate combination of text and graphics in a web page contribute to a faster cognitive processing of a user. According to Lin et al. (2013), a ratio of graphics to text between 3:1 to 1:1 should be considered. It is concluded that this ratio will match the user's impression of easy-to-use and clear-to-follow. Agreeing to this, Belanche et al. (2012) stated that more than the multimedia effects, it is better to concentrate on simple and easy to follow web design.

2.4. Single Usability Measure

The Single Usability Metric (SUM) model was utilized to measure the degree of usability of the said system. The model shown in Figure 2 is based in ANSI (2001) and ISO 9241 pt. 11 (ISO 1998) stating that usability is defined by three dimensions—effectiveness, efficiency, and satisfaction. In obtaining the SUM, the average of the metrics was computed plus 1.5 for the sigma shift (Sauro and Kindlund 2005).

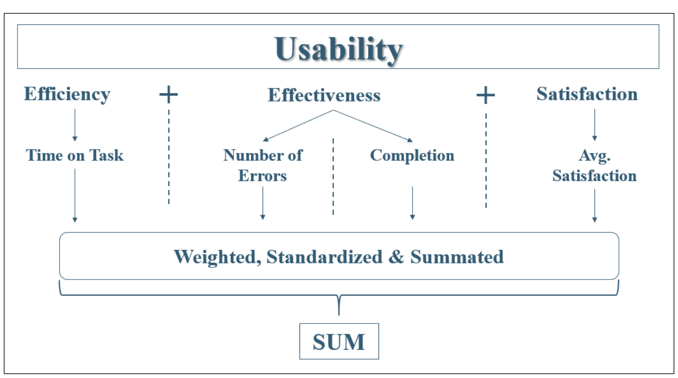

Figure 2. Single Usability Measure (SUM) Model

2.5. Hypothesis

H1: The command buttons, specifically visual properties, labels, and order would influence the overall efficiency, effectiveness, and satisfaction scores resulting to improved SUM.

H2: The entry fields, specifically label length, textbox position, format aids, and screen-based controls would influence the overall efficiency, effectiveness, and satisfaction scores resulting to improved SUM.

H3: The graphics specifically placement and text-graphics ratio would influence the overall efficiency, effectiveness, and satisfaction scores resulting to improved SUM.

3. Methodology

The established framework was assessed through a case study on the website of PRC: LERIS. In doing so, usability testing was conducted in the said site to serve as the Design 0 phase following the tasks below.

1. Open PRC: LERIS website
    a. Click OK in all pop-ups
    b. Click CLOSE in the last pop-up
2. Register
    a. Run through the terms and conditions
    b. Click I AGREE after the last section in terms and conditions
    c. Fill out all the required fields
    d. Click REGISTER
3. Sign in
    a. Fill out all the required fields
    b. Click SIGN IN
4. Edit profile
    a. Fill out personal information
    b. Fill out contact details
    c. Fill out family background
    d. Fill out education and employment
    e. Fill out valid ID and other information
    f. Click SAVE INFORMATION
5. Upload photo
    a. Click camera icon
    b. Choose photo to upload
    c. Click UPLOAD IMAGE

The execution of the tasks was screen recorded to obtain a more accurate documentation. As discussed in the previous sections, the usability of the website was examined using the Single Usability Metrics (SUM) which is defined by efficiency, effectiveness, and satisfaction. The discussion of each metric used in this study can be found in the next sub sections.

Design 1 phase started at the implementation of improvement on the previously established design factors. This was accomplished using the Microsoft Excel Visual Basic application since the study concerns a live and restricted (government-operated) website.

3.1. Efficiency Score

Efficiency score is specified by time-on-task defined in (1). It is measured in terms of task time which is the difference between the end and start time.

$$Task\ time = End\ time - Start\ time \qquad (1)$$

Effectiveness Score

In relation to SUM Model, effectiveness is defined by two metrics called task completion rate and error rate. As discussed by (Sauro and Kindlund 2005), the task completion rate is the ratio between the number of completed tasks successfully and the total number of tasks which is mathematically stated in (2).

$$Task\ completion\ rate = \frac{Number\ of\ completed\ tasks}{Total\ number\ of\ tasks} \qquad (2)$$

Then, the error rate is calculated by tallying the number of errors committed by the users dividing it by the total opportunities for errors found in (3).

$$Error\ Rate = \frac{Total\ number\ of\ errors}{Total\ Opportunities} \qquad (3)$$

The number of opportunities is defined by the buttons, text boxes, combo boxes, and other fields in the registration process where errors can be made (Sauro and Kindlund 2005).

3.2. Satisfaction Score

The satisfaction score is measured by distribution a questionnaire about the experience of using the system. It captures the subjective reactions regarding the system. There are different questionnaires to use for this metric. The System Usability Scale (SUS) by (Brooke and Weerdmeester 2011) was specifically used in this paper. It is comprised with ten (10) questions which are scored on a 5-point scale from "Strongly Disagree" (1) to "Strongly Agree" (5). In obtaining the usability score, 1 is subtracted from the rating on odd numbered questions. While for the even numbered questions' rating must be subtracted from 5.

4. Results and Discussion

The results on both Design 0 and 1 phases are discussed and presented in this section. This also exhibits the improved version of the website, which was created through Visual Basic.

4.1. SUM Assessment for Design 0

Efficiency Score

a) Time on Task
This metric is quantified through obtaining the z-score where the value to be distributed is the specification limit (Sauro and Kindlund 2005). The specification limit is established using the "Expert" user time which is the fastest user multiplied by 1.5 (Lewis 1982). The average of each user's completion time is calculated to serve as the mean. Similarly, the standard deviation is obtained by comparing the average completion time of each user. Table 1 shows the results of the time-on-task metric which encapsulates the efficiency score.

Table 1. Design 0 time on task results

Tasks	Specification Limits (seconds)	μ (seconds)	δ (seconds)	Z-value	Quality Level
1	8	9.89	3.02	-0.79	0.21435
2	119	139.78	51.86	-0.41	0.34080
3	45	49.11	17.29	-0.24	0.40602
4	302	399.56	200.94	-0.49	0.31278
5	39	51.67	22.72	-0.56	0.28855

Effectiveness Score

a) *Task Completion Rate*

This is a binary metric where the completed task is rated as 1 and 0 if failed. The completion is based on the specification limit used in task time. The tasks which are completed beyond the limit were considered failures.

Table 2. Design 0 completion rate results

Task	Completion Rate	Z-score
1	56%	*0.140*
2	33%	*-0.431*
3	56%	*0.140*
4	44%	*-0.140*
5	44%	*-0.140*

In Table 2, the computed values for task completion rate were presented. It can be observed that the values are unsatisfactory as it ranges from 30% to 50% only.

b) *Error Rate*

Table 3 exhibits the measures used in obtaining the error rate. The basis for the z-value is the quality level, which is the complement of error rate.

Table 3. Design 0 error rate results

Tasks	Number of Errors	Error Opportunities	Error Rate	Quality Level	Z-value
1	0	9	0%	100%	6.00
2	11	99	11%	89%	1.22064
3	7	27	26%	74%	0.64563
4	19	342	6%	94%	1.59322
5	3	36	8%	92%	1.38299

Satisfaction Score

In here, System Usability Scale was utilized to capture the satisfaction rating of each user. It is composed of 10 questions generally asks their perception of the system.

Table 4. Design 0 satisfaction score results

Metric	Value
Specification Limit	70
μ	63.8889
δ	9.9303
Z-Score	0.6154
Quality Level	0.7309

The table above presents the summary of results for satisfaction score. The mean and standard deviation were obtained by comparing the answers of each user. The specification limit is set to 70 because (Bangor et al. 2008) argued that systems which are at least passable have SUS scores above this value. Clearly, the current system did not meet this specification.

Single Usability Metric (SUM)

Finally, using the values from efficiency, effectiveness, and satisfaction scores, usability rating was computed. As discussed earlier, to obtain this metric, the scores were averaged, and sigma shift is added (1.5). The SUM is evidently far from 3-sigma level which is considered acceptable for most systems.

Table 5. Design 0 sum results

Metric	Z-score
Task Completion	-0.0837
Error Rate	1.41884
Time on Task	0.24559
Satisfaction	0.6154
SUM	2.04905

4.2. Design 1 Development

The development in the current system is implemented through Visual Basic for Applications (VBA) in Microsoft Excel. The process of registration is imitated in the said program to apply the improvement on the previously defined design factors. Similar to Design 0 phase, SUM is calculated through the efficiency, effectiveness, and satisfaction score. The following presents the design improvements done.

Command Buttons

- Visual Properties: The button is filled with shadows
- Labels: The labels are straightforwardly describing the action
- Order: The “Next” button is placed on the right side as it moves the user forward with the process. The “Back” button is positioned at the left side of the form because it depicts a backward movement.

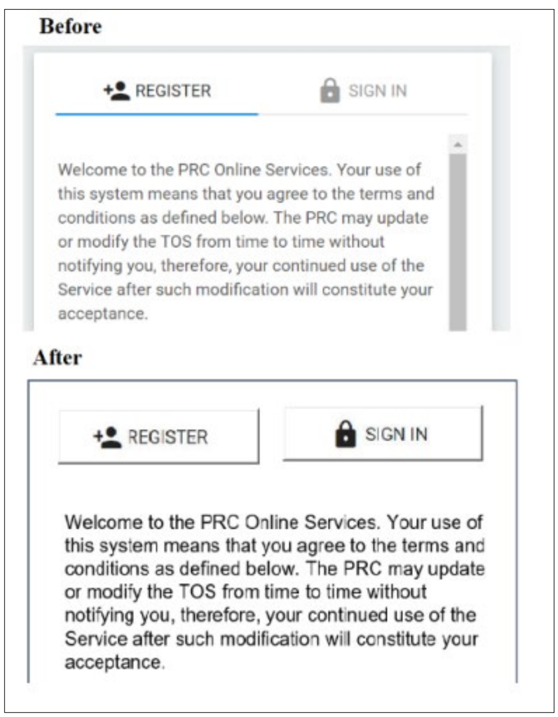

Figure 1. Improvement on visual properties

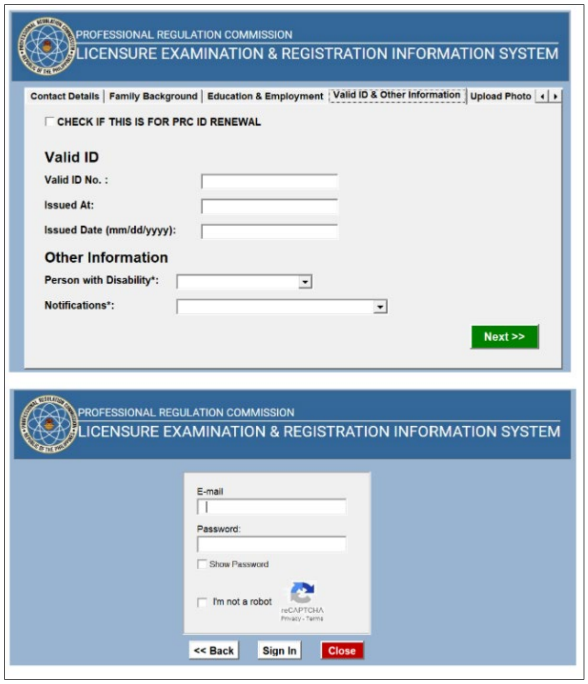

Figure 2. Improvement on order

Entry Fields

- Label length: The captions are limited to one up to three words
- Textbox Position: Short labels are placed at the left side of the textbox instead on top.
- Format Aids: The explanation of certain entry fields is minimized to 1 to 2 words.
- Screen-based Controls: The required fields are specified by asterisk (*) which is clearly placed beside the label.

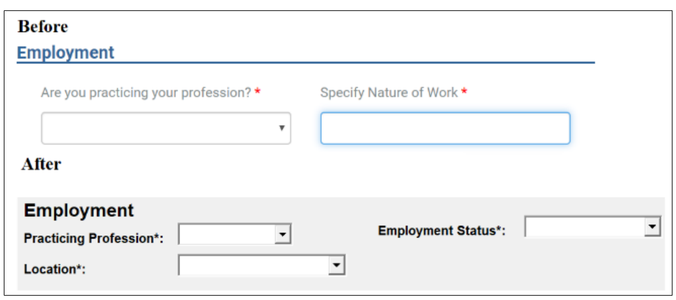

Figure 3. Improvement on label length and textbox position

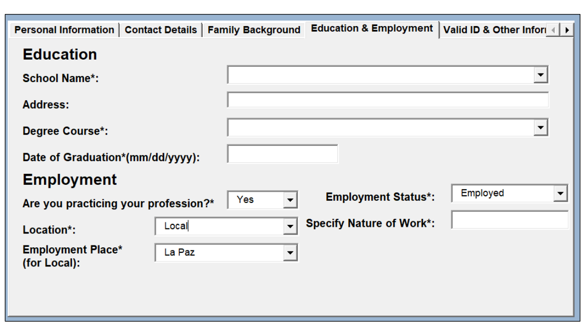

Figure 4. Improvement on format aids

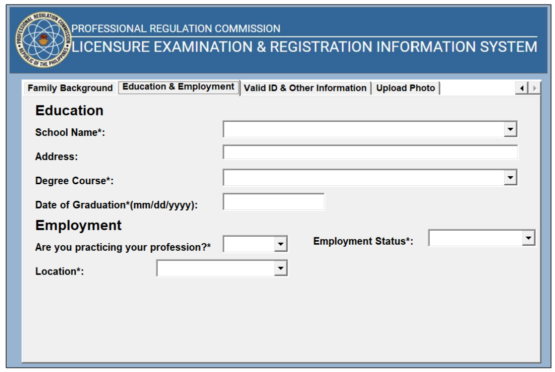

Figure 5. Improvement on screen-based controls

Graphics

- Placement: The graphics in a form are placed in the top which functions as a banner or header.
- Ratio: In every form, minimal to no graphics were used. Aside from the logo of the website and symbols of each service, no other graphics was used.

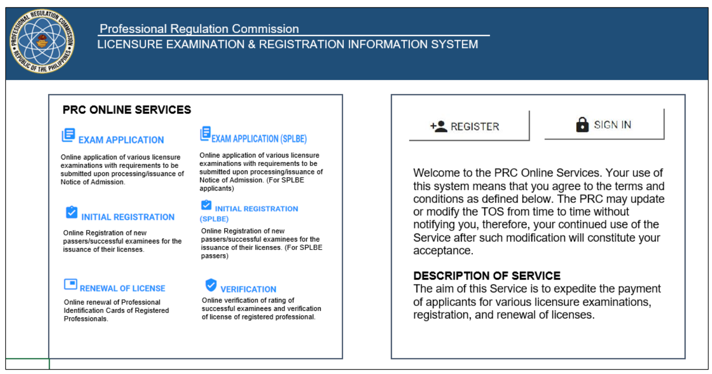

Figure 8. Improvement on placement and ratio of graphics

4.3. SUM Assessment for Design 1

Efficiency Score

a) *Time on Task*

Similar to Design 0 phase, the specification limit used is the "Expert" user time. The quality level significantly increased in the Design 1 phase. The tasks were finished within a shorter amount of time when compared to the results for Design 0.

Table 6. Design 1 time on task results

Tasks	Specification Limits (seconds)	μ (seconds)	δ (seconds)	Z-value	Quality Level
1	8	10.00	2.74	0.18	0.57243
2	119	43.78	12.53	-0.50	0.30815
3	45	18.22	4.60	-0.05	0.48075
4	302	182.22	64.35	-0.87	0.19116
5	39	15.78	4.99	-0.46	0.32417

Effectiveness Score

a) *Task Completion Rate*
In contrast to the improved metric of efficiency, the task completion rate decreased. This is caused by the significant increase in users' task times. A number of users finished the tasks in speedy manner which the specification limit is based on. Particular users did not meet this limit hence, not completing the tasks.

Table 7. Design 1 task completion rate results

Task	Completion Rate	Z-score
1	67%	0.431
2	33%	-0.431
3	67%	0.431
4	22%	-0.765
5	33%	-0.431

Based on the table above, it is evident that completion rate decreased but not significantly. The task which has the lowest completion time is "Edit Profile" where numerous entry fields must be filled out.

b) *Error Rate*
As Table 8 shows, the quality level of error rate metric substantially increased. Although the number of opportunities decreased because of the omitted input fields, the significant decrease in number of errors greatly affected the metric. The only task with errors is, again, the "Edit Profile". Evidently, this can be noted as a considerable improvement.

Table 8. Design 1 error rate results

Tasks	Number of Errors	Error Opportunities	Error Rate	Quality Level	Z-value
1	0	9	0%	100%	6.0000
2	0	81	0%	100%	6.0000
3	0	27	0%	100%	6.0000
4	3	297	1%	99%	2.3226
5	0	18	0%	100%	6.0000

Satisfaction Score

This was calculated using the process used in Design 0. Ratings of each user were compared to one another in computing for the mean and standard deviation. The satisfaction increased and finally met the specification limit (shown in Table 9), even higher. This will result to a satisfactory z-score hence, better process sigma value.

Table 9. Design 1 satisfaction score results

Metric	Value
Specification Limit	70
μ	85.5556
δ	16.0943
Z-Score	0.9665
Quality Level	0.8331

Single Usability Metric (SUM)

Using the same computation in Design 0 phase, the process sigma value improved from 2.049 to 2.49943 shown in Table 10. Almost all the metrics improved in value expect the task completion rate. It is worthy to note that the SUM became closer to 3-sigma which means approximately 99% defect free (Sauro & Kindlund, 2005).

Table 10. Design 1 satisfaction results

Metric	Z-score
Task Completion	-0.1397
Error Rate	2.46012
Time on Task	0.71076
Satisfaction	0.96652
SUM	2.49943

5. Conclusion

The formulated hypotheses concerning the command buttons, entry fields, and graphics were evidenced through comparison between the SUM of Design 0 and 1. The improved value of SUM verified the usefulness of the established framework, specifically the design factors. Most of the metrics increased from Design 0 to 1 except task completion rate. Despite this, the improvement on other metrics greatly affected the SUM which significantly increased from 2.05 to 2.50. This denotes that researchers and web designers can use this study as a basis in achieving a successful website design.

6. Recommendation

Given the contributions of this study, the design was still not able to reach the 3-sigma level. It is necessary to conduct further study on the site and uncover opportunities for improvement. Other area of exploration can be on implementation of the design factors in different website which can strongly justify the effectiveness of the framework. Further, the design must be further iterated to achieve a higher SUM reaching up to 6-sigma level. In relation to this, a more extensive review of literature must be done to uncover more design factors.

Acknowledgement

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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. Polancos 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.