SmartKADASTER Interactive Portal (SKiP), is it fit for purpose?

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Abstract. The Department of Survey and Mapping Malaysia (JUPEM) developed SmartKADASTER Interactive Portal or SKiP in order to provide a multipurpose cadastral survey information-based platform for accurate spatial analysis. Whether SKiP is viable for its purpose is still undetermined. Therefore, this paper highlights the methodology of assessing the usability of SKiP. A usability test was conducted by using the System Usability Scale or SUS. Fifty-nine participants from various public and private agencies, participated in the assessment and were categorised as Existing, New and Potential users, as well as Familiar and Not Familiar with the spatial analysis concept. The overall SUS score for SKiP is 69.8, which concludes that the usability of SKiP is fit for its purpose and can be perceived as marginal high for acceptance under the Acceptability Range. The SUS score was subsequently extracted to determine additional information on the Learnability and Usability components that resulted as 57.8 and 72.8, respectively. The SUS score implies that SKiP is an excellent platform for Usability and perceived good for Learnability, within the Adjective Ratings. Further analysis of the SUS scores suggests that regardless of which category the users were grouped, those who are familiar with the spatial analysis concept are likely to score higher. The correlation efficient supports the SUS score result as the Learnability components of SKiP requires further improvement. It was also found that the usability test participants are distinct as Passively Satisfied users. In line with the overall SUS and Nett Promoter Score (NPS) scores, additional mitigation and interventions are needed to convert SKiP Passively Satisfied users to Promoters and reduced Detractors. Recommendations from the study are highlighted in this paper to value-add SKiP in the next phase while the prominence on ease of doing the spatial analysis is emphasised.

1. Introduction
The Department of Survey and Mapping Malaysia or JUPEM has always been involved in the business of mapping the nation. Maps and plans published by JUPEM have long served as a fundamental purpose of understanding the land and geographical context in Malaysia. JUPEM is the authorised custodian for cadastral survey information in Malaysia. The significance of the geospatial component of the cadastre system specifically as the basis for spatial analysis [1] is of particular importance to the nation in understanding who owns what, land value, land use and the location. It illustrates “what” is happening “where”, helping us to understand “why” and to design appropriate decisions effectively.
1.1 Data handling for spatial analysis

In providing the “where”, integration of some geospatial datasets are required for the spatial analysis. For example, cadastral survey information links the 1:1 relationship between land parcels and land registration, namely Rights, Restriction and Responsibility thus provides a better understanding and traceability of the spatial analysis made. The ease of using GIS-based software have led non-surveyors to manage the geospatial datasets as well [2]. However, as more data source is being utilised for integration, the more challenging it will be for users to manage. Therefore, a comprehensive understanding of coordinates, vertical and horizontal datums, and types of map projections are required, as well as access to reliable data. Ideally, such knowledge is significant to avoid mismatches and misinterpretations of geospatial data sets [3]. Realising the complexity to grasp geospatial data handling specifically on cadastral survey datasets, JUPEM has developed SmartKADASTER Interactive Portal or SKiP, to provide a common reference platform where users can utilise it for spatial analysis. High-quality coordinate transformations are being emphasised in SKiP to ensure that data is non-jeopardised throughout the transformation process and can be optimised and displayed in a seamless horizontal and vertical manner.

1.2 SmartKADASTER Interactive Portal (SKiP)

The use of the National Digital Cadastral Database or NDCDB becomes paramount when the concern of a spatial analysis is on the relationship of the people (property owner) and their land (property)[4]. Hence, the basis of SmartKADASTER is NDCDB. SKiP was planned to be developed in phases, and the first phase SKiP covered the entire FT Kuala Lumpur and Putrajaya. Even though a cumbersome endeavour at that time, various geospatial data sources were also optimised and leveraged. Sensors namely from nadir camera, oblique cameras and a Lidar unit were utilised and leveraged to develop the 3D city model of FT Kuala Lumpur and Putrajaya into the SKiP environment, in order to provide the basis for Smart City enablement. Respectively, the phase 1 development was completed and opened for use in 2016, with the objective to establish a realistic and smart cadastral-based spatial analysis platform for an effective planning, decision making, enabling efficiencies and enhancing communication and management [5]. The idea and concept of the SmartKADASTER environment adaptation are shown in Figure 1.

![Figure 1. SmartKADASTER adaptation process.](image-url)
1.3 Purpose of the study

Previous research [6] identified four key front end attributes as crucial inputs towards portal effectiveness: service delivery; customer orientation, usability, and trustworthiness. These attributes were considered and applied during the SKiP development process. Whether SKiP is viable for its use is still unanswered. Therefore, it is the purpose of this study to understand SKiP’s usability. It should be noted that this paper does not intend to explain the functions and capabilities of SKiP. However, to enable readers to comprehend SKiP’s capabilities, Figure 2 depicts the overall 2D functionality of SKiP, while Figure 3 shows the functions that can be operated by registered users in the SKiP’s 3D interface.

![Figure 2. 2D Functionality of SKiP.](image)

![Figure 3. 3D Functionality of SKiP.](image)
2. Methodology

The following research methodology was adapted from previous research [7-10] and applied, as depicted in Figure 4.

![Usability Test Process Diagram]

Figure 4. SKiP Usability Test Process.

2.1 Usability Assessment

The context of usability adopted in this study referred to the definition from the International Standard Operations. Usability is described as the degree to which a product (or SKiP in this study) can be used and is learnable by its users to achieve insights with effectiveness, efficiency, and satisfaction [11] (or for the purpose of spatial analysis, in this study). The System Usability Scale method or SUS was selected based on its attractive attributes such as a reliable and credible tool [12], a popular tool for measuring usability [8], direct access, correct ‘conclusion’ quicker [13] and easy to administer and perform the assessment. SUS covers a variety of aspects of system usability, namely for support, training to complexity. Consequently, SUS provides a high level of face validity for measuring the usability of the product [11, 14]. Apart from that, three unique components can be derived from the SUS score result. They are the SKiP’s Usability and Learnability component and also the Net Promoter Score (NPS) of SKiP users. In the context of this study, the NPS value can be used for gauging users’ satisfaction and the concept is widely used by established and emerging industries [15]. Users are grouped based on the Promoters, Passively Satisfied or Detractors categories. The user’s categories shall provide a general prediction of the SKiP’s growth/expansion based on the user’s satisfaction and likely to recommend.

2.2 Usability Test Participants

A reliable usability test of any products requires a purposive sampling of end-users. Because of this, 68 participants were selected and consequently invited to partake in the usability test. Instead of a homogenous background, participants were of heterogeneous background, experience and were grouped as Existing, New and Potential users of SKiP to reduce bias. Out of the 68 people invited, 59 of them participated in the assessment. The minimum number for a reliable SUS result is twelve [16], and therefore, the number of participants in this study have complied to the minimum requirement. The profiles of the usability test participants are also classified into those who are familiar or not familiar with the spatial analysis concept, as shown in Figure 5.
2.3 Usability Test Protocol and Testing
SUS protocol recommended from previous researchers [8, 17] was adopted in this research. The protocol included dedicated time for exploring SKiP prior to the usability assessment for a holistic view of real and perceived user experience. Participants were instructed to score the SUS statements accordingly. They were frequently prompted of the alternate nature of the standard positive and negative SUS statements to avoid the occurrence of unintentional responses due to user’s assumption of an overall positively worded SUS statements. Regardless of the standard SUS or positive nature SUS, researcher [10] highlighted both yielded similar SUS scores that indicate the reliability and validity of SUS. The SUS scores could not provide specific information on how the user struggle or like when using the product. Therefore, in this study “Any comments?” were applied at the end of the assessment. The open-ended question shall disclose additional information about the usability test that could not be captured solely on the SUS statements. In addition, to analyse user’s comments, the summative content analysis approach was also used in this study.

2.4 SUS score method and indicator
A special SUS calculation formula is used to calculate the SUS overall score. Each SUS statement’s score contribution is ranged from 0 to 4. The scale score contribution is minus 1 for the positive SUS statement. In the negative SUS statements, the score contribution is 5, minus the scale position. The overall value of the SUS statements is obtained by multiplying the 2.5 factor with the sum scores. The Usability and Learnability components can be determined from the SUS score by utilising the multiplying factors for SUS summed score contributions of 3.125 and 12.5, respectively [11]. A SUS score of 68 is considered above average SUS score. Any SUS scores lower than 68 are described as below average [14]. Even though the maximum SUS score is 100, it is not percentile. The scores are generally described and associated in three different ways, namely as Grade Scale, Adjectives Rating and Acceptability Range. In the Acceptability Range indicator, SUS scores that are below 50 are judged as unacceptable. SUS scores in the range of 50 and 70 are described as marginally acceptable, while 64 to 70 scores are considered as marginal high. SUS scores in between 50 to 63 are labelled as marginally low. Ultimately, a product is considered acceptable is when the SUS score is higher than 70 [11]. The Net Promoter Score (NPS) has a strong correlation with SUS scores [13], which means if a user rates usability as high, they are much more likely to recommend the product to others. The NPS categories can be established by dividing the overall SUS score with 10. Direct reading of the SUS score of at least 81 (NPS value of 9 or 10) infers to a Promoter while a maximum score of 53 or below (NPS value of 1 through 6) is considered as Detractor, while others are considered Passively Satisfied [18]. Promoters are described as enthusiastic user that will help promote and bring in new users, Passively Satisfied are known as satisfied user but unlikely to promote and may become Promoters or Detractors given the exact motivation and mitigation. Detractors are unhappy users who could damage a brand and impede growth through negative word-of-mouth.
3. Analysis & Result

3.1 Overall SUS score
The overall mean SUS score for SKiP is 69.8. The Learnability component is scored as 57.8, while the Usability component is scored as 72.8. SKiP’s NPS value is 69.8 or 7. All of the scores were calculated in accordance to the SUS score formula. The result indicators of the overall SUS scores are shown in Figure 7.

![Figure 6. Overall mean SUS Score Result Indicator.](image)

![Figure 7. Net Promoter Score.](image)

3.2 Comparison of group’s SUS score
SUS score of each group of participants is also compared in this study. The result for each group is described in Table 1.

| Group    | Overall Score SUS | Learnability | Usability | NPS |
|----------|-------------------|--------------|-----------|-----|
| Existing | 79.4              | 67.3         | 82.4      | 7.9 |
| New      | 66.8              | 52.1         | 70.7      | 6.7 |
| Potential| 59.5              | 53.6         | 62.1      | 6.0 |

3.3 Correlation analysis on SUS score
Figure 5 depicts the relationship of the participant’s profile group with the SUS score by utilising the statistical Pearson Correlation Coefficient (r) method (SPSS version 23). Prior to the assessment, it was hypothesised that the existing SKiP users’ group and those who are familiar with spatial analysis would give a higher SUS score. The result showed in Table 2 indicates that the participant’s profile group have a very strong correlation with statistical significance towards the overall SUS score and Familiarity (familiarity with spatial analysis). Thus, it confirms the hypothesis.
Table 2. Pearson correlation covariance between SUS and User Group and Familiarity.

| Variables   | Overall SUS Score | User Group | Familiarity |
|-------------|-------------------|------------|-------------|
| SUS Score   | Pearson Correlation | 1          | -.625**     | -.896**     |
|             | Sig. (2-tailed)    | .000       | 1           | .456**      |
|             | N                  | 59         | 59          | 59          |
| User Group  | Pearson Correlation | -.625**    | 1           | .456**      |
|             | Sig. (2-tailed)    | .000       | .000        |             |
|             | N                  | 59         | 59          | 59          |
| Familiarity | Pearson Correlation | -.896**    | .456        | 1           |
|             | Sig. (2-tailed)    | .000       | .000        |             |
|             | N                  | 59         | 59          | 59          |

**Correlation is significant at the 0.01 level (2-tailed).

A regression model analysis was also conducted to determine the causal relationship of the SUS score. The linear modelling result in Figure 7 indicates that although both familiarities with spatial analysis and user type group are statistical significance towards the overall SUS score, familiarity has higher importance and effect towards the SUS score result.

3.4 Summative Text Content Analysis

Table 3 shows the result for the summative text content analysis from the participants, using Text Analyser. Only 41 comments were received that offer additional insights that could not be captured from the SUS statements. The comments were analysed to reassure that all pertinent issues have been covered in this study [19]. The average Lexical Density using Ure’s method [20] is 59.62% which is almost 60%, thus implies the written comments were easily understood, and the amount of information the text tries to convey is sufficient. The types of comments received from the usability test are shown in Figure 8,
58% are positive feedbacks, 42% are constructive feedbacks, and none was received for negative feedback.

Table 3: Summative Text Content Analysis.

| Description                              | Value  |
|------------------------------------------|--------|
| Number of characters (including spaces)  | 2071   |
| Number of characters (without spaces)   | 1705   |
| Number of words                          | 365    |
| Lexical Density                          | 59.62% |
| Number of sentences                      | 41     |
| Number of syllables                      | 569    |

Figure 9. Percentile Feedbacks of Usability Test Participants.

4. Discussion and Recommendation

As a platform for spatial analysis and its purpose for effectiveness, efficiency, and satisfaction for right decision making, SKiP is perceived as a good platform within the Adjective Ratings. The Usability component of SKiP is acceptable, while its Learnability component is marginally acceptable by the users according to the Acceptability Range. The score, however, contradicts with Lewis and Sauro [21]. According to their research, the tendency of the SUS score value of the Learnability component is commonly greater than the value of the Usability component. In this study, it was found that the SUS score for the Learnability component is lower than the Usability component, in every profile groups. Summative content analysis on the comments supported this result as 42% of the participants highlighted constructive feedbacks on enhancing the learnability of SKiP. For example, adding manuals, step-by-step analysis guide, laymen terminology, technical references, how-to videos and additional information for better SKiP democratisation and rectifying common knowledge-based mistakes related to cadastral survey information or land-based spatial analysis.

The Existing user group provided a very high overall SUS score of 79.4, which indicates that users perceived SKiP as an excellent platform for its purpose. Even though the participants were grouped into Existing, New and Potential users, it was found in the study that regardless of their user categories, individuals who have exposure in the spatial analysis concept provided high mean SUS overall score. The SUS scores lessened with respondents that have inadequate exposure to the spatial analysis concept. The claim is supported with the existence of a very strong statistically significant correlation between Familiarity, User Group type and SUS scores. The finding provided sustenance that the Learnability component does need to be addressed to increase SKiP usability. The Usability component, on the other hand, is acknowledged as an excellent platform by all category users based on its usefulness, functionality, simplicity and fit for purpose.

Another interesting finding based on the SUS score is the NPS value. The overall NPS value is 69.8 or 7, which indicate that most SKiP users are Passively Satisfied regardless of their user categories. As passive users, they are satisfied, but unenthusiastic customers who are vulnerable to competitive
offerings [22]. On another note, a large number of feedbacks from the participant suggested the accessibility to SKiP could be friendlier by utilising multiple browsers; optional mobile platforms, currentness of data and broader coverage of development (not limited to specific areas only). Ease of accessibility is considered one of the primary reason to reduce the number of Detractors [22]. Based on the result and analysis, JUPEM should focus on the task of stimulating the user’s NPS growth and loyalty through mitigation and increasingly improving SKiP. The goal is clear-cut, actionable, and motivating for JUPEM as the concern is to convert SKiP Passively Satisfied to Promoters and reduced Detractors. Since user type give less importance to the SUS score compared to spatial analysis familiarity, interventions such as an increase of SKiP awareness and promotion focusing in ease for spatial analysis may attract more Promoters in the future.

5. Conclusion

Literature has shown SUS as one of the great tools for measuring usability. With SUS, the usability of SKiP can be determined, and its findings added to the existing body of knowledge. Not only the overall SUS score, but this study has also identified two other components of Usability and Learnability that were extracted with multiplying factors, as well as derived the NPS value. So, is SKiP fit for its purpose? The SUS scores revealed that the answer is YES. The overall SUS score for SKiP was above 68-score average and perceived as marginal high for acceptance by users. Although individual group scores described highly of the SKiP’s usability, the Learnability component of SKiP on the other hand still requires further mitigation and actions from JUPEM. Mitigations on the Learnability component may influence and attract more Promoters, in which should be JUPEM’s direction in ensuring the relevance of SKiP for its purpose. It should be noted that any fit-for-purpose application, it can be improved over time whenever necessary or relevant as the purposes evolve [23]. The results, findings and recommendations from this study are hoped to facilitate JUPEM in better understand venues for improvement, including to democratise SKiP to all users and focus on ease of doing spatial analysis to all level of users. The whole concept of ‘capture once, used by many’, should also be upheld in value-adding SKiP and its accessibility in the following phases.

References

[1] R. Bennett, N. Tambuwala, A. Rajabifard, J. Wallace, and I. Williamson, "On recognizing land administration as critical, public good infrastructure," Land Use Policy, vol. 30, no. 1, pp. 84-93, 1//2013.

[2] G. Navratil and E.-M. Unger, "Requirements of 3D cadastres for height systems," Computers, Environment and Urban Systems, vol. 38, p. 11, 2013.

[3] Shariff, J. Gill, Z. Amin, and K. Omar, "Towards the Implementation of Semi-Dynamic Datum for Malaysia," International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences, vol. 42, 2017.

[4] N. Z. A. Halim, S. Sulaiman, K. Talib, O. Yusof, M. Wazir, and M. Adimin, "Identifying the role of National Digital Cadastral Database (NDCDB) in Malaysia and for land-based spatial analysis," International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences, vol. 42, 2017.

[5] M. N. Isa, C. H. Teng, and N. Z. A. Halim, "SmartKADASTER: Observing beyond traditional cadastral capabilities for Malaysia " The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. Volume XL-2/W4, , p. 99, 28–30 October 2015 2015.

[6] B. Maheshwari, V. Kumar, U. Kumar, and V. Sharan, "E-government portal effectiveness: managerial considerations for design and development," 2007.

[7] A. S. Alghamdi, A. Al-Badi, R. Alroobaea, and P. Mayhew, "A comparative study of synchronous and asynchronous remote usability testing methods," International Review of Basic and Applied Sciences, vol. 1, no. 3, 2013.
[8] S. McLellan, A. Muddimer, and S. C. Peres, "The effect of experience on System Usability Scale ratings," *Journal of Usability Studies*, vol. 7, no. 2, pp. 56-67, 2012.

[9] S. Khodambashi and Ø. Nytrø, "Usability Evaluation of Published Clinical Guidelines on the Web: A Case Study," in *2016 IEEE 29th International Symposium on Computer-Based Medical Systems (CBMS)*, 2016, pp. 140-145.

[10] P. Kortum, C. Z. Acemyan, and F. L. Oswald, "Is it time to go positive? Assessing the positively worded System Usability Scale (SUS)," *Human factors*, p. 0018720819881556, 2020.

[11] N. Halim, S. Sulaiman, K. Talib, and M. Isa, "Assessing the usability of the NDCDB checklist with Systematic Usability Scale (SUS)," in *IOP Conference Series: Earth and Environmental Science*, 2018, vol. 169, no. 1, p. 012099: IOP Publishing.

[12] S. C. Peres, T. Pham, and R. Phillips, "Validation of the System Usability Scale (SUS) SUS in the Wild," in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 2013, vol. 57, no. 1, pp. 192-196: SAGE Publications Sage CA: Los Angeles, CA.

[13] J. Brooke, "SUS: a retrospective," *Journal of usability studies*, vol. 8, no. 2, pp. 29-40, 2013.

[14] J. Brooke, "SUS-A quick and dirty usability scale," in *Usability evaluation in industry*. London: Taylor and Francis, 1996, pp. 189-194.

[15] D. Gadkari, "Factors Influencing the Net Promoter Score (NPS): A Case of Funnel," ed, 2018.

[16] J. S. Dumas and B. A. Loring, *Moderating usability tests: Principles and practices for interacting*. Morgan Kaufmann, 2008.

[17] M. R. Drew, B. Falcone, and W. L. Baccus, "What does the system usability scale (SUS) measure?," in *International Conference of Design, User Experience, and Usability*, 2018, pp. 356-366: Springer.

[18] D. Hamilton *et al.*, "Assessing treatment outcomes using a single question: the net promoter score," *The bone & joint journal*, vol. 96, no. 5, pp. 622-628, 2014.

[19] A. O’Cathain and K. J. Thomas, ""Any other comments?" Open questions on questionnaires – a bane or a bonus to research?," *BMC Medical Research Methodology*, vol. 4, pp. 25-25, 11/0807/16/received11/08/accepted 2004.

[20] J. Ure, "Lexical density and register differentiation.–G. Perren, JLM Trim (Eds.). Applications of Linguistics. Selected Papers of the Second International Congress of Applied Linguistics, Cambridge 1969," ed: London: Cambridge University Press, 1971.

[21] J. R. Lewis and J. Sauro, "The factor structure of the system usability scale," in *International conference on human centered design*, 2009, pp. 94-103: Springer.

[22] F. F. Reichheld, "The one number you need to grow," *Harvard business review*, vol. 81, no. 12, pp. 46-55, 2003.

[23] E. Zysk, A. Dawidowicz, S. Źróbek, and R. Źróbek, "The concept of a geographic information system for the identification of degraded urban areas as a part of the land administration system- A Polish case study," *Cities*, vol. 96, p. 102423, 2020.