Spring Bed Mattress Recommendation System Using Simple Additive Weighting Method

Rofi Aditya, Wirawan Istiono

***Abstract*—The spring bed mattress is a bed facility that can provide comfort for its users and is one of the board's needs. Spring beds are available in a wide selection of product variations from different brands of spring bed mattresses. People often feel confused when they have to choose a spring bed mattress that suits their needs, and this is because spring bed mattresses have many variations in sizes and models, the prices of various spring beds, guarantees, and different types of springs or springs used. The demands of work and the busyness of society today make many people unable to choose and see the spring bed that suits their needs in the store directly. Therefore, this system was created as a recommendation system for people to choose a spring bed mattress that suits their needs and buy mattresses online based on community preference criteria. The recommendations given by this system are obtained from calculations using the simple additive weighting method or known as the weighted addition method. This simple additive weighting method has been tested in this research and can be implemented correctly and as needed. Based on the results of the trials that have been carried out, the user satisfaction test was found to be 88.67% concerning the end-user computing satisfaction (EUCS) model, so that the recommendation system that has been successfully built can be said to be very good for users in providing recommendations for spring bed mattresses.**

***Keywords*— End User Computing Satisfaction, Simple Additive Weighting, Spring Bed Mattress Recommendation System.**

I. INTRODUCTION

Along with current developments, people are increasingly critical in choosing household appliances. The spring bed mattress business is one of the businesses that can thrive today. A spring bed mattress is a bed facility that can provide softness for its users and is one of the board's needs [1]. The spring bed mattress has a spring or spring layer as an aspect inside, which functions as a buffer between the foam and wood layers that can provide comfort for the user to rest [2].

The author has conducted interviews with Monica Esti, it was found that people often feel confused when they want to find a spring bed mattress because of the many choices of spring bed mattresses available, ranging from size variants, models, guarantees, prices, and types of springs or springs used, so it takes a long time to choose a spring bed mattress, because not all people know about spring bed mattresses and the components contained in them according to user needs.

There are several factors in the selection of a spring bed mattress, including size, price, warranty, and the level of softness of the spring bed mattress [3]. Currently, spring bed mattresses are developing very rapidly, and there are various choices of the latest spring bed mattresses at various prices, so people feel confused about finding the brand or type of spring bed mattress that suits their needs. There are 8 types of spring beds and mattresses for quality sleep: innerspring, pocketed coil spring, natural fiber, plush top, hybrid, memory mattress, innerspring latex hybrid mattress, and pillow top. The type of spring bed mattress selection must be in accordance with the community's needs. This is because each type of spring bed mattress has different benefits depending on the components used. In this study, 4 types of spring beds were used: pocketed coil springs, plush tops, memory mattresses, and pillow tops consisting of several brand variations such as Airland, Spring Air, Elite, and Comforta [4].

Based on the results of an interview with Mr Bariyadi (2021), an employee who works at a spring bed mattress company, the resource person said that people often feel confused. It takes a long time to choose a spring bed mattress because of the many choices of spring bed mattresses available with size variants, models, warranties, price, and various types of springs or springs. Based on these conditions, the community needs a recommendation system to determine the choice of spring bed mattress to be selected.

The method used in running this system is simple additive weighting. The simple additive weighting method is known as the weighted addition model method. The basic concept of the SAW method is to find a weighted sum with a performance rating on each alternative on the overall attribute[5]. The SAW method scoring is obtained by adding the contribution of each attribute [6]. The SAW method is used to compare each alternative against certain criteria.

"Designing a Watch Purchase Recommendation System Using the SAW Method. Bachelor's Thesis, Multimedia Nusantara University". This system is very helpful for users to provide watch recommendations when users want to buy watches based on the criteria used such as accuracy, material, display, type, and shape of the watch. Based on this research [7], [8], the simple additive weighting method can provide the best recommendations in accordance with the comparison of alternatives and available criteria and the simple additive weighting method is very effective compared to other methods [9], [10].

The SAW method was chosen because it can provide appropriate considerations in making decisions based on all the criteria and the weights used [11]. There are advantages in the SAW method which can make an assessment accurately and quickly, based on the value of the criteria,

sub-criteria, and the weight of each criterion used, and the calculation formula is easy to understand [12]. In addition, the SAW method has the advantage of being able to select the best alternative, so it is very useful to get the ranking order needed in making this spring bed mattress recommendation system, so the author uses the SAW method in this study to provide recommendations for spring bed mattresses and make it easier for users or the public [13].

"Design and Build a Face Mask Recommendation System Using Weighted Products". This system is very helpful for users, especially those who like to do facial treatments, to provide recommendations for face masks when users want to buy face masks based on the criteria used, namely skin, desired results, how to use masks and prices. Based on this research, the weighted product method can provide good recommendations according to the criteria used [11].

II. Literature Review

The simple additive weighting method, also known as the weighted addition method, is the process of finding the weighted summation of the performance ratings for each alternative across all attributes [14], [15]. This method can help in case study decision-making, but it can only produce the largest value that will be selected as the best alternative in its calculations. This calculation is in accordance with the method used if the selected alternative meets the predetermined criteria. The simple additive weighting method is more efficient in its use because the computation time is shorter.

The process of the simple additive weighting method uses the normalization of the decision matrix to a scale that can be compared with the available alternative ratings. Each attribute rating must obtain dimensional freedom in the sense that it has passed the previous matrix normalization process. The stages of completion of the SAW method are as follows [16]:

1. Can determine the criteria that will be used as a reference for decision making, namely Ci.
2. Determine the value of the weight as W for each of the criteria used.
3. Make a suitability rating of each alternative on each of the criteria used.
4. Make decision matrix based on the criteria (Ci), then normalize the matrix based on the equation that is adjusted to the type of attribute, namely the profit attribute (benefit) or cost attribute (cost) so that the R normalized matrix is obtained.

$$r_{ij} \begin{cases} \dfrac{Xij}{\max Xij} \\ \dfrac{\min Xij}{Xij} \end{cases}$$

The formula is the use of the formula with the maximum value used if the value of j is a benefit attribute, while the use of the formula with the minimum value is used if the value of j is a cost attribute.

Description:

- *rij*: normalized performance rating.
- *xij*: attribute value belonging to the criteria.
- *max xij*: the largest value of the criteria.
- *min xij*: the smallest value of the criteria.
- *Benefit*: if the greatest value is the best.
- *Cost*: if the smallest value is the best

5. The final result is obtained from the ranking order, namely the addition and multiplication of the normalized matrix R with the weight vector so that the largest value is chosen as the best alternative as a solution. The following formula for ranking the SAW method used can be seen in the formula.

$$Vi = \sum_{j=1}^{n} w_j r_{ij}$$

Description:

- *Vi*: alternative final value.
- *Wj*: the value of the weight of each criterion that has been determined.
- *rij*: normalized performance rating value.

III. Methodology

A. Research Methodology

First step the research methodology is using Interview, where in this process, he conducted an interview with Mr. Bariyadi (2021) as an employee who works at a spring bed mattress company to find out about all knowledge related to spring bed mattresses and also conducted an interview with Monica Esti as the community to find out the community's understanding of spring bed mattresses.

After that the study is continue to literature study, where in this process, the researchers conducted the search, read, and study stages of reference sources regarding theories related to the design and construction of a spring bed recommendation system using the simple additive weighting method. The literature used is e-books, journal articles, student thesis, and other learning references. This literature study aims to strengthen this research process with several basic theories supporting the research, such as theories related to spring bed mattresses, simple additive weighting methods, and recommendation systems.

Next step in this research is collect the data, where the data collection process was carried out to collect product size data, product price data, product warranty data, spring bed mattress softness data and sample data for spring bed mattresses with various brands. The data used in this study is based on the explanation listed on the official website of the spring bed mattress brand used. The spring bed mattress data in this study is only used as reference/reference data that will be recommended to the public/users.

After data collection, this research next step is to create system plan, where the recommendation system design process consists of data flow diagrams (DFD), sitemaps, flowcharts, table structures, and system mockups. The next step is do implementation system, where at this stage, it contains the results of the implementation of the methods used in the system that has been created and the results of calculations with simple additive weighting produced to make recommendations for spring beds based on the criteria

entered by the system user.

The next step of research is do analysis, where in this analysis process serves to determine the needs that are in accordance with the specified problem by browsing the official website of the spring bed mattress brand used and also based on spring bed mattress experts. The results of this analysis are useful for the community or users to determine the spring bed mattress that suits their needs.

After do analysis, the next step is do is testing the system, where in the system testing process, testing of the system that has been made will be carried out. System testing is carried out to see the suitability of the results or the accuracy of the implementation of the simple additive weighting method. The trial phase of using the system will be carried out to system users.

The next step in this research is evaluation, where the evaluation stage measures the level of user satisfaction of the spring bed mattress recommendation system, validating the calculation results with scenario tests and correcting if there are errors in the source code. This evaluation process is carried out after the system has been successfully built through the analysis of the final results of the questionnaire. The evaluation aims to determine whether the purpose of measuring the level of user satisfaction of the spring bed mattress recommendation system is met. The model used in this evaluation stage is the end user computing system (EUCS).

Last step in this research is reviewing and repairing, where in this process the researchers made improvements from the aspects of errors that occurred during the previous system test. After all process is done, the report is created, to documentation the research progress and result.

B. System Design

Data flow diagram (DFD) is a diagram that can describe the flow of data from a process or system so that it can help the system become structured and clear. This DFD starts from DFD level 0, which describes the system as a whole. The following is a DFD used in the spring bed mattress recommendation system.

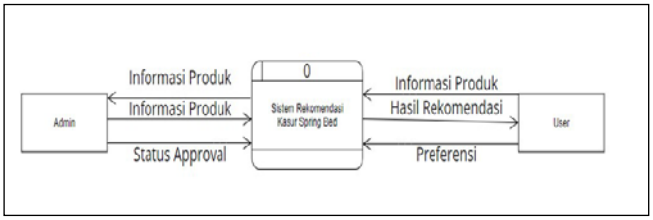

Figure 1. DFD Level 0

Figure 1 shows DFD level 0 provides an overview of how the two available entities can interact with the system to be built. Then, this diagram can also show the data sent by each entity to the system and the feedback data returned by the system. Users of this system are authorized to process data such as filling in product information data, approval status to the system, and the system providing feedback in the form of product information data if the user has an entity as admin and can fill in preferences, product information data on the system, and the system provides recommendation results. If user has entity as user.

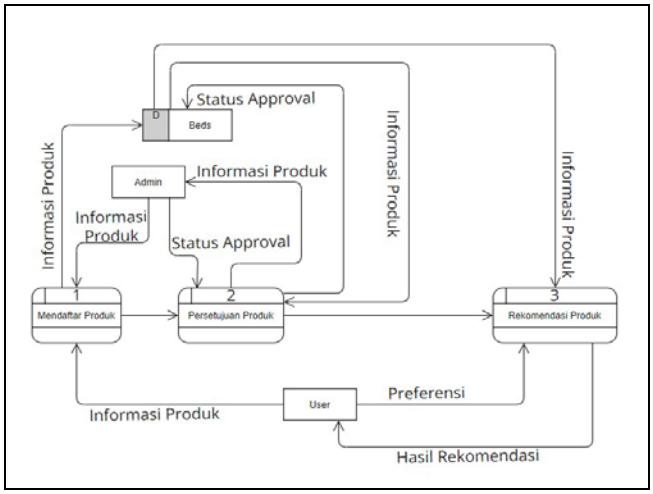

Figure 2. DFD Level 1

Figure 2 shows DFD level 1 on the spring bed mattress recommendation system. DFD level 1 has 3 processes in it, namely product registration, product approval, and product recommendations. In the product registration process, when the admin or user fills in product information data, the data will be stored in a database called beds. Next, the product approval process sends the approval status to a database called beds, then beds provide feedback in the form of product information on the product approval process, in this process product information data is sent to the admin, then the admin provides feedback in the form of approval status to the product approval process. Then beds send product information to the product recommendation process. When the user submits a preference for the product recommendation process, this process will provide feedback in the form of recommendation results to the user.

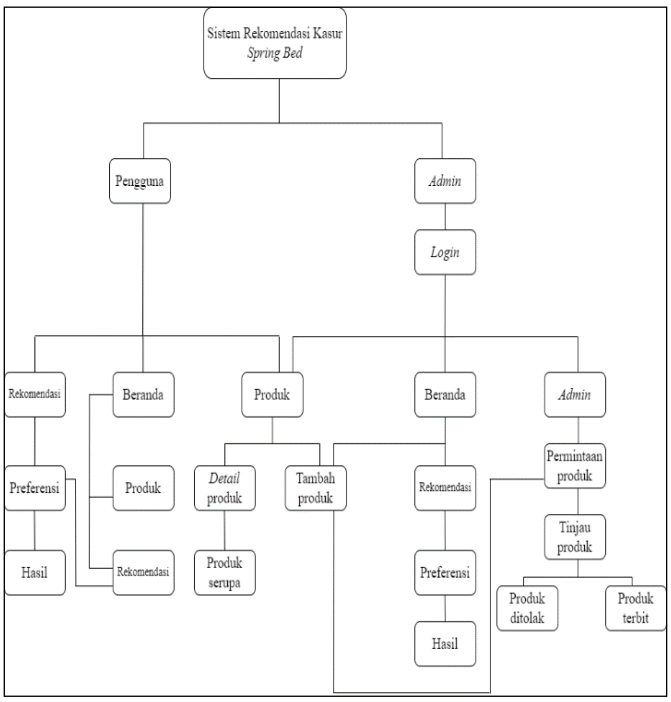

Figure 3. Sitemap

Figure 3 shows sitemap or sitemap serves to map several pages contained in the system to be designed and built. Sitemap or sitemap of the spring bed mattress recommendation system. In this system there are two main parts, namely the system as a user and the system as an admin. In the system section as a user, there are three main pages of the system: the homepage, products, and recommendations. On the home page, users can view product information that has been successfully registered, and introduce the recommendation feature contained in this system, and users can also add products when product options are unavailable on this system. The recommendation page, the user can select the spring bed mattress by filling in the preferences according to their needs, then the system will display the recommendation results. On the product page, users can view product details, similar products, and add products when product options are not available on this system. When the user successfully adds a product, the product will be entered on the product request page in the admin section of this system, to wait for the status of the decision whether the product is rejected or published by the admin.

Before the user enters the admin page, the user is required to register to register personal data information, when the registration is successful, the user can log in as an admin on this system. In the system as an admin, there are three main pages: the home page, admin, and product. On the product page, the admin can add products when options are unavailable on this system, view product details, and similar products. On the home page, the admin can add products when the product selection is not available on this system, view product information that has been successfully registered, and introduce the recommendation feature contained in this system, the admin can also select a spring bed mattress by filling in preferences according to their needs, then the system will display the results of the recommendations. On the admin page, the user as an admin can see a list of product requests that the admin or user has successfully registered, then the admin reviews the product to process whether the product will be rejected or published, the admin can also make product changes, and product deletion.

C. Flowchart

Flowchart is a means of presenting systematic information in the form of pictures or charts that show the sequence and relationship between processes and other instructions. Symbols and the relationships between processes can represent each particular process can be represented by connecting lines. This system can be described with a main flowchart, in which there are modules so that it becomes structured and clear.

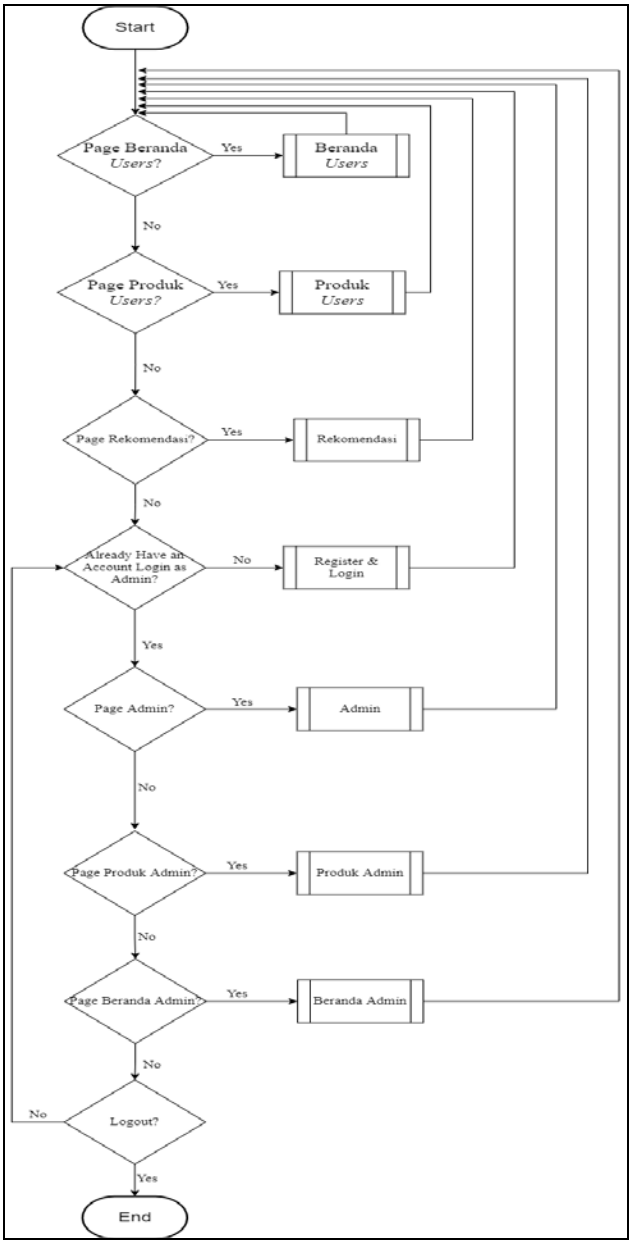

Figure 4. Main Flowchart

Figure 4 is the main flowchart used in the spring bed mattress recommendation system. In this system flow there is a check whether the user is on the users home page, if yes then the system will enter the users homepage module, if no the system will check whether the user is on the users product page. Next on the users product page, if yes then the system will enter the users product module, if no the system will check whether the user is on the recommendation page. On the recommendation page, if yes then the system will enter the recommendation module, if no the system will check whether the user already has a login account as an admin. If the user does not yet have a login account as an admin, the system will enter the register module and login to register personal data information as an admin on this system, if yes, it will check whether the user is currently on the admin page. On the admin page, if yes, the system will enter the admin module, if no the system will check whether the user is on the admin product page. Next on the admin product page, if yes it will enter the admin product module, if no it will check whether the user is on the admin

homepage. On the admin homepage, if yes then the system will enter the admin homepage module, if no the system will check whether the user wants to logout from this system. If yes, the system flow process is complete, and if no, it will repeat the process or loop.

IV. RESULT

The process of implementing a system mockup from the system design that has been done previously can be seen in Figures 5 to Figure 9.

Figure 5. Register Page

Figure 5 shows the result of implementing the register page on the spring bed mattress recommendation system. On this page there is the website name, homepage, product, and recommendations located in the website header. The register page functions to register personal data information as an admin including name, e-mail address, password, and confirm password. Then there is a register button that functions to store all personal data as admins into the users database, then the admin can do the login process.

Fig 6. Login Page

Figure 6 shows the result of implementing the login page on the spring bed mattress recommendation system. On this page there is the website name, homepage, product, and recommendations located in the website header. On this page there are two text boxes that the admin can use to fill in the e-mail address and password. On the login page there is a "Remember Me" checkbox feature, which is a feature that functions to store admin data. If the admin wants to access this system, the admin is required to login, but the admin does not need to fill in the e-mail address and password again, because the admin data used to login is already stored. On this page there is a login button that serves to enter the admin page.

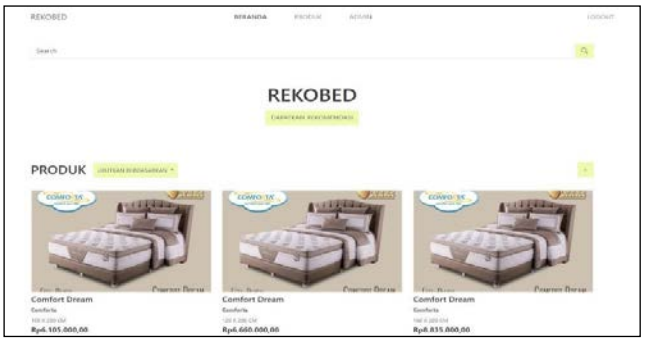

Fig 7. Home Admin Page

Figure 7 shows the result of implementing the admin home page on the spring bed mattress recommendation system. On this page is the website's name, homepage, product, admin, and logout located in the website header. Admin will be directed to the page according to their needs. On this page, there is a searching feature that follows the default input value based on the letters of the alphabet a-z according to the search made by the user as an admin. Next, the admin can click the Get Recommendation button, then the user as an admin will be directed to the recommendation page. In addition, there is a sorting feature on this page that follows the default value search keyword, where all product data information will display the results sorted by name: a to z, name: z to a, price: low to high, and price: high to low. On this page, the admin can add products as desired, then the website will display all product data that the user or admin has added. Then the admin can see product details and similar products and visit the product page when the button is clicked.

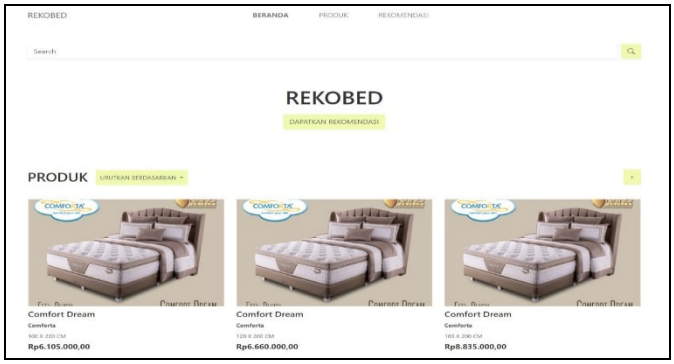

Fig 8. Home Users Page

Figure 8 shown the result of implementing the user's home page on the spring bed recommendation system. On this page there is the website name, homepage, product, and recommendations located in the website header. Users will be directed to the page according to their needs. On this page, there is a searching feature that follows the input default value based on the letters of the alphabet a-z according to the search made by the user. Then the user can click the Get

Recommendation button, then the user will be directed to the recommendation page. In addition, there is a sorting feature on this page that follows the default value search keyword, where all product data information will display the results sorted by name: a to z, name: z to a, price: low to high, and price: high to low. On this page, users can add

products as desired, then the website will display all product data that the user or admin has added. Furthermore, users can see product details and similar products and visit the product page when the button is clicked.

Fig 9. Recommendation Page

Figure 9 shows the result of the implementation of the user recommendation page on the spring bed recommendation system. On this page there is the website name, homepage, product, and recommendations located in the website header. Users will be directed to a page according to their needs. On this page, users can make recommendations for choosing a spring bed by filling in the desired preferences, then the user can press the get button, then the results of the spring bed recommendation will appear.

Testing the user satisfaction of the spring bed recommendation system using the end user computing satisfaction (EUCS) model has been carried out by distributing questionnaires using google forms to the public or system users and obtained as many as 30 respondents. The questionnaire contains 5 components to measure quality such as content, accuracy, format, ease of use, and timeliness.

Table 1. Table of questionnaire results list

No	A list of questions	Answer				
		STS	TS	N	S	SS
1.	Is the content of this system in accordance with user needs?	0	0	4	11	15
2.	Has this system provided clear information?	0	0	4	11	15
3.	Has this system provided specific and accurate information?	0	0	3	12	15
4.	Has this system displayed the correct and correct page?	0	0	4	11	15
5.	Is the design of this system easy for users?	0	0	4	11	15
6.	Does this system have easy-to-understand menu options?	0	0	2	13	15
7.	Is the system easy to use and understand by users?	0	0	3	12	15
8.	Is the system very useful to users?	0	0	2	12	16
9.	Can this system save time in finding the spring bed mattress required by the user?	0	0	3	12	15
10.	Does the system always provide up-to-date information?	0	0	3	12	15

Table 1 are results as many as 30 respondents who have filled out the questionnaire. The next process is to calculate the percentage score calculation using a likert scale.

V. Conclusion

The spring bed mattress recommendation system has been successfully designed and built using the simple additive weighting method. This system has a function to make recommendations for spring bed mattresses that are found in several variations of brands that are used to make comparisons against criteria such as product size, product price, product warranty, and comfort level of spring bed mattresses. This system is built based on a website using the Laravel framework and the PHP programming language.

This system has been tested with manual calculations using excel and system calculations. The comparison shows that the results of the calculations carried out by the system match and are the same as the results of manual calculations using excel. User satisfaction with the system was measured using a questionnaire to 30 respondents referring to the end user computing satisfaction (EUCS) model. The ease-of-use section has the highest value with a value of 88.67% and the format section has the lowest value with a value of 87.00%. The final result for the user satisfaction level of the spring bed mattress recommendation system is at a value of 88% which states that the user strongly agrees with the system, based on testing the level of user satisfaction.

Based on the research that has been successfully carried out, there are several suggestions from researchers that can be used as a reference or reference in the development of a spring bed mattress recommendation system that has been successfully designed and built as well as for future research. The suggestions described are as follows.

1. This research can be developed by implementing other methods that are still included in the multi-criteria decision making (MCDM), namely the AHP method / TOPSIS method, so that by carrying out these developments by implementing other methods can find the best method to produce spring bed mattress recommendations.
2. The addition of other criteria to add to the consideration of this recommendation system, for example limited edition, so that this addition is expected to produce other various alternatives.
3. The process of getting recommendations in this study can be developed using filtering, so that the public or users can produce appropriate spring beds based on their needs.

Acknowledgment

Thank you to the Universitas Multimedia Nusantara, Indonesia which has become a place for researchers to develop this journal research. Hopefully, this research can make a major contribution to the advancement of technology in Indonesia.

References

[1] G. Caggiari, G. R. Talesa, G. Toro, E. Jannelli, G. Monteleone, and L. Puddu, “What type of mattress should be chosen to avoid back pain

and improve sleep quality? Review of the literature," *Journal of Orthopaedics and Traumatology*, vol. 22, no. 1, 2021, doi: 10.1186/s10195-021-00616-5.

[2] Y. X. Chen, Y. Guo, L. M. Shen, and S. Q. Liu, "The quantitative effects of mattress and sleep postures on sleep quality," *International Asia Conference on Industrial Engineering and Management Innovation: Core Areas of Industrial Engineering, IEMI 2012 - Proceedings*, no. September 2017, pp. 107–115, 2013, doi: 10.1007/978-3-642-38445-5_11.

[3] I. Siregar, R. Ginting, and F. Agnesia, "Redesign Spring Bed Based on the Needs of Consumers," *MATEC Web of Conferences*, vol. 104, pp. 1–6, 2017, doi: 10.1051/matecconf/201710403003.

[4] J. Suharyadi and A. Kusnadi, "Design and Development of Job Recommendation System Based On Two Dominants On Psychotest Results Using KNN Algorithm," *International Journal of New Media Technology*, vol. 5, no. 2, pp. 116–120, 2019, doi: 10.31937/ijnmt.v5i2.954.

[5] D. Meidelfi, Yulherniwati, F. Sukma, D. Chandra, and A. H. Soleliza Jones, "The implementation of SAW and BORDA method to determine the eligibility of students' final project topic," *International Journal on Informatics Visualization*, vol. 5, no. 2, pp. 144–149, 2021, doi: 10.30630/joiv.5.1.447.

[6] I. Kaliszewski and D. Podkopaev, "Simple additive weighting - A metamodel for multiple criteria decision analysis methods," *Expert Systems with Applications*, vol. 54, pp. 155–161, 2016, doi: 10.1016/j.eswa.2016.01.042.

[7] N. Vafaei, R. A. Ribeiro, and L. M. Camarinha-Matos, "Assessing Normalization Techniques for Simple Additive Weighting Method," *Procedia Computer Science*, vol. 199, pp. 1229–1236, 2021, doi: 10.1016/j.procs.2022.01.156.

[8] M. Michael and W. Winarno, "Design and Development of Computer Specification Recommendation System Based on User Budget With Genetic Algorithm," *International Journal of New Media Technology*, vol. 5, no. 1, pp. 25–29, 2018, doi: 10.31937/ijnmt.v5i1.814.

[9] D. Wira Trise Putra and A. Agustian Punggara, "Comparison Analysis of Simple Additive Weighting (SAW) and Weigthed Product (WP) in Decision Support Systems," *MATEC Web of Conferences*, vol. 215, pp. 1–5, 2018, doi: 10.1051/matecconf/201821501003.

[10] N. Setiawan *et al.*, "Simple additive weighting as decision support system for determining employees salary," *International Journal of Engineering and Technology(UAE)*, vol. 7, no. 2.14 Special Issue 14, pp. 309–313, 2018.

[11] Adriyendi, "Multi-Attribute Decision Making Using Simple Additive Weighting and Weighted Product in Food Choice," *International Journal of Information Engineering and Electronic Business*, vol. 7, no. 6, pp. 8–14, 2015, doi: 10.5815/ijieeb.2015.06.02.

[12] L. C. Chen and D. N. Utama, "Decision Support Model for Determining the Best Employee using Fuzzy Logic and Simple Additive Weighting," *Journal of Computer Science*, vol. 18, no. 6, pp. 530–539, 2022, doi: 10.3844/jcssp.2022.530.539.

[13] A. Alinezhad, A. Amini, and A. Alinezhad, "Sensitivity analysis of simple additive weighting method (SAW): the results of change in the weight of one attribute on the final ranking of alternatives," *Journal of Industrial Engineering*, vol. 4, pp. 13–18, 2009.

[14] D. Kalibatas and V. Kovaitis, "Selecting the most effective alternative of waterproofing membranes for multifunctional inverted flat roofs," *Journal of Civil Engineering and Management*, vol. 23, no. 5, pp. 650–660, 2017, doi: 10.3846/13923730.2016.1250808.

[15] F. Haswan, "Application of Simple Additive Weighting Method to Determine Outstanding School Principals," *SinkrOn*, vol. 3, no. 2, p. 186, 2019, doi: 10.33395/sinkron.v3i2.10082.

[16] R. Meri, "Simple Additive Weighting (SAW) Method on The Selection of New Teacher Candidates at Integrated Islamic Elementary School," *IJISTECH (International Journal of Information System & Technology*, vol. 4, no. 1, pp. 428–435, 2020.

Rofi Aditya was born in Tangerang, Indonesia. He received Bachelor's degree in Infomatics from Multimedia Nusantara University in 2022. His focus research in Information technology, SAP/ERP, and business analyst. Now, he works as UAT PBT Project Roll Out (Production Planning Module) at PT PAN Brother Tbk. Email: rofi.aditya@student.umn.ac.id.

Wirawan Istiono was born in Jakarta Indonesia, he received his Masters of Computer Science degree in Budi Luhur University, Indonesia, in 2018, focusing in the Software Engineering field. He is currently a lecturer and researcher in Universitas Multimedia Nusantara and also serving as the head coordinator of the Game Development Laboratory. His research interests include requirements engineering in software application development, computer engineering, and human computer interaction. Email: wirawan.istiono@umn.ac.id.