Anchor University Journal of Science and Technology (AUJST)
A publication of the Faculty of Natural, Applied and Health Science, Anchor University Lagos

URL: fnas.aul.edu.ng

In AJOL: https://www.ajol.info/index.php/aujst

Vol. 4 No 1, September 2023, Pp. 39 - 51

ISSN: 2736-0059 (Print); 2736-0067 (Online)

SUBJECTIVE EVALUATION OF RECOMMENDER SYSTEM USING MODIFIED DELONE &MCLEAN SUCCESS MODEL

[1]Sulyman Abdullahi Tope, [1]Kabir Inuwa Musa and [1]M. J. Mallo

[1]Department of Management and Information Technology, Abubakar Tafawa Balewa University Bauchi, Bauchi State

***Corresponding author Email**:

Submitted 10 July, 2023
Accepted 26 July, 2023

Competing Interests.
The authors declare no competing interests.

ABSTRACT

One of the most significant and difficult challenges of recommender systems is recommending items that satisfy user needs and thus improve the quality of the experience in the system. In the context of recommender systems, collaborative filtering (CF) is one of the most widely used techniques. A modified and updated version of Delone and McLean IS success factor model was used to assess how recommender systems were perceived. The IS success model was changed using the privacy variable. Information quality, service quality, system quality, and privacy are the variables considered in this study. These analyses used multiple linear regression to determine how those variables affected the user. The study's findings indicate that while information quality has little bearing on recommender creation, privacy, service quality, and system quality do. This encourages users to return to the website, which boosts sales and profitability.

Keywords: Recommender, DeLone and McLean Model, privacy, system, information, quality, perception, satisfaction

1. INTRODUCTION

Recommender systems (RS) were inspired by information economics, which centers economic activity more on information than on tangible items (Konst *et al*, 1998). The effect of information and information systems on consumer economic decision-making and the wider economy is the fundamental tenet of information economics. Information overload is the outcome of the World Wide Web (WWW) and information technology being used more often, which has led to an overload of information for decision-making that is greater than what humans can absorb and quickly identify information that is valuable according to user preferences for products and services, RS is an automated tool that tailors or matches the user with goods (Monti et al., 2020; Da'u & Salim 2020). In order to fulfill the preferences and tastes of the users in a shorter amount of time, the recommender system aims to reduce the issues of information overload through personalization (Dong, *et al* 2020; Rezaimehr & Dadkhah,2020). The recommender system makes predictions about users' preferences based on their past behavior. The use of recommender systems has been expanded to a number of industries, including e-commerce, medicine, music, research papers, videos, transportation, news, travel and tourism, marketing, and supply chains. To boost sales promotion, click-through rate (CTR), sales and revenue, high user

https://dx.doi.org/10.4314/aujst.v4i1.6

engagement, and customer retention, for instance, e-commerce has used the recommender system (Jannach & Jugovac, 2019). For instance, cross-selling accounted for 35% of Amazon sales in 2006, and it also occurs on YouTube. In order to establish the model for generating recommendations to active users, it is crucial to assess how the system is perceived by users in addition to the algorithm's accuracy. The user experience of the recommender system model is not sufficiently analyzed by algorithmic correctness. The continuous use or inactivity of an information system (IS) is not a factor in determining whether it will succeed or fail. However, using the Delone and McLean (2003) Updated IS Success Model, the success or failure of IS was determined by the capacity to handle the three communication challenges of technical, semantic, and effectiveness issues (Mardiana, *et al*, 2015). Technical is concerned with producing correct and effective information, semantic is concerned with communicating messages that are intelligible and effective is concerned with information about the recipient's behavior's predicted effects. The technical level of the information system consists of the quality of the information, the system, and the services. Evaluating user experience is crucial to the acceptance of recommender systems since they rely on users with similar interests to provide recommendations (Šmýkala, 2018). Evaluating system accuracy or precision is not enough to justify user perception of the system. There is a need to carry out research in validating DeLone and McLean Updated IS Success Model in the context of a recommender system for consistency of result with a comprehensive, diversified and large sample of trustworthy respondents (Šmýkala, 2018).

The aim of this study is to examine user perception of recommender systems using modified updated Delone and Mclean (2003). In this study Survey approach was employed to gather data on the perceptions of users from masters' students of faculty management science of Abubakar Tafawa Balewa university Bauchi, Bauchi State.

2. Previous Research Work

2.1. Recommendation System

Information overloading is a problem where a massive amount of product and content information is beyond the human capacity to process, this may be due to technology that matches users. Thus, one of the goals of the recommender system is to alleviate the problem of information overloading (Dong *et al,* 2020; Rezaimehr & Dadkhah, 2020). A recommender system (RS) is an automated tool and technique that suggest a set of items that match the user's interest profile based on the past preference to influence current user decision-making processes (Ricci, Rokach & Shapira, 2015). Recommender system is domain-independent that is they are deployed to suit the specific purpose-like differ in terms of specific items it recommends to users. Items in the recommender system can be news, CD, Books, Food, etc. these specific items are personalized to suit specific user's interests. Recommender system uses the user model or user profile to learn user interest and based on the past preference it predicts the user. User interests are known through

https://dx.doi.org/10.4314/aujst.v4i1.6

feedback rating, this rating can be explicit, implicit, and emotional. The explicit rating uses the feedback rating users provide for items after purchase, rating can be on five-point or ten-points scaling ranging from strongly-like to strongly-dislike. Implicit rating is an observed user behavior on the website, the system interprets this behavior as either positive or negative rating e.g. time duration on a page, print, delete, sharing of page, reply, comment, post follow up, hypertext, repetition, etc. (Jannach *et al*, 2011; Oard & Kim, 1998; Ricci *et al* 2015). Others added emotional information; this study used the sentiment as user review.

Recommendation system can be view from the managerial, user, IT: to view as a decision support system that recommends product sales and promotion offer, as an advisory system that influences user decision process and as an interactive computing platform that uses the model to learn user preference respectively (Pondel & Korczak, 2018). For instance, in 2006 35% of Amazon sales is from cross-sales, likewise on YouTube and ricciNetflix 60% and 75% of what people watch on their site were from recommendations (Jannach & Jugovac, 2019).

2.2. Types of Recommender System Techniques

Recommender systems (RS) can be personalized or non-personalized, with the former providing a personalized list of suggested goods based on the user's taste/ preference and the latter just informing the user of the set of popular available items that he or she may like/purchase (Jannach *et al*, 2011). Collaborative filtering, content-based, and hybrid-based recommender systems are the most common types of recommender systems (Attarde and Singh, 2017; Salunke & Chaudhari, 2017).

2.2.1. Collaborative Filtering.

Collaborative Filtering Recommender System employs information filtering and user profiling to provide an effective recommendation of a product or service that is similar to the preferences of the users (Yadav *et al*, 2018a). Collaborative filtering recommender system (CFRS) predicts for the current user based on the user's preference/interest profile or users with similar preferences (Parvin, *et al*, 2018). Collaborative filtering recommender system recommends items to the active user by aggregating similar users' preferences based on link-mind individuals are more likely to enjoy the same item (Ghavipour & Meybodi, 2018).

2.2.2. Content-based

Content-based matches Item-feature and user-profile to generate suggestions to the active users (Attarde & Singh, 2017). The techniques generate suggestions for the active users based on the similarity in the feature / attribute of the items active users like in the past and unseen item. Exploit explicit or implicit feedback to learn user interaction with items, user's latent/favored features are extracted from these items, the similarity is computed and top N items are recommended to a user (Ren & Chi, 2018). Unlike collaborative filtering, they are not faced with the challenges of data sparsity

https://dx.doi.org/10.4314/aujst.v4i1.6

2.2.3. Hybrid Based

Exploits the properties of two or more recommendation techniques to create a robust system that complements the disadvantages of the techniques (Attarde & Singh, 2017; Frémal & Lecron, 2017). Attarde and Singh (2017) categorized how techniques could be hybridized in the recommender system in the following ways:

Weighted Method: compute and combine the weighted score or output of recommendation techniques into a single recommendation, e.g., P-TANGO. This weight can be static or dynamic.

Switching Method: defined criteria are used to decide among recommendation techniques that will process a specific input depending on a situation, e.g., the Daily Learner system.

Mixed method: the results of recommendation techniques are combined to suggest activities for active users, e.g., television viewing schedules.

Feature Combination: Features of some recommendation techniques are combined in one recommendation algorithm.

Cascade: this methodology arranges stages in sequence in which the current stage refines the output of the previous stage, e.g., EntreeC. The result is a higher priority.

Feature Augmentation: integrate some recommendation techniques to improve the performance of the system.

Metalevel: This method merges the first recommendation model as input for the second recommendation technique, e.g., the Fab system.

2.3. Empirical Review

Šmýkala's (2018) study evaluates the YouTube Video Recommender System from the user's perspective. Investigating the elements of recommender systems that are important to their effectiveness is the author's goal. User satisfaction is significantly impacted by system and information quality, but not as significantly by service quality. While other relationships were shown to be meaningful, the relationships between service quality and user happiness, use and user satisfaction, and information quality and use were not validated. However, despite employing a thorough, varied, and sizable number of reliable respondents, the author was unable to study the model in different recommender systems and enhance the research's findings.

DeLone and McLean's Information Systems Success model was intended to be expanded by Edgardo et al. (2018) for the adoption of cloud computing. The authors looked into the effects of open information exchange, flexible IT architecture, high-quality cloud systems, IT security, and cloud privacy. The study used a quantitative approach and used 117 IT professionals with at least three years of experience who are now employed in the United States as a research sample. The study demonstrates that the success of cloud computing depends on the free flow of information and the overall quality of the cloud system, whereas users' perceptions of privacy and security threats have no bearing on the uptake of cloud computing. The authors, however, were unable to further delve into the

https://dx.doi.org/10.4314/aujst.v4i1.6

reasons why worries about IT security and cloud privacy do not have an impact on the adoption rate of cloud computing. In Najma *et al* (2017) study to gauge the success of e-commerce in Malaysia, the Delone and Mclean extended IS success model including trust and privacy is used. Data from 381 users in the business faculty at Klang Valley institutions in Malaysia was collected to measure the IS aspects. Confirmatory factor analysis (CFA) and structural equation modeling (SEM) were used by the authors to analyze the data, and it was shown that while other components are substantial, only information quality has a little impact on customer satisfaction.

3. Theoretical Framework and Hypotheses Development

DeLone and Mclean IS success model has been applied in a number of studies, with modifications made to the model to fit the circumstances. The suggested framework concentrates on extending the updated DeLone and McLean IS successes model to evaluate how the recommender system is perceived by the user.

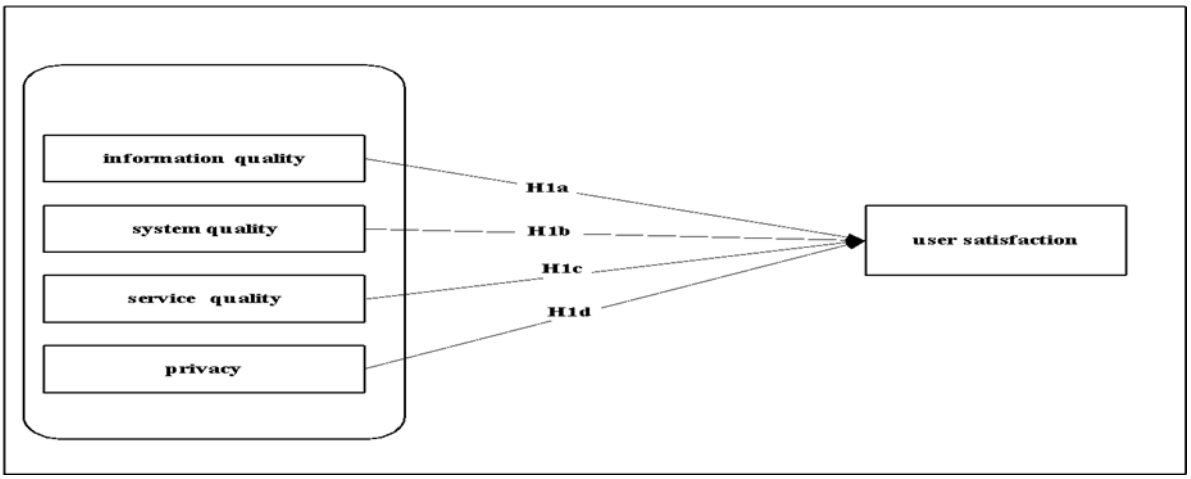

Figure 4 Research conceptual framework and hypotheses development

3.1. Hypotheses Development

(i) User satisfaction

It is the user's attitude towards using the information system that determines whether that attitude is good or negative. It plays a significant role in determining how well an information system works. Individuals generate positive or negative psychological effects towards the system based on their experiences by evaluating the difference between relevant and irrelevant predictions of the system output. Reliability, relevance, usefulness, and efficacy are among the US attributes that Yakubu and Dasuki examined in terms of user satisfaction. Recurring visitors, reliability, relevance, usefulness, and effectiveness are measured.

H1: user perceived satisfaction has a positive and significant impact on recommender system

ii. Informational quality

According to Ali (2017), information quality

https://dx.doi.org/10.4314/aujst.v4i1.6

refers to the desired attributes of a system's outputs, such as management reports and web pages. Information quality may be assessed in terms of the system's completeness, dependability, security, flexibility, personalization, correctness, timeliness, and ease of understanding. Information quality depends on how well it meets the user's needs. It focuses more on the information system's output content and aims to give users the information they need. The system's information provision aims to lessen the party receiving the information's sense of uncertainty. In this study, information quality will be utilized to assess a system's capacity for individualized content creation and to gauge its usefulness, timeliness, relevance, and accuracy.

H_1a: Information quality has a positive effect on the user satisfaction in recommender system model

iii. System quality

It concerns how well software and hardware work in creating quality output (Yaser, 2019). Delone and Mclean used usability, availability, dependability, flexibility, and reaction time as a measure of system quality. According to respondents in other research, the system's quality was good, it was simple to use, the information was up to date, and there was help available. Other studies assessed it in terms of availability, stability, accuracy, efficiency, and user friendliness. (Nugroho and Prasetyo, 2018; Begoña, 2010; Raija *et al* 2017) Customization, accessibility, privacy, and security. In Raija et *al,* (2017) study, they used good availability, stability, user friendliness, and respondents thought the system quality was positive; nevertheless, responses regarding customization, ease of navigation, and security were only somewhat favorable. Similar to the studies by Raija *et al*, this one will measure it.

H_{1b}: System quality has a positive effect on user satisfaction in recommender system model

iv Service quality: Before and after a transaction in an online environment, the organization makes the user an intangible offer that results in ownership of nothing (Najma, 2018). It is the assistance that a company offers an information system user during their connection with the system (Begoña, 2010). The user's perception of the organization's service quality and excellence has an impact on their decision in an online environment. Poor service perception by the user can lead to low system utilization, whereas excellent service perception results in high system usage. For the purpose of evaluating IT service, this architecture was modified from the marketing field (Petter, *et al*, 2003). According to Yakubu and Dasuki (2018), service quality gauges how tangible, trustworthy, responsive, assured, and empathic the system's service is

System availability, effectiveness, fulfillment, responsiveness, assurance, and empathy are used to measure it.

H_{1c}: Service quality has a positive effect on the user satisfaction on recommender system model

v. Privacy

Users are hesitant to disclose their personal information for organizational purposes since privacy is essential to them and pertains to their choices (Najma et al., 2018). Users are

https://dx.doi.org/10.4314/aujst.v4i1.6

discouraged from rating particular items of interest because they fear that doing so may expose their preferences to their closest neighbors, who might use them to make suggestions. Organizations may gather both implicit and explicit ratings from users when making recommendations. Biographical data, demographic information, behavioral data, purchase and rating history, and other information are used to create user profiles. The gathering and improper use of this data provide privacy problems (Cong *et al*, 2018).

H_{1d}: Privacy has a positive effect on user satisfaction on recommender system models.

4. METHODOLOGY

Structured questionnaire was used in the collection of the data from 171 postgraduate students of faculty of management sciences in Abubakar Tafawa Balewa university Bauchi, Bauchi state. The questionnaires used in this study were adapted from a number of studies as shown in the instrument for data collection table.Cross-sectional quantitative method would be adopted for measuring user perception of the recommender system. In this study questionnaire would be design based on the number of variables adapted and the questionnaire was adapted from previous studies to the needs of these research objectives. Convenience sampling technique was utilized in this study. a total number of 25 closed ended questions in section two that was answered by Likert's 5-step. The data collected was analyzed using Statistical Package for Social Sciences (SPSS) 23. In order to assess user perception of the recommender system model, multi linear regression was employed to identify the underlying dimensions and structure of Delone and McLean IS success model and user perception of adoption of recommender system model to determine relationship the IS success model construct.

5. RESULTS AND DISCUSSION

Results derived from the use of multi linear regression analysis are presented and interpreted. SPSS was used for data analysis. This study collected data for a period of three weeks from ATBU post graduate students. The data covered from January to February, 2022. The total number of respondents in this research is 171 but 154 usable responses were used in this study. 17 questionnaires were not usable.

Table 2 is the Model Summary table. The multi linear regression test analysis shown in the model summery table indicate that R square of 0.576 revealed that the independent variables within the model can predict 57.6% of change/ variance in customer satisfaction. R = 0.759 depicts that there is correlation of 75% between the independents and dependent variables of the study. Adjusted R square (.564) not far from R square (.576) shows a good generalization of the result with little variation of result from sample size. Table 3 is the ANOVA[a] table, in the table 3 the value of F (50.56) shows that the model is deemed fit with data samples and it is significant. Table 4 below is the Coefficients table that shows the significance of the independent variable against the dependent variable in the model. All variables in this study are significant in different magnitudes. The p-value is <0.05, which is the tolerable level.

https://dx.doi.org/10.4314/aujst.v4i1.6

Table 1 Instrument for data collection

s/n	Variable	Number of items	Source of instrument
1	Information quality	5	Šmýkala, 2018; Yakub & Dasuki, 2018
2	System quality	5	Šmýkala, 2018; Lee *et al,* 2021
3	Service quality	5	Yakub & Dasuki, 2018; Šmýkala, 2018;
4	Privacy	5	Najma, 2018; Lee *et al,* 2021;
5	User satisfaction	5	Najma, 2018; Šmýkala, 2018; Yaser, 2019

Table 2 Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.759[a]	.576	.564	.37303
a. Predictors: (Constant), service_Q, system_Q, information_Q, privacy				

Table 3 ANOVA[a]

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.143	4	7.036	50.562	.000[b]
	Residual	20.733	149	.139		
	Total	48.876	153			
a. Dependent Variable: customer_S						
b. Predictors: (Constant), service_Q, system_Q, information_Q, privacy						

Table 4 Coefficients[a]

Coefficients[a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.110	.344		6.140	.000
	Privacy	.249	.040	.398	6.253	.000
	information_Q	-.153	.080	-.121	-1.905	.059
	system_Q	-.170	.075	-.137	-2.274	.024
	service_Q	.594	.076	.541	7.795	.000
a. Dependent Variable: customer_S						

https://dx.doi.org/10.4314/aujst.v4i1.6

Table 5 variables regression analysis

Independent Dependent	P-value	Significance
service quality customer satisfaction	.000	Significance
Privacy customer satisfaction	.000	Significance
system quality customer satisfaction	.024	significance
Information quality customer satisfaction	.059	Non-significance

5.1. DISCUSSION OF RESULT

Individual data are utilized for testing the model to validate objective measures of the recommender system. In the study it was found that three hypotheses (H_{1b}, H_{1c} and H_{1d}) are significant while H_1 is not significant. Recommended systems with good service quality, privacy and system quality feature would translate to high visitor return to the website and in turn increase organization sales. Thus, user satisfaction increases, organization revenue increases. The developer of the recommender system needs to pay attention to the feature that increases customer satisfaction. The results from this shows that service quality have positive significant influence on user satisfaction, this is in consistent with other studies such as Jamal *et al*, (2018) and Johana, *et al*, (2019), this result from good experience of experience of user with recommender system, system friendliness and good response time increases user satisfaction. Hypothesis H_{1b} is accepted. Privacy has a positive significant influence on user satisfaction, this result similar to the work of Najma *et al*, (2018) that confirmed that user privacy is more important in an online environment. Hypothesis H_{1d} is accepted.

System quality is significant to recommend a system in a bidirectional way. This implies that an increase in one direction led to decrease in another direction. Thus, an increase in system quality features may lead to a similar decrease in user satisfaction. Rammutloa, (2017), Najma *et al*, (2018), (2018) and Johana *et al*, (2019), Jamal *et al*, (2018) stated that system quality has significant influence on the customer satisfaction while Begoñaa (2010) and Yakubu and Dasuki (2018) studies contradict the other studies previously mention. This might result from people using the recommender system might not capitalize on the system quality and also the procedure effect of using the system may cause it. Hypothesis H_{1c} is accepted.

Information quality has no significance on user satisfaction. This may be due to users' feeling is more derived from the system making recommendation than the system itself. Users may not be ready to divulge their information to enable it to make recommendations because of trust issues as observed by Johana *et al*, (2019). The result from this corroborates with the study of Begoñaa (2010), Rammutloa, (2017) and Yakubu and Dasuki (2018) studies where they found information quality not significant to user satisfaction. Hypothesis H1a

https://dx.doi.org/10.4314/aujst.v4i1.6

is rejected

Most of the variable measured user perception are significant (privacy, service quality and system quality) while information quality is not significant. It can be established that user perception has influence on the recommender system. There is a need to put focus on those features that are significant when developing a recommender system to increase user satisfaction.

6. CONCLUSION

This study evaluated the performance of the recommender system from the user's perspective on which aspect of the recommender system is vital to them is equally important as performance of the system. This study explores DeLone and McLean Updated IS Success Model in the context of a recommender system for consistency of result. The dimensions used in this study are privacy, information quality, service quality and system quality. The IS dimension was modified with privacy. This study gathered data from postgraduate students of faculty of management and analyzed the data collected using SPSS. multilinear regression was used for the method of analysis. From this study privacy, service quality is found to have a positive influence on the development of recommender systems. The multi linear regression test analysis of R square of 0.576 revealed that the independent variables within the model can predict 57.6% of change/ variance in customer satisfaction. R = 0.759 depicts that there is correlation of 75% between the independents and dependent variables of the study. Adjusted R square (.564) not far from R square (.576) shows a good generalization of the result with little variation of result from sample size. System quality has negative significance which implies increase in system quality features may decrease user satisfaction vice versa. Information quality was found not significant. This may result from mandatory issues, since e-commerce websites developed it to improve their sales without consumer consideration. Therefore, the study recommends the following in case of further investigation

i. More attributes can be added to a user's profile for more accurate recommendation, attributes such as user privacy, trust, review, location can be utilized for recommendation models.

ii. Evaluation of users' perception of the recommender system using the success factor of DeLone and McLean model should be carried out in different contexts of the recommender system and in the large-scale. This study omitted Behavioral intention, use and net benefit, inclusion of these important dependent variables can help in generalization of the result.

REFERENCES

Ali, B. J. (2017). Evaluation Information System Success: Applied DeLone and McLean Information System Success Model in Context Banking System in KSA. International Review of Management and Business Research,6 (2),829-845.

Attarde, D. V. & Singh, M. (2017). Survey on Recommendation System using Data Mining and Clustering Techniques.

https://dx.doi.org/10.4314/aujst.v4i1.6

International Journal for Research in Engineering Application & Management (IJREAM), *3*(9). doi : 10.18231/2454-9150.2017.0062

Begoña, P. M. (2010). Validity of DeLone and McLean's Model of Information Systems success at the web site level of analysis (3531) [Doctoral Dissertations, Louisiana State University]. https://digitalcommons.lsu.edu/gradschool_dissertations/3531

Cong W., Yifeng, Z., Jinghua, J. &Kui, R. (2018). Toward Privacy-Preserving Personalized Recommendation Services. *Research Cybersecurity Review*, *4* (2018) 21–28. https://doi.org/10.1016/j.eng.2018.02.005

Da'u, A. & Salim, N. (2018). Recommendation system based on deep learning methods: a systematic review and new directions. *Journal of Artificial Intelligence Review, 53*(4),2709-2748. https://doi.org/10.1007/s10462-019-09744-1

DeLone, W.H., McLean, E.R. (2003), The DeLone and McLean model of information systems success: A ten-year update. *Journal of Management Information Systems, 19*(4), 9-30.

Dong, M., Zeng, X., Koehl, L. & Zhang, J. (2020). An Interactive Knowledge-based Recommender System for Fashion Product Design in the Big Data Environment. *Information Sciences*, *540*, 469-488.

Edgardo, D., Indira, R. G., Monica, A. & Wenli, W. (2018). A Cloud Update of The Delone and Mclean Model of Information Systems Success. *Journal of Information Technology Management, 24* (3), 23-34.

Ghavipour, M. &· Meybodi, M. R. (2018). Stochastic trust network enriched by similarity relations to enhance trust-aware recommendations. *Journal of applied intelligence*,*49*,435-448 https://doi.org/10.1007/s10489-018-1289-9

Jamal, M. H., Yusti, F., Rizal, A. S., Gunawan, A., Denny, P. & Dwiza, R. (2018). Measuring Quality of Information System Through Delone Mclean Model in Online Information System of New Student Registration (SISFO PPDB). The 6th International Conference on Cyber and IT Service Management (CITSM 2018) Inna Parapat Hotel – Medan, August 7-9, 2018

Jannach, D., Zanker, M., Felfernig, A. & Friedrich, G. (2011). Recommender Systems: An Introduction. Cambridge University Press, DOI: 10.1017/CBO9780511763113,

Jannach,D, & Jugovac, M.(2019). Measuring the Business Value of Recommender Systems. ACM Trans. *Management Information. System, 10* (4). doi: 10.1145/3370082.

Johana, R. A., Hermawan, A. & Imam S. A. (2019). Analyzing E-Commerce Success using DeLone and McLean Model. *Journal of Information Systems Engineering and Business Intelligence*, 5 (*2*), 156-162.

https://dx.doi.org/10.4314/aujst.v4i1.6

Konstan, J.A, Riedl J., Borchers, A. & Herlocker, J. L. (1998). Recommender systems: A GroupLens Perspective. AAAI Technical Report WS-98-08. Retrieved from https://www.aaai.org

Lee, C. C., Nagpal, P., Lim, H. S., Dutil, L., Lee, R. & Kim, Y. (2021) A Variation of the DeLone and McLean Model for Collaborative Commerce Services: A Structural Equation Model. *Journal of International Technology and Information Management, 29*(3). https://scholarworks.lib.csusb.edu/jitim/vol29/iss3/4

Mardiana, S. Tjakraatmadja, J. H. & Aprianingsih, A. (2015). DeLone–McLean IS Success Model Revisited: The Separation of Intention to Use - Use and the Integration of Technology Acceptance Models. *International Journal of Economics and Financial Issues*, *5*(2015), 172-182.

Mardiana, S. Tjakraatmadja, J. H. & Aprianingsih, A. (2015). DeLone–McLean IS Success Model Revisited: The Separation of Intention to Use - Use and the Integration of Technology Acceptance Models. International Journal of Economics and Financial Issues, 5(2015), 172-182

Monti, D., Rizzo, G & Morisio, M. (2020). A systematic literature review of Multicriteria recommender systems. *Journal of Artificial Intelligence Review,54,*427-468. https://doi.org/10.1007/s10462-020-09851-4

Najma I. A., Samsuri, S., Abu Seman, M. S., Imtiaz Ali Brohi, I. A. & Shah, A. (2018). Measuring E-Commerce Success in Malaysia: Modified Delone Mclean Model with Trust and Privacy. *International Journal of Engineering & Technology, 7* (4.15),524-529.

Parvin, H., Moradi, P. & Esmaeili, S. (2018, February 28-March 2). *A collaborative filtering method based on genetic algorithm and trust statements*. 6th Iranian Joint Congress on Fuzzy and Intelligent Systems (CFIS), 13-16.

Petter, S. DeLone, W & McLean, E. (2008). Measuring information systems success: models, dimensions, measures, and interrelationships. *European Journal of Information Systems,* 17, 236–263

Pondel, M. & Korczak, J. (2018). Collective clustering of marketing data recommendation system Upsaily. Proceedings of the Federated Conference on Computer Science and Information Systems, 15, 801–810. DOI: 10.15439/2018F217

Pradnya V., Kulkarni, P. & Rai, S. & Kale, R. (2020). Recommender System in eLearning: A Survey. In Bhlla, S., Kwan, P. Bedekar, M. Phalnikar, R. & Sirsikar, S. (Eds). Proceeding of internation conference on computational science and applications. *Algorithms for intelligent systems.* Springer, Singapore. 119-126.doi: 10.1007/978-981-15-0790-8_13

Raija, H., Tom, A., William, G. & Kieran, C.

https://dx.doi.org/10.4314/aujst.v4i1.6

(2017). Delone & McLean success model as a descriptive Tool in evaluating a virtual learning environment. *International journal of information system and social change, 1*(2), 36-48. Doi:10.4018/jissc.201004103

Rammutloa, M. W. (2017). Application of the delone and mclean's model to assess the effectiveness of an intranet in an open distance learning Library (Master of Philosophy, Stellenbosch University). Stellenbosch University https://scholar.sun.ac.za

Ren, Y. & Ch, C. (2018) Research on Recommendation Technology based on Collaborative Filtering. In Wang, J., Kun, Z. & Miracle, J. 8th International Conference on Social Science and Education Research (SSER 2018). *Advances in Social Science, Education and Humanities Research,238.*

Rezaimehr, F. & Dadkhah, C. (2020). A survey of attack detection approaches in collaborative filtering recommender systems. *Journal of Artificial Intelligence Review, 54,*2011-2066 https://doi.org/10.1007/s10462-020-09898-3

Ricci, F., Rokach, L.,Shapira, B. (2015). Recommender systems: introduction and challenges, in: Ricci, F., Rokach, L.,Shapira, B (Eds.), Recommender Systems Handbook, Springer US, Boston, MA, 2015, 1–34. doi :10.1007/978-1-4899-7637-6_1

Salunke, J. & Chaudhari, A. (2017). Classification of Recommendation System for E-commerce Application. *Journal of Computer Science Engineering and Software Testing, 3*(3), 1-10,

Šmýkala, M. (2018). Evaluate Recommender System with DeLone and McLean's Model (Master's thesis, Masaryk University, Faculty of Informatics). Brno, Spring.

Yadav S., Vikash, S. & Nagpal S. (2018). An improved collaborative filtering-based recommender system using bat algorithm. *International conference on computational intelligence and data science (ICCIDS 2018), Procedia computer science 132*(2018) 1795-1803.

Yakubu, M. N., & Dasuki, S. I. (2018). Assessing eLearning systems success in Nigeria: An application of the DeLone and McLean information systems success model. *Journal of Information Technology Education: Research,17*, 182-202. https://doi.org/10.28945/4077

Yaser, H. S. A. (2019). Measuring information Systems Success in Yemen: Potential of Delone and Mcleans model. *International Journal of scientific & technology research, 8*(7), 793-799.

https://dx.doi.org/10.4314/aujst.v4i1.6