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Assessing the Success of University Social Networking Sites: Engineering Students' Perspective*

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In the higher education industry, web-based marketing has already been widely applied to service current students, as well as to attract new ones. All major universities in the world have incorporated their websites with social networking sites (SNSs), but it is likely that a significantly larger proportion has no clear knowledge of how successful their SNSs are. Accordingly, this study proposes an integrated model for evaluating the effectiveness of SNSs from an engineering student point of view. This model is based on the DeLone and McLean IS success theory coupled with the socio-demographic conditions perspective. The model was tested by using data collected from 638 engineering students. The results show that seven hypothesized relationships between seven success variables were significantly supported and two socio-demographic characteristics were significantly related to SNSs use. Our analysis showed that all three quality dimensions (i.e., information quality, system quality, service quality) had a positive impact on user satisfaction, and that only information quality had a significant effect on SNSs use. User satisfaction had positive and direct effects on SNSs use. Female students and self-funding students tend to use SNSs (i.e., Facebook, Instagram, Twitter) more than male students and students with government scholarships. Therefore, gender and funding options should be considered as significant characteristics, since as control variables play significant role in the model. Engineering academic institutions can use the results of this research to assess the success of their SNSs implementation from their students' perspective.

Keywords: social networking site; D&M model; engineering students; SEM

1. Introduction

Social networking sites (SNSs) such as Facebook have flourished in recent years [1]. SNSs are systems that allow individuals to create a virtual public profile, articulate a list of connections, and view and traverse that list [2]. On such an online system, users can jointly investigate network contents, share their experience and build up a relation for different purposes, such as social, or educational [3]. In the era of digital economy, many organizations utilize SNSs to market their services to potential customers [4]. The popularity of internet and information technologies has provided a platform for all organizations, not only to deliver information for advertising and promotion directly to their consumers, but also to establish two- way communication [4]. SNSs are a new way of managing relationships with potential customers and improving brand image, thus further enhancing customer loyalty and encouraging positive word-of-mouth recommendations [5].

In the higher education industry, the application of e-business through web-based marketing has already been widely applied to service current students, as well as to attract new ones from various high schools and industry. In addition, application of SNSs in engineering education is mostly related to improvement of teaching-learning processes and collaboration [6–8]. Educators nationwide have tapped into the potential impact of SNSs on enrollment and education [1]. All major universities in the world have incorporated their websites with SNSs (e.g., Harvard University, The University of Oxford, The University of Cambridge). Even though e-business strategy towards the use of SNSs is popular, it is likely that a significantly larger proportion of organizations has no clear knowledge of how successful their SNSs are [4, 5, 9] especially during the selection and pre-enrollment phase. In addition, the understanding of the primary antecedents of students' intention to use SNSs is limited [1], especially in the field related to engineering education. Recent studies in websites and SNSs have examined the role of demographic characteristics [10] and their importance in the prediction of the use of technologies [11–15]. A better theoretical understanding of demographic characteristics and IS use is needed to benefit research in the IS field [16]. A study on various social factors for expanding the horizon of the research on the SNSs users and the effects of SNSs use needs to be conducted [17]. Studies that deal with the demographic influences on SNSs use

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during the selection and pre-enrollment phase are scarce [18]; to the best of our knowledge, no research has been conducted to assess SNSs from both an e-business standpoint and students' perspective during the selection and pre-enrollment phase. We aim to fill this gap. In response to this, we intend to address the following research questions in this study:

(a) How much effort must an educational institution put into improving their SNSs to achieve their desired benefits when attracting new students?
(b) How can universities effectively measure the performance of their SNSs from the perspective of the potential students?
(c) How do socio-demographic characteristics of the potential students drive the SNSs success during the selection and pre-enrollment phase?

This study presents an empirically validated model for assessing the success of university SNSs during the selection and pre-enrollment phase from the students' perspective. We used the updated DeLone and McLean [19] IS success model in our research. The data was collected from 604 freshman students from the University of Novi Sad, Serbia using a questionnaire. The students were using the university SNSs (i.e., Facebook, Instagram, Twitter) during the selection and pre-enrollment phase. Seven hypothesized relationships between seven success variables were significantly supported and two socio-demographic characteristics were significantly related to use. The findings of this study can be used to assess the success of SNSs from the standpoint of students, to effectively develop an e-business strategy regarding SNSs, and to attract more prospective students.

The remainder of the paper is organized into five sections. Section 2 presents a literature review on SNSs and applicability of IS success modeling. The section also proposes a conceptual model and hypothesis. Section 3 describes the materials and methods. Section 4 presents the results of measurement and structural modeling. Section 5 includes a discussion of theoretical and managerial implications of the SNSs success model. Finally, in Section 6, a conclusion and directions for future research are provided.

2. Background and related work

2.1 Social networking sites success

Social networking sites—such as Facebook, Twitter, and Instagram—enable users to create a public profile as well as to build relationships with other people, peer groups or organizations [20]. For example, Facebook, a leading SNS, has more than 1.94 billion monthly active users as of March 31, 2017 [21], and the site is still exponentially growing in popularity. Among users there is a prevalence of young people who are at college or university [22].

The introduction of SNSs has brought operational benefits for organizations, and all their stakeholders (e.g., employees, customers). Organizations regularly use SNSs to disseminate information about their products and services [23]. Universities use SNSs to distribute information such as text, images, audio and video, to service current and potential students [24]. They use their SNSs to promote their study programs, facilities, student life and all relevant elements for prospective and current students. Universities can easily engage with students through SNSs pages [5]. New postings are shared directly with users who follow the university. Besides, SNSs affect communication, marketing, and instruction, they have changed students' information-seeking behaviors [25]. The wealth of user-generated content allows students to share experience with other students and seek for everyday-life information. Since SNSs have become readily available and accessible through smartphones and tablets, students can create, discuss and share information on different topics anywhere, anytime.

As SNSs are type of IS [24, 26, 27] and their success is a complex concept, they need to be assessed with multidimensional factors [19, 28]. Although research on SNSs success is in its infancy, general research on IS success has been conducted for almost three decades [29, 30]. Previous studies that investigated SNSs success focused on two models (i.e., technology acceptance model and IS success model) and their amendments. The technology acceptance model (TAM) by Davis [29] explained why some ISs are accepted by users better than others. One of the first successful attempts to apply the TAM on SNSs was made by Hossain and de Silva [31]. They extended the original TAM model with a social factor (i.e., different types of social ties) and applied it on social networks to examine user adoption. Lorenzo-Romero et al. [32] applied the TAM on SNSs focusing on the effect of the levels of trust and perceived risk associated with SNSs acceptance. In addition, Kwon and Wen [33] developed a model showing the effect of individual differences (e.g., social identity, altruism, and telepresence) on SNSs use by amending the TAM. A recent study used the modified TAM (i.e., UTAUT) model to compare two SNSs in regards to trust [34].

Lin [35] constructed a model of the impact of system characteristics (e.g., information and system quality) and social factors (e.g., trust and social usefulness) on the implementation of successful online communities by expanding the DeLone and

McLean's (D&M) IS Success Model. Valaei and Baroto [36] applied expectation-confirmation theory on the D&M information system success to test the continuance intention of SNSs use. Seol et al. [5] constructed a model of continuance usage of SNSs by amending the updated D&M model with the constructs from communicative ecology theory.

Acceptance and use alone, however, are not the same as success, although acceptance and use of SNSs are necessary elements for measuring success [37]. Thus, this research focuses only on the D&M IS success model as a measurement for SNSs assessment. In their review, Petter et al. [37] found that the D&M model is applicable in a variety of contexts and serves as a significant basis for imminent studies. The updated D&M model is applicable to the assessment of an information system's effectiveness in the World Wide Web environment [19]. However, the limits of the model are not well-known or understood [27]. The original authors suggested that further field-studies of their model are needed [19]. Thus, we assume that the updated IS success model can be adapted to e-business success measurement in the SNSs context from the students' perspective.

2.2 Socio-demographic factors that influence SNSs use

Previous empirical and theoretical studies have confirmed the determining effects of demographic and socio-economic differences in an information system's use [11–13, 15, 16]. Individuals less likely to take part in online interactions are typically less skilled technologically, older and less educated [38]. The capability to assess the effect of socio-demographic characteristics on SNSs use is needed for organizations to monitor their success and improvement regarding target groups. This may happen through developing a model for SNSs measurement and assessment or through benchmarking [36].

Nam [12] and Stefanovic et al. [15] categorize the dimensions of socio-demographic characteristics in IS use as age, gender, education, job position, monthly income, residential categories, and self-identified partisanship. Monthly income of users is a proxy measure of socioeconomic status. Residential categories are rural, suburban or urban [15]. Trauth [16] found that gender in IS papers focuses on the adoption and use of information technology, typically searching for gender differences. Nevertheless, in the case of SNSs, the diversity of factors that influence use is limited to gender and age. Jankovic et al. [10] found that the usage of Facebook when using it for educational purposes depends on gender. Lalic and Marjanovic [39] found that residential place and funding option influence use of SNSs. In a study conducted by Manca and Ranieri [14] it was found that gender has a limited impact on the decision to use SNSs for teaching. Another study found that sex has a strong impact on SNSs use [18]. In their study the authors found that females and young people spend more time on Facebook and have more Facebook friends. It is worth observing that older students are likely to use SNSs for education in comparison with younger adults, and this would be consistent with the results relating to the age as a discriminating factor that have been reported elsewhere [40]. Yoo and Jeong [17] are calling to include different social factors to further understand how these factors of SNSs users affect SNSs use. Therefore, to understand the interdependent relationships among the D&M IS success model's categories further and to develop a new measure that can be incorporated into the SNSs model, the authors used different factors of socio-demographic characteristics other than gender and age (i.e., income, residential, education, computer literacy) that can be applied in the context of university SNSs.

2.3 SNSs at the University of Novi Sad, Serbia

In 2014, Serbia had about 3.5 million Facebook users, 53% of whom were men [41]. Most Facebook users (1.18 million) are between the ages of 18 and 24, which is approximately 33% of the total number of users in Serbia. According to the data published in 2013 by the Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia (http://mtt.gov.rs), the most popular social networks in Serbia are Facebook and Twitter, and 93.4% of the population between 16 and 24 years of age has a profile on at least one of these two social networks. The educational system of the Republic of Serbia consists of five state universities and two private ones [42]. The University of Novi Sad is the only university in the northern province of Vojvodina. Students can finance costs of university education through a government scholarship or self-funding. Serbia is considered a developing country with 59% urban population with 62.8% of households that have Internet access. Gender is equally distributed in Serbia with 51% of females, but the disparity in the use of the Internet between men and women is very high. Approximately, 66.4% of men are Internet users compared with 46.8% of women [43]. Serbia is considered as an upper-middle-income country with an average monthly net income of RSD 48,000 or $430 [44], which is considered one of the lowest in Europe.

The University of Novi Sad uses three SNSs (i.e., Facebook, Instagram, Twitter) for attracting new students. The process starts in February with the creation of new SNSs for each generation, with the aim of targeting the third grade of high school

students and ends in July the following year when high school students enroll at the university. During the 18-month campaign the main objective is to attract a large number of members since the university found a high degree of correlation between the number of SNSs members and university applications. With face-to-face events (e.g., University open day, Education fair, high school visits) the university attracts new members for the SNSs. There are two purposes of attracting new members—dissemination of information and establishment of two-way communication. The University disseminates information regarding offline events, promotional articles and videos, news from the university website, application requirements, important dates, et cetera. The use of SNSs is voluntary since high school students could get the same information by visiting the university website. Two-way communication is the most important aspect of the strategy since it represents the best way to engage with high school students and provide answers to all their questions. The policy of the university is 12-hour response time. Since the University of Novi Sad receives additional income from self-funded students, the authors used the funding option as a factor of socio-demographic characteristics.

2.4 Conceptual model and hypothesis

In this paper, we tried to use the concepts and models mentioned in similar studies, considering the views of engineering students, and provide a model for measuring the success of SNSs, extending previous research. As SNSs are considered to be an aspect of IS [9, 27], their success can be analyzed with the updated D&M IS success model [19]. This study modified the D&M IS success model and accepted the recommendation of Nam [12] and Stefanovic et al. [15] to include socio-demographic conditions as a construct. Based on the review of previous research results [12, 13, 19, 27], we designed the initial conceptual model, presented in Fig. 1. Brief definitions of each measure in the model are as follows:

- Information quality—the content that a SNS or an information system has. The higher the quality of the content, the more successful it will be due to more recurrent visits [27]. The quality of the information provided to the users by IS is considered to be a key factor affecting IS success [45]. Information is the reason most people use academic institution SNSs. In the SNSs context, information quality insinuates delivering up-to-date, useful and complete information [19, 27, 28, 46]. It is assumed that the higher the quality of SNSs information, the more potential engineering students would visit, browse, and comment on it.
- System quality—the technical quality of SNSs. It measures the technical success [19]. Higher system quality is expected to lead to higher user satisfaction and use, thus leading to positive impacts on individual productivity [27]. For instance, if the SNSs require an extra click from the user, it might make a difference to, or have a lasting psychological impact on the user. Thus, the effect of system quality as a motivator in facilitating user satisfaction and usage increase may be significant. System quality was measured in terms of ease of use, navigation, user friendliness and functionality [9, 19, 27, 28, 47].
- Service quality—the quality of support that potential engineering students receive from online community personnel [45]. To provide better service, educational institutions implement several service functions into the SNSs, such as online chat, online forum, FAQs. In addition to system and information quality, service quality measures the general quality of SNSs from the perspective of the readiness of personnel to provide a proper service [48], personnel willingness to provide service [48, 49], speed of the provided service [46, 49], accessibility to provide service [50] and technical competence to provide service [45].
- SNSs use—the degree and manner in which potential engineering students utilize the capabilities of SNSs [45]. In the context of academic institution SNSs, this construct measures the behavior and attitude of users in regard to frequency of system use, use for information retrieval, as well as tendency and duration of use [27, 28].
- User satisfaction—the attitude towards SNSs [30]. User satisfaction is the general idea the users have about the information system [51]. It measures the potential engineering students' general satisfaction, efficiency, effectiveness and experience with the SNSs.
- Net benefits—the extent to which the SNSs contribute to the success of individual students [45]. Every user experiences certain effects after using the system. This needs to be measured to evaluate the success of academic institution SNSs. Since the focus of this study is on the measurement of the success of SNSs from the engineering student perspective, the net benefit in this study refers to the student-perceived net benefit evaluation of a specific SNS.
- Socio-demographic conditions—demographic and social characteristics of SNSs users. Based on the call of Yoo and Jeong [17], and previous research in the IS field (e.g., [10, 12, 15]) we have

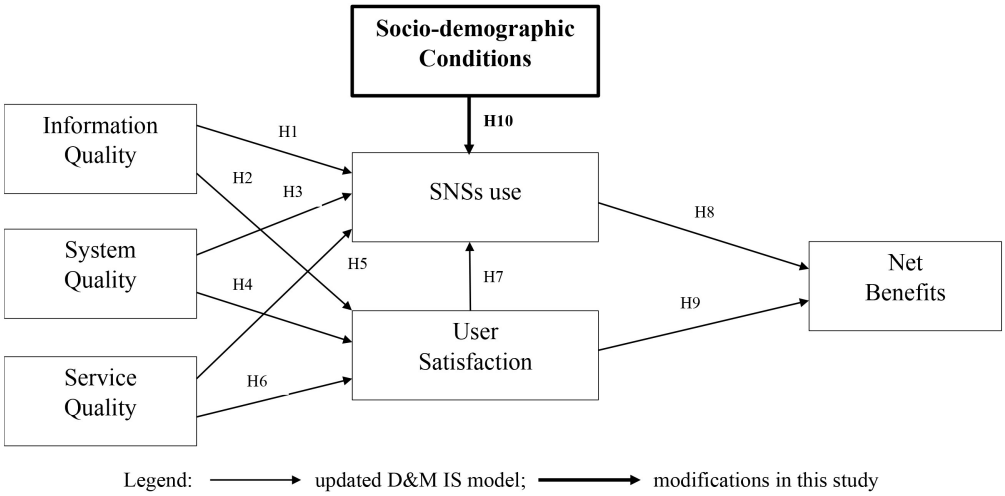


Fig. 1. Conceptual model to be tested for success of university social networking sites.

included the following socio-demographic conditions in this study: gender, age, monthly family income of the students as proxy measures of socioeconomic status, residential categories – where the student comes from, high school GPA as proxy for education, computer literacy as a measurement on how well the student is technologically skilled, and funding options—the way the student pays for his or her education.

According to Fig. 1, the updated D&M model is coupled with socio-demographic characteristics to measure the success of SNSs. DeLone and McLean [19] contend that use and the intention to use are alternatives in their model, and that the intention to use may be a more acceptable variable in the context of mandatory usage. Thus, we chose to consider both the intention to use and other measures of system use as the same construct for this study.

IS success is a multidimensional and interdependent construct and it is, therefore, necessary to study the interrelationships among those dimensions [19]. Our hypotheses about the relationships in the model are presented below:

H1: Information quality of SNSs has a positive effect on students' use of SNSs.
H2: Information quality of SNSs has a positive effect on user satisfaction of students.
H3: System quality of SNSs has a positive effect on students' use of SNSs.
H4: System quality of SNSs has a positive effect on user satisfaction of students.
H5: Service quality of SNSs has a positive effect on students' use of SNSs.
H6: Service quality of SNSs has a positive effect on user satisfaction of students.
H7: Students' user satisfaction with the SNSs has a positive effect on use of SNSs.
H8: Use of SNSs has a positive effect on students' net benefits.
H9: Students' user satisfaction with the SNSs has a positive effect on students' net benefits.

Nam and Sayogo [52] found that socio-demographic conditions strongly matter for information system use. A finding from the study conducted by Nam [12] revealed that socio-demographic conditions influence the usage level of various functionalities of information systems. In a study conducted by Stefanovic et al. [15] it was found that socio-demographic conditions have a limited impact on the decision to use an information system. According to the Diffusion of Innovations Theory, early adopters of any technology innovation share common characteristics: young, well-educated, and higher income [53]. Therefore, it is hypothesized that:

H10: Socio-demographic conditions (gender, age, income, residential status, high school GPA, computer literacy and funding option) of engineering students have a positive effect on use of SNSs.

3. Materials and methods

3.1 Measures

The indicators and constructs of the conceptual model have been determined based on previous research on IS success. The measures that were used to analyze the success of various types of IS in previous studies and which have been adopted in this study are listed in Table 1.

3.2 Sample and data collection procedure

The data used to test the conceptual model were obtained from a sample of newly enrolled engineer-

Table 1. Construct measures for social networking site success

Construct	Indicator	References
Information quality (IQ)	Comprehensive information	[16, 24]
	Useful information	[42, 43]
	Up to date information	[25, 43]
System quality (SQ)	Easy to use	[16, 44]
	Navigability	[9]
	User-friendly	[25, 43]
	Functional	[27]
Service quality (SV)	Willingness to provide service	[44, 45]
	Speed of provided service	[42, 45]
	Provide service	[48]
	Accessible to provide service	[50]
	Technical competence	[45]
SNSs use (U)	Frequency of use	[25, 43]
	Duration of use	[44, 50]
	Use to retrieve information	[55]
User satisfaction (US)	Experience	[27]
	Efficiency and effectiveness	[27]
	Overall satisfaction	[25, 52]
Net Benefits (NB)	Time savings	[16, 25]
	Improved interaction with faculty staff	[27]
	Improved interaction with other students	[27]

ing students from the University of Novi Sad, Faculty of Technical Sciences, Serbia. The focus was on engineering students that have used the university SNSs. 87% of students reported that they used SNSs during selection and pre-enrollment. The Faculty of Technical Sciences is organized into13 departments which in total enroll 2323 students. Thus, to increase the generalizability of the results, all newly enrolled engineering students were selected to take part in the survey. Following Dillman et al. [57] recommendations of applying the total design method of surveys, we emailed 2323 students via the SurveyMonkey [58] online survey tool. A total of 638 responses, that were using SNSs during the selection and pre-enrollment phase, were received over a period of ten weeks, representing a response rate of 27.5%. After conducting non-engaged bias analysis, 34 responses were deleted and the remaining 604 useful responses were available for data analysis, yielding a 26% usable response rate. Approximately, 56% of the respondents were male. Age distribution was as follows: under 19 (12.7%), 19 (76.0%), 20 (5.8%), and over 20 (5.5%). The residential areas of respondents were

Table 2. Demographic details of the respondents (n = 604)

Measure	Items	Frequency	%
Gender	Male	338	56.0
	Female	266	44.0
Age	<19	77	12.7
	19	459	76.0
	20	35	5.8
	>20	33	5.5
Family income	Less than $200	69	11.4
	$200 to $400	157	26.0
	$401 to $600	188	31.1
	$601 to $1000	117	19.4
	More than $1000	73	12.1
Residential place	Urban	355	58.8
	Suburban	112	18.5
	Rural	137	22.7
High School GPA	More than 4.5	384	63.6
	Between 3.5 and 4.5	203	33.6
	Less than 3.5	17	2.8
Computer literacy	Professional	157	26.0
	Advanced	394	65.2
	Beginners	53	8.8
Funding option	Government scholarship	395	65.4
	Self-funding	209	34.6

identified as urban (58.8%), suburban (18.5%), and rural (22.7%). Family income distribution of the respondents was approximately normal: less than $200 (11.4%), between $200and $400 (26.0%), between $401and $600 (31.1%), between $601and $1000 (19.4%), and more than $1000 (12.1%). Regarding the high school GPA (on the scale 1 to 5, where 5 is the best); we observed that most respondents had more than 4.5 (63.6%). Most respondents (65.2%) indicated that they had an advanced level of computer literacy. Nearly 65% of respondents were enrolled at the university through government scholarships. We used t-tests to compare the means and further computed the Kolmogorov–Smirnov test statistics to examine the sample distribution of the two groups [59]. The responses from the two groups did not differ significantly in terms of either sample means or sample distributions (non-bias). Detailed descriptive statistics relating to the demographic characteristics are shown in Table 2. To measure all the constructs, 21 indicators were measured with the five-point Likert scale [60].

4. Results

In general, the Structural Equitation Modeling (SEM) technique was conducted in SPSS Amos to examine the model fit for each construct (to assess the measurement model) and to test the relationships among the constructs (to test the hypotheses in the structural model).

4.1 Measurement model

For the purpose of validity testing of the measurement model, the Confirmatory Factor Analysis (CFA) was conducted by SPSS Amos [61]. We used the following goodness of fit indices: the ratio of χ^2 to degrees-of-freedom (*df*), adjusted goodness of fit index (AGFI), normalized fit index (NFI), comparative fit index (CFI), and root mean square error of approximation (RMSEA). As shown in Table 3, all the model-fit indices exceeded their respective common acceptance levels suggested by previous research [62–64], thus demonstrating that the measurement model exhibited a fairly good fit with the data collected (χ^2 = 575.18 with df = 193, AGFI = 0.886, NFI = 0.933, CFI = 0.952, RMSEA = 0.062).

Reliability was evaluated by calculating Cronbach's alpha coefficients [60]. The reliability of each factor collected by the survey instrument was as follows: information quality = 0.840; system quality = 0.878; service quality = 0.928; SNSs use = 0.839; user satisfaction = 0.788; net benefit = 0.761. The reliability of the whole instrument was 0.928. In addition, the reliability and convergent validity of the factors were estimated by the Composite Reliability (CR) and Average Variance Extracted (AVE). The results are presented in Table 4. All the Cronbach's alpha coefficients and composite reliability values satisfied the minimum criterion value of 0.70 or greater, as suggested by Hair et al. (2009). The average variances extracted were all above the recommended 0.50 level [66], which meant that more than one half of the variances observed in the items were accounted for by their hypothesized factors. CR was greater than AVE for each factor. Thus, all the factors in the measurement model had adequate convergent validity.

Discriminant validity can be evaluated by examining the Average Variance Extracted (AVE), Max-

Table 3. Summary of goodness of fit statistics for CFA and SEM

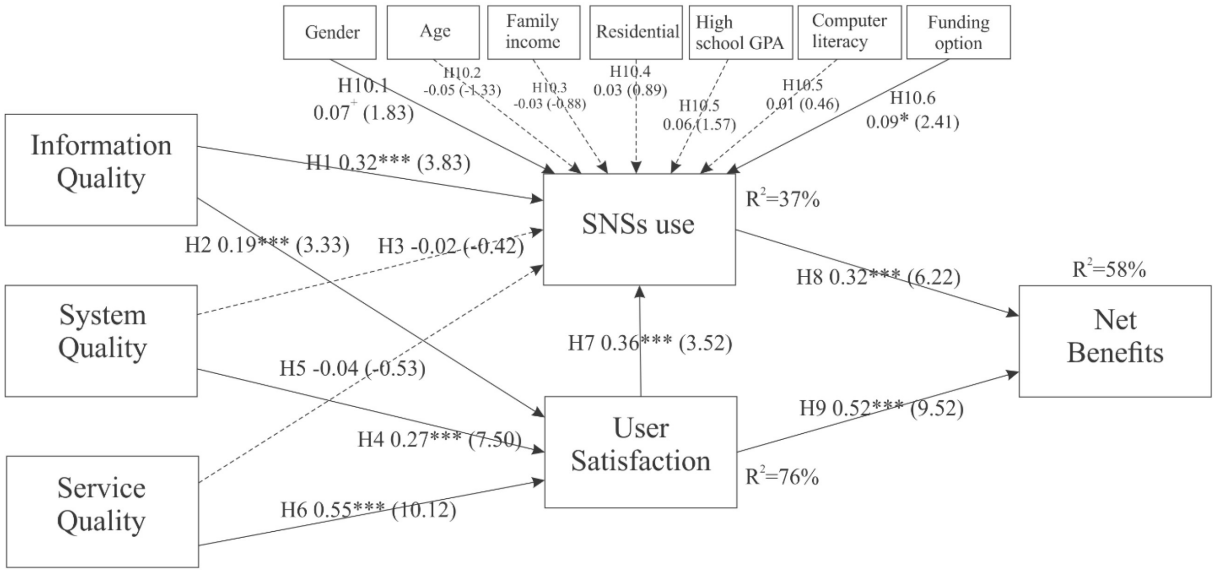
Model	χ^2/df	AGFI	NFI	CFI	RMSEA
Measurement model	2.98	0.886	0.933	0.952	0.062
Structural model	2.99	0.871	0.910	0.922	0.057
Recommended value	< 3.00[a,b]	> 0.80[b]	> 0.90[b,c]	> 0.90[a,c]	< 0.08[a,b,c]

Note. AGFI = adjusted goodness of fit index; NFI = normalized fit index; CFI = comparative fit index; RMSEA = root-mean-square error of approximation; [a][65], [b][66], [c][62].

Table 4. Reliability, convergent validity, and construct correlations

Factor	Mean	SD	α	CR	AVE	MSV	ASV	SQ	IQ	SV	U	US	NB
SQ	4.24	0.74	0.878	0.884	0.657	0.366	0.217	0.811[a]					
IQ	4.69	0.54	0.840	0.843	0.642	0.594	0.416	0.506	0.802[a]				
SV	4.70	0.61	0.928	0.929	0.723	0.663	0.409	0.400	0.771	0.850[a]			
U	4.15	0.84	0.839	0.846	0.648	0.397	0.278	0.355	0.548	0.486	0.805[a]		
US	4.60	0.60	0.788	0.818	0.704	0.663	0.491	0.605	0.763	0.814	0.577	0.839[a]	
NB	4.25	0.79	0.761	0.770	0.528	0.511	0.365	0.421	0.590	0.627	0.630	0.715	0.727[a]

Note. α = Cronbach's alpha; CR = composite reliability; AVE = average variance extracted; MSV = maximum shared variance; ASV = average shared variance; [a]It indicates the square root of AVE of the construct.



Note. statistically significant ——; statistically non-significant -------; $^{+}p < 0.1$, *p < 0.05, ***p < 0.001, ( ) z-score.

Fig. 2. Results of the structural analysis for the success of university social networking sites.

imum Shared Variance (MSV), and Average Shared Variance (ASV). Following the Hair et al. (2009) recommendation, MSV not greater than AVE, ASV not greater than AVE, and Square root of AVE greater than inter-construct correlations will lead to discriminant validity. None of the factors had convergent validity concerns (see Table 4). In summary, the measurement model had adequate reliability, convergent validity, and discriminant validity.

Next, we conducted the Common Method Bias (CMB) test. CMB refers to the measurement error resulting from variance due to the measurement method utilized [67]. The Common Latent Factor (CLF) test is employed to examine for common method bias. This test is conducted to capture the common variance among all the observed variables in the model [67]. If there are great differences (greater than 0.2) in the standardized regression weights from the model with CLF to the standardized regression weights of a model without the CLF, then there is a CMB issue [67]. Using this approach, CLF test of the items in our study was conducted. This analysis showed that the differences in the standardized regression weights with and without CLF were smaller than 0.2 in all 21 observed variables, which is a strong indication that common method bias is not present in our sample.

4.2 Structural model

The same set of fit indices was used to examine the structural model. As Table 3 shows, all fit indices values are in the acceptable range, indicating a good fit of the model ($\chi^2 = 1011.73$ with df = 338, AGFI = 0.871, NFI = 0.910, CFI = 0.922, RMSEA = 0.057). The standardized path coefficient, p-values, z-scores, and variance explained are shown in Fig. 2.

Information quality is both related to user satisfaction and SNSs use ($\beta = 0.320$; $p < 0.001$, $\beta = 0.191$; $p < 0.001$), providing support for hypotheses 1 and 2. System quality had a significant influence on user satisfaction ($\beta = 0.277$; $p < 0.001$). Thus, hypothesis 4 was supported. Service quality is related to user satisfaction ($\beta = 0.552$; $p < 0.001$), providing support for hypothesis 6. User satisfaction had a significant influence on both SNSs use and net benefits ($\beta = 0.367$; $p < 0.001$, $\beta = 0.529$; $p < 0.001$), providing support for hypotheses 7 and 9. SNSs use is also related to net benefits ($\beta = 0.329$; $p < 0.001$), providing support for hypothesis 8. The influence of gender on SNSs use was not significant at $p < 0.05$, but significant at $p < 0.1$. Thus, hypothesis 10.1 was marginally supported ($\beta = 0.069$). The results reveal that the funding option is related to SNSs use ($\beta = 0.090$; $p < 0.05$), providing support for hypothesis 10.7. The remaining relationships in the model were evaluated as non-significant. Table 5 summarizes hypothesis testing.

Henseler et al. [68] suggested using the coefficient of determination (R^2) of the endogenous latent variables as the essential criterion for the assessment of the structural model. R^2 was 76% when the quality triad was used to predict user satisfaction. And the coefficient of determination for SNSs use was 37%, when predicted by the quality triad and user satisfaction. The overall model accounted for

Table 5. Summary of hypothesis testing

Hypothesis	Relationship	t-value	β-value	Result
H1	IQ → U	3.836***	0.320	Supported
H2	IQ → US	3.333***	0.191	Supported
H3	SQ → U	–0.429	–0.024	Not Supported
H4	SQ → US	7.500***	0.277	Supported
H5	SV → U	–0.532	–0.024	Not Supported
H6	SV → US	10.122	0.552	Supported
H7	US → U	3.525***	0.367	Supported
H8	U → NB	6.224***	0.329	Supported
H9	US → NB	9.527***	0.529	Supported
H10.1	Gender → U	1.839+	0.069	Marginally Supported
H10.2	Age → U	–1.335	0.050	Not Supported
H10.3	Family income → U	–0.883	–0.033	Not Supported
H10.4	Residential → U	0.899	0.033	Not Supported
H10.5	High School GPA → U	1.571	0.059	Not Supported
H10.6	Computer literacy → U	0.467	0.017	Not Supported
H10.7	Funding option → U	2.406*	0.090	Supported

Note. +p < 0.1, *p < 0.05, ***p < 0.001.

58% of the variance in the perceived net benefit, with user satisfaction exerting a stronger direct effect than SNSs use on the perceived net benefit.

5. Discussion

This research has addressed the problem of measuring the success of SNSs deployment from the perspective of freshman engineering students as primary users during the selection and pre-enrollment phase. In this study we empirically revalidated the model for measuring the success of SNSs based on the updated DeLone and McLean [19] IS success model and assessed socio-demographic characteristics and their influences on the use of SNSs. Our results revealed that: (1) the researchers have advocated extending and revalidating past theories and framework in a new context [69]. As such, the current study represents the first comprehensive examination of the socio-demographic conditions and success of SNSs using scales derived from the existing literature. The results have implications for practitioners in the engineering education sectors in terms of social networking based communication and marketing, for the SNSs managers in terms of instructional design and development of SNSs, and finally for the future researchers to use this instrument as a reference. (2) SNSs should actively seek methods of improving information quality, since this factor significantly increases use and user satisfaction. Thus, community managers in engineering schools should make full use of the comprehensiveness, usefulness and timeliness of information on the SNSs to increase SNSs use and user satisfaction. (3) The results of the empirical analysis indicated that system and service quality have a strong and significant influence on user satisfaction. Thus, information technology managers and administrators should pay much more attention to promoting a system's ease of use, navigation, user friendliness and functionality of the SNSs to increase user satisfaction. In addition, they need to be concerned with willingness, speed, access and knowledge when providing service regarding SNSs to increase user satisfaction. (4) It was found that the relationships between system quality and SNSs use, and between service quality and SNSs use are not statistically significant. These results are not unusual since there are other studies that found no statistically significant relationship between system quality and SNSs use [28, 55, 70, 71], and service quality and SNSs use [55]. Such results revealed the weaknesses of the updated IS success model [19] since our results showed the presence of a high degree of validity of the quantitative analysis. (5) User satisfaction, with regards to experience, efficiency and effectiveness of using SNSs, significantly contributed to the continuance usage. (6) In our model, SNSs use and user satisfaction were found to have a direct effect on net benefits, indicating the importance of system use and user satisfaction in promoting student-perceived net benefits of SNSs. (7) Looking at the socio-demographic variables that are related to SNSs use, the results demonstrate that gender has a limited impact and funding option a significant influence on the decision to use SNSs during the pre-enrollment process. Slight differences were found with females preferring to use SNSs to retrieve information in the pre-enrollment phase. This result is in line with previous research that also found a positive influence of gender on the use of information systems [11, 12] and especially the use of SNSs [14]. This finding is also consistent with more general studies on Facebook or Twitter usage showing that females spend more time on Facebook and have more Facebook friends [18]. On the

contrary, funding option is a more influential variable. From this point of view, one can draw the conclusion that the funding option is a discriminating factor to predict the use of SNSs. Therefore, it is worth observing that the engineering students with financial aid use SNSs less than self-funding students. Thus, marketing managers need to be aware that potential female students and self-funding students tend to use SNSs (i.e., Facebook, Instagram, Twitter) more than male students and students with government scholarships.

Our empirical results provide several theoretical and practical contributions in SNSs effectiveness and socio-demographic conditions. From a theoretical perspective, this study empirically validated the DeLone and McLean's IS success model [19] and revealed its weaknesses. The revalidated model could successfully explain the success of SNSs from the standpoint of e-business. While the D&M model has been widely used in studying information system applications, it appears that the model can also apply to online services (i.e., university SNSs) but in a modified way. In addition, this study successfully revealed the weakness of the updated model by extending the original model with socio-demographic conditions. Therefore, the proposed model might be used as an alternative theoretical model for evaluating e-business success initiatives in future studies.

From practitioners' perspective, the findings of socio-demographic conditions, related to the use of SNSs, provide managers/designers with an insight that they should carefully re-examine engineering students' socio-demographic characteristics when they develop or update their SNSs. Our model underscored the importance of information, system and service quality, SNSs use and user satisfaction as a driving force in obtaining benefits for engineering students such as time saving and improved interaction with faculty staff and prospective students. In practice, university managers need to measure the quality of marketing operations to assess the productivity and efficiency of their SNSs. This needs to be done annually [72]. More than 50 percent of online teens, and more than 80 percent of college students, use SNSs for their academic as well as their everyday-life information-seeking purposes [25]. Using our instrument, managers could assess the overall strength, as well as the effectiveness of their SNSs. Such information allows decision makers to carry out corrective actions to increase the effectiveness of e-business strategy regarding SNSs, develop strategies to address problems, provide better service for students to attract more prospective students. We are hopeful that our research findings can benefit developers to be more effective by ensuring that the SNSs strategy contributes to a positive attitude of the SNSs audience.

Our study is one of the first to provide empirical evidence regarding the influence of socio-demographic conditions on the updated D&M IS success model of SNSs. An additional set of determinants representing socio-demographic characteristics of engineering students is included in the structural model as control variables. It has been shown that gender and funding options do confound the D&M research model.

6. Conclusion

This research paper examined the IS success of the university SNSs on the individual level of analysis from the engineering students' perspective. A field survey was conducted at the University of Novi Sad, Serbia to test the model. The empirical results verified the validity of the D&M success model in the context of SNSs and revealed the weaknesses of the updated model. Our analysis showed that all three quality dimensions (i.e., information quality, system quality, service quality) had a positive impact on user satisfaction, and that only information quality had a significant effect on SNSs use. User satisfaction had positive and direct effects on SNSs use. Both SNSs use and user satisfaction are significant in predicting net benefits.

Other than socio-demographic conditions included in this study, there could also be other factors influencing usage. Further research considering different factors (e.g., social interaction, behavioral expectation) could enhance an understanding of success determinants for SNSs. The data that were used in this study were collected in only one country, Serbia, and the narrow data focus may limit the generalization of the results. Future research may replicate this study from a global perspective.

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Appendix. Questionnaire items used in this study

Information quality

IQ1: The university social networking sites provide comprehensive information.
IQ2: The university social networking sites provide useful information.
IQ3: The university social networking sites provide up-to-date information.

System quality

SQ1: The university social networking sites are easy to use.
SQ2: In general, it is easy to navigate the university social networking sites.
SQ3: The university social networking sites are user-friendly.
SQ4: The university social networking sites are always up-and-running as necessary.

Service quality

SV1: The responsible university personnel are willing to provide service over SNSs.
SV2: The responsible university personnel are fast in providing service over SNSs.
SV3: The responsible university personnel always provide service over SNSs.
SV4: The responsible university personnel are always available to provide service over SNSs.
SV5: The responsible university personnel are competent to provide service over SNSs.

SNSs use

U1: The frequency of use with the university social networking sites is high.
U2: The duration of use with the university social networking sites is high.
U3: You used the university social networking sites to retrieve information.

User satisfaction

US1: You are satisfied with your experience of using the university social networking sites.
US2: The university social networking sites are efficient and effective.
US3: Overall, you are satisfied with the university social networking sites.

Net benefits

US1: The university social networking sites saved my time.
US2: The university social networking sites improved interaction with faculty staff.
US3: The university social networking sites improved interaction with other students.

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