Assessing the Success of the University Information System: A User Multi-group Perspective

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Abstract. The purpose of the paper is to identify the key success factors that determine the perception of university information system based on latent dimensions of DeLone and McLean IS Success Models. These dimensions were identified on the basis of empirical data gathered on a sample of 759 university students and staff members. Two-group structural equation sub-models are constructed in the analysis of the measurement equivalence and estimation of two types of models: IS Success Model and Updated IS Success Model with feedback loop. The results show that parameters of IS Success Model differ significantly across groups, indicating the system quality for students, and information quality for staff members, as key factors shaping the satisfaction and individual and organizational impact of university information system. It is also noticeable that it was not possible to estimate sub-models of Updated IS Success Model due to unacceptable values of the stability index.

Keywords: University information system · IS success models · Multigroup SEM

1 Introduction

Computerized information systems (IT/IS) are the subject of many research approaches aiming at assessing the perceived quality, functionality and satisfaction of their users. Apart from its wide business use, IT/IS applications are increasingly used and are important for the functioning of universities and higher education institutions. These include socio-technical systems supporting the learning process, course management systems and its integrated forms like integrated university information systems.

The analysis of perceived effectiveness and success is most often based on attitude-behavior (A-B) models, used to assess the relationship between cognitive and affective dimensions of attitudes and behavior intentions or actual use of the system. These types of models include Theory of Reasoned Action (TRA) [1, 14] and Theory of Planned Behavior (TPB) [2, 3], which serve as the basis for many other behavioral models that were applied in the IT/IS domain. The best-known models are (among others) Technology Acceptance Model (TAM) [10, 11], The Unified Theory of Acceptance and Use of Technology (UTAUT) [32], DeLone and McLean IS Success Model [12] and DeLone and McLean Updated IS Success Model [13].

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The aim of the paper is to assess the individual and organizational impact of University Study-Oriented System (USOS) system, resulting from the behavioral models of DeLone and McLean IS Success Model and Updated DeLone and McLean IS Success Model. These models were used to elaborate the relationship between individual and organizational effects and the perceived quality of the USOS system, perceived quality of information in the system, satisfaction and intentions of using the system. Taking into account that the system is used by different users, who have different expectations as to the system functionality, we took a multi-group perspective, in which the evaluation of the relationship between variables in the model is formed by students and staff group (lecturers and administrative staff supporting the education process).

The authors believe that such a comprehensive study of the functioning of the USOS system does not exist in the literature. There are numerous studies that compare DeLone and McLean IS success models conceptually, including DeLone and McLean paper, introducing the updated model [13]. There is, however, noticeable that the studies comparing empirically these models on the same data sample are at least scarce. The authors have had undertaken an excessive literature search[1] and according to the best knowledge, such studies do not exist at all in the university information systems context, which indicates research gap for our research.

In order to answer the research problem, several research questions have been developed:

- RQ1: What is the relationship between system quality and information quality with system use and user satisfaction?
- RQ2: What are the key determinants of individual and organizational impact of the system?
- RQ3: What are the mediation effects of system use and satisfaction?
- RQ4: What is the strength and direction of relationship between factors within particular groups (students and staff)?

Due to the exploratory nature of the research and the lack of existing research results in this regard, no research hypotheses were made, but two propositions were formulated for further testing:

- Satisfaction with the system and use significantly explain (mediate) the relationship between the perceived quality and individual and organizational effects.
- In the group of students there is a stronger relationship between system quality and satisfaction, while in staff group there is a stronger influence of information quality on satisfaction with the use of the USOS system.

The models were estimated using multi-group structural equation model (SEM) with assessment of measurement equivalence across groups. In order to grasp differences between IS success models two types of two-group models were developed. The first

[1] The literature query including keywords “DeLone”, “McLean”, “university” and “comparison” or “comparing”, introduced to abstracts of the publications contained in the databases EBSCOhost, Emerald, ScienceDirect, Scopus and Web of Science did not return relevant papers (i.e. comparing both models empirically on the same data sample).

model was recursive DeLone and McLean IS Success Model with individual and organizational impact as the focal dependent variables. The second model was non-recursive (with feedback loop) Updated DeLone and McLean IS Success Model with Net Benefits as a focal dependent variable. The data was gathered through the sample of students and staff at Cracow University of Economics.

2 University Study-Oriented System

Educational institutions, such as universities deal with large volume of information in their organizational processes. The processing of this information is supported by massive automation and computerization of daily tasks. However, there is no universal solution that is commonly used as each university will choose its individual information system implementation. Universities use various classes and types of computerized tools devoted to performing specific tasks. They build heterogenous systems [15, 33] including student and course management system, library and distance learning system to mention the most popular. There are, however, attempts to put together many functions and implement an integrated solution covering various university activities. Integrated solutions are most commonly referenced as University Information Systems [5, 18, 23], Campus Information Systems [7, 27, 28] or Campus-Wide Information Systems [26].

The presented research relates to an integrated university information system implemented at Cracow University of Economics, Krakow, Poland. The University Study-Oriented System (USOS) is an integrated standard software for managing and operating processes related to the study of all levels and forms at the Polish universities (bachelor, master, postgraduate and doctoral studies). The system was launched in 2000 at the University of Warsaw as the result of cooperation between the largest Polish universities. The system is owned by MUCI (Interuniversity Information Center) – a consortium of Polish universities established in 2001. USOS is a non-profit undertaking implemented "by universities for universities." System developers are also its users. Consequently, people deploying the system have the necessary knowledge about processes and procedures in Polish universities. In addition, the universities that have implemented USOS cooperate with each other and provide mutual support – not only in IT/IS dimension, but also in matters related to higher education in general. The last remark is also associated with real influence on the decisions of the Ministry of Science and Higher Education.

The system includes a number of modules that handle various activities such as [8]: recruitment and enrolment, study schedule planning, handling student requests, student thesis archive and management, scholarships, tuition online payment service, and many others. The software is created in Oracle Forms and Java and consists mainly of Web-based applications. In order to integrate with other university systems, developers can also use USOS API, which allows developers to access the central database. Additionally, USOS exchange the data with various external systems (e.g. banking or public administration) enabling, i.a. [20]: managing international exchange (including in the Erasmus Without Paper and NAWA (National Agency for Academic Exchange programs)), export and import of money transfers to banking systems, internal reporting and reporting to the Central Statistical Office (CSO), sending data to The Integrated System of Information on Science and Higher Education POL-on as well as downloading results of high school final exams from the National Register of Matura (KReM). USOS is currently used in 37% of public universities (48 out of 130 all Polish public universities) and is interacted by 57% of all public university students (512 thousand out of 901 thousand) [9].

3 DeLone and McLean IS Success Model

The concept of information system success (IS success) is one of the most vital ideas, ever-present in the IT/IS literature. Its uniqueness comes from the fact that IS success is a complex phenomenon and includes various interrelated factors. It is impossible to judge on IS success purely in monetary categories as other non-material factors are equally important.

The most comprehensive multi-level information success model was for the first time presented by DeLone and McLean [12]. The authors have analyzed 180 papers on IS success published in IT/IS literature and identified six major interdependent success constructs (Fig. 1). They include [12, pp. 64, 66, 68, 69, 74]: System Quality (measure of information processing system itself), Information Quality (measure of information system output), Use (recipient consumption of the output of the information system), User Satisfaction (recipient response to the use of the output of an information system), Individual Impact (the effect of information on the behavior of the recipient) and Organizational Impact (the effect of information on organizational performance). The proposed model is considered to be a process construct including both, temporal and causal effects determining the overall IS success. System Quality and Information Quality jointly influence Use and User Behavior, which are mutually interdependent and together shape Individual Impact. Individual Impact, finely, determine Organizational Impact which is the focal outcome variable of the model.

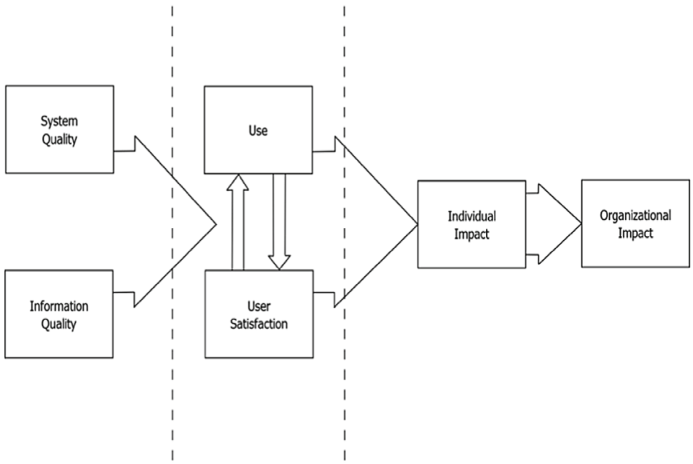

Fig. 1. IS Success Model. Source: [12, p. 87]

Ten years later after DeLone and McLean published their first paper, they published the second paper in which they modified the IS success original model [13] (Fig. 2). This modification was an answer to ongoing discussion present in the IT/IS literature concerning the model improvement.

The modification included several improvements. First, it was adding a new construct – Service Quality in order to measure the quality of the IT/IS service staff. This construct was inspired by a concept of SERVQUAL originating from marketing. Second, they divided original Use construct into two: Intention to Use and Use forming them into one construct. Third, two original constructs: Individual Impact and Organizational Impact were combined into one – Net Benefits, being a focal dependent variable of the model. Fourth, the model introduces the feedback loop connecting Net Benefits as the variable influencing Intention to Use and User satisfaction simultaneously.

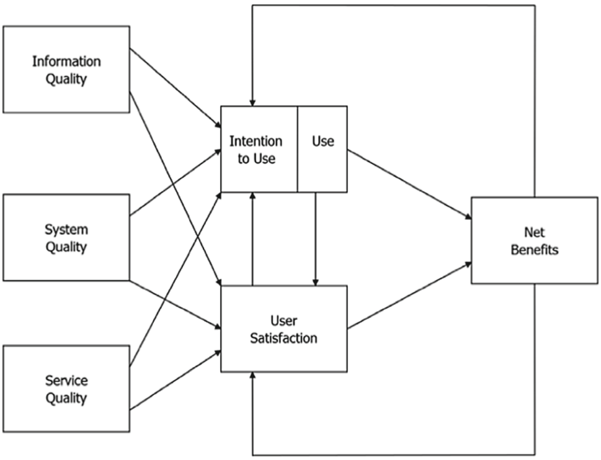

Fig. 2. Updated IS Success Model. Source: [13, p. 24]

Service Quality constitutes the third exogenous variable, together with the two already known from the previous model System Quality and Information Quality variables. They jointly influence User Satisfaction and Intention to Use/Use. User satisfaction strengthen or weakens Intention to Use while Use impact User satisfaction. Intention to Use is linked with exogenous variables (and endogenous User Satisfaction) while Use impacts User Satisfaction and the focal dependent variable – Net Benefits. Finally, Net Benefits influence Intention to Use and User Satisfaction. The original paper on IS success [12], belongs to the most highly cited papers of IT/IS community [30]. The IS success model is still a concept under study and builds the cumulative research tradition of IT/IS discipline [24, 31].

DeLone and McLean IS success model in both the original and modified versions was frequently verified and tested in various scenarios of different information systems implementations. Specific research includes knowledge management [29], information systems implemented in small and medium-sized enterprises (SMEs) [19], electronic brokerage systems in China [6], hospital information systems in a developing country [22], banking sector in Saudi Arabia [16] to mention some examples. The model has also been successfully used in the university information systems context in the developed [17, 25] and developing countries [21, 34].

4 Data and Scales Reliability

The survey was conducted at the Cracow University of Economics on January 16–31, 2020 (the original deadline for the survey availability January 16–24, was extended to January 31). The research frame has included total population of university system users. As the entire population of university employees and students was available, the questionnaires were sent to the entire population of system users (no random selection was made among system users). Technically, a link to the online survey form was sent by email to 10617 system users. Of these, 1279 people (12%) were university employees. Two callbacks (remainder contacts) were use to maximize the response rate. Finally, the survey was completed by 759 people (7.1%) including 643 students, 115 staff and 1 unidentified respondent. It is hard to evaluate whether the sample selected is biased to non-response error, but distribution of the sample approximates the structure of total population. The structure of sample is given in Table 1.

All survey questions were adjusted to USOS specifics and measured on 7-point Likert scale.

As conceptual models take into account latent variables and constitute the system of path relationships between constructs, the empirical estimation and evaluation of the two conceptual models, has involved structural equation modelling with latent variables (SEM). It allowed for a more complete evaluation of the model fit, assessment of measurement equivalence in multi-group analysis, evaluation of the reliability of scales based on the confirmatory factor analysis model, estimation of path coefficients and testing the mediation effects between constructs. Below are the measurement characteristics of the analysed constructs

System Quality construct was measured by 5 items: 1/ “The system is well adapted to my needs” (mean = 3.65, std. dev. = 1.66, alpha if deleted = 0.84, item-total correlation = 0.79), 2/ “The system is generally easy to use” (mean = 3.74, std. dev. = 1.82, alpha if deleted = 0.85, item-total correlation = 0.78), 3/ “The system has all the important functions” (mean = 3.70, std. dev. = 1.66, alpha if deleted = 0.87, item-total correlation = 0.67), 4/“The system is reliable” (mean = 2.93, std. dev. = 1.66, alpha if deleted = 0.89, item-total correlation = 0.60), 5/“It is easy to adapt to the specificity of the system” (mean = 3.69, std. dev. = 1.83, alpha if deleted = 0.85, item-total correlation = 0.77). The Cronbach’s alpha = 0,885, rho reliability coefficient = 0.889, greatest lower bound reliability = 0.920, Bentler’s dimension-free lower bound reliability = 0.920 and Shapiro’s lower bound reliability for a weighted composite = 0.933. The optimal short scale consists of item 1, item 2, item 3 and item 5.

Information Quality construct was measured by 5 items: 1/ “The information in the system is complete” (mean = 3.48, std. dev. = 1.75, alpha if deleted = 0.83, item-total correlation = 0.75), 2/ “The information in the system is timely” (mean = 3.98, std. dev. = 1.72, alpha if deleted = 0.83, item-total correlation = 0.75), 3/ “The

Table 1. The structure of sample

Age	Below 20	21–30	31–40	41–50	51–60	61–70	Above 70
	17%	66%	4%	8%	3%	1%	1%
Gender	**Females**	**Males**					
	67%	33%					
Study type	**Regular students**	**Part time students**	**(Staff)**				
	52%	34%	(14%)				
Study level	**Under-graduate**	**Graduate**	**Doctoral**	**Unified master**	**(Staff)**		
	46%	37%	1%	2%	(14%)		
Study year	**1st year**	**2nd year**	**3rd year**	**4th year**	**5th year**	**(Staff)**	
	36%	34%	1%	4%	10%	(14%)	
Position	**Students**	**Administra-tive staff**	**Professors**	**Adjuncts**	**Lecturers**	**Others**	
	86%	3%	3%	4%	3%	1%	
Education	**Primary**	**Secondary**	**Higher**				
	2%	46%	52%				

information in the system is tailored to my personal needs" (mean = 3.62, std. dev. = 1.64, alpha if deleted = 0.81, item-total correlation = 0.81), 4/ "The information contained in the system is clear to me" (mean = 4.13, std. dev. = 1.72, alpha if deleted = 0.85, item-total correlation = 0.65), 5/ "The information in the system is securely stored" (mean = 4.59, std. dev. = 1.44, alpha if deleted = 0.88, item-total correlation = 0.52). The Cronbach's alpha = 0.871, rho reliability coefficient = 0.880, greatest lower bound reliability = 0.906, Bentler's dimension-free lower bound reliability = 0.906 and Shapiro's lower bound reliability for a weighted composite = 0.923. The optimal short scale consists of item 1, item 2 and item 3.

System Use construct was measured by 5 items: 1/ "I use the system almost every day" (mean = 2.66, std. dev. = 1.70, alpha if deleted = 0.61, item-total correlation = 0.52), 2/ "I use the system at all times regardless of the time of day" (mean = 3.83, std. dev. = 2.16, alpha if deleted = 0.61, item-total correlation = 0.51), 3/ "Navigation on the system's web pages is easy" (mean = 3.63, std. dev. = 1.78, alpha if deleted = 0.61, item-total correlation = 0.51), 4/ "I feel even addicted to the system" (mean = 1.56, std. dev. = 1.25, alpha if deleted = 0.68, item-total correlation = 0.35), 5/ "The system can be used on many devices (computer, tablet, smartphone)" (mean = 4.86, std. dev. = 1.73, alpha if deleted = 0.68, item-total correlation = 0.35). The Cronbach's alpha = 0,690, rho reliability coefficient = 0.704, greatest lower bound reliability = 0.766, Bentler's dimension-free lower bound reliability = 0.766 and Shapiro's lower bound reliability for a weighted composite = 0.775. All of 5 items are included in optimal scale (item 1 - item 5).

User Satisfaction construct was measured by 4 items: 1/ "I intend to constantly use the system" (mean = 3.62, std. dev. = 1.78, alpha if deleted = 0.86, item-total correlation = 0.72), 2/ "Generally, the system is worth recommending to anyone who has a relationship with the University" (mean = 3.54, std. dev. = 1.89, alpha if deleted = 0.82, item-total correlation = 0.81), 3/ "I feel satisfied that the system is implemented at my University" (mean = 3.78, std. dev. = 1.93, alpha if deleted = 0.81, item-total correlation = 0.84), 4/ "If the system stopped working it would be discomfort for me" (mean = 3.90, std. dev. = 1.97, alpha if deleted = 0.90, item-total correlation = 0.62). The Cronbach's alpha = 0,882, rho reliability coefficient = 0.887, greatest lower bound reliability = 0.908, Bentler's dimension-free lower bound reliability = 0.908 and Shapiro's lower bound reliability for a weighted composite = 0.931. The optimal short scale consists of item 2 and item 3.

Individual Impact was measured by 5 items: 1/ "The system increases the quality of my work/study" (mean = 3.04, std. dev. = 1.75, alpha if deleted = 0.89, item-total correlation = 0.81), 2/ "I achieve better results (work/learning) thanks to the system" (mean = 2.31, std. dev. = 1.47, alpha if deleted = 0.90, item-total correlation = 0.76), 3/ "The system allows more efficient decision making in my work/study" (mean = 2.91, std. dev. = 1.74, alpha if deleted = 0.89, item-total correlation = 0.84), 4/ "Thanks to the system, I achieve my goals related to work/studying faster" (mean = 2.72, std. dev. = 1.67, alpha if deleted = 0.88, item-total correlation = 0.87), 5/ "I save time by using the system" (mean = 3.82, std. dev. = 2.06, alpha if deleted = 0.92, item-total correlation = 0.69). The Cronbach's alpha = 0,916, rho reliability coefficient = 0.918, greatest lower bound reliability = 0.940, Bentler's dimension-free lower bound reliability = 0.940 and Shapiro's lower bound reliability for a weighted composite = 0.947. The optimal short scale consists of item 1, item 2 item 3 and item 4.

Organizational Impact was measured by 5 items: 1/ "The system reduces the operating costs of the University" (mean = 4.02, std. dev. = 1.54, alpha if deleted = 0.81, item-total correlation = 0.73), 2/ "The system allows attracting new students to the University" (mean = 3.23, std. dev. = 1.66, alpha if deleted = 0.84, item-total correlation = 0.63), 3/ "The system enables additional income for the University" (mean = 3.42, std. dev. = 1.40, alpha if deleted = 0.83, item-total correlation = 0.65), 4/ "The system shortens queues to the dean's office" (mean = 4.43, std. dev. = 1.92, alpha if deleted = 0.85, item-total correlation = 0.62), 5/ "The system reduces student service costs" (mean = 4.20, std. dev. = 1.62, alpha if deleted = 0.81, item-total correlation = 0.75). The Cronbach's alpha = 0,858, rho reliability coefficient = 0.861, greatest lower bound reliability = 0.902, Bentler's dimension-free lower bound reliability = 0.902 and Shapiro's lower bound reliability for a weighted composite = 0.916. All of 5 items are included in optimal scale (item 1 - item 5).

Service Quality construct was removed from the final scale because the USOS system does not enable the direct contact of end users (students and staff) with service providers (staff in IT department). Therefore, the items concerning service quality, credibility, empathy of service providers and reactivity are not valid in this case.

5 Comparison of USOS Success Models

5.1 Measurement Equivalence of Constructs

In multi-group analysis, the comparison of latent variables means, and variances requires the valid assumption of measurement equivalence. There are three levels of measurement equivalence – configural (congeneric), metric and scalar. In configural equivalence, constructs (latent factors) should be characterized by the same pattern of loadings across groups. In metric (weak) equivalence, each item should have the same factor loadings across groups (the contribution of items to the latent construct is the same). In scalar (strong) equivalence, the item intercepts should be equivalent in the groups.

Table 2. Tests of measurement invariance; Source: own based on Mplus 8.1

	Chi_Square, df, P-level	CFI, TLI	RMSEA
Configural model	1566.59, 388, 0.00	0.898, 0.871	0.090 (0.085-0.094)
Metric model	1591.35, 404, 0.00	0.888, 0.872	0.088 (0.084-0.093)
Scalar model	1728.40, 420, 0.00	0.876, 0.864	0.091 (0.086-0.095)
Metric vs. Configural	20.26, 16, 0.218	–	–
Scalar vs. Configural	165.11, 32, 0.000	–	–
Scalar vs. Metric	143.99, 16, 0.000	–	–

Additionally, the residual (strict) equivalence assumes the equality of residuals across groups. The two-group (students vs. staff) confirmatory factor analysis of IS success sub-models with invariance testing is given in Table 2.

The CFA model's goodness-of-fit is not so good. The Chi-Square test is significant (that means the rejection of exact fit). Comparative fit index (CFI) and Tucker-Lewis Index (TLI) seem to be too low and below the acceptance thresholds of 0.9. The Root Mean Square Error of Approximation (RMSEA) is near the level of approximate fit (0.08). The measurement invariance comparison indicates that the weak equivalence hypothesis is supported. The metric model is insignificantly worse than the configural one ($p > 0.05$). Comparison of scalar vs. metric enables to reject the hypothesis concerning strong measurement equivalence. Because metric equivalence is established, therefore it is possible to compare the structural sub-models across groups.

5.2 Comparison of Multi-group Models

Two empirical models (two sub-models for each model) were developed: IS Success Model and Updated IS Success Model. Having reliable and equivalent latent variable indicators, only structural parts of these models are presented and developed. IS Success Model, as is given in Fig. 1, has involved six constructs: System Quality (qual), Information Quality (qualinf), System Use (use), User Satisfaction (sat), Individual Impact (indimp) and Organizational Impact (orgimp). The structure of the sub-models, path coefficients and their standard errors (in brackets) for student and staff groups are given in Figs. 3 and 4.

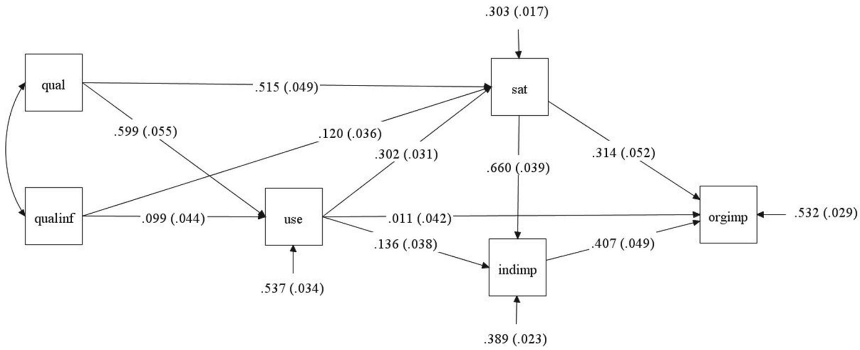

Fig. 3. Multi-group Structural IS Success Model – students group sub-model

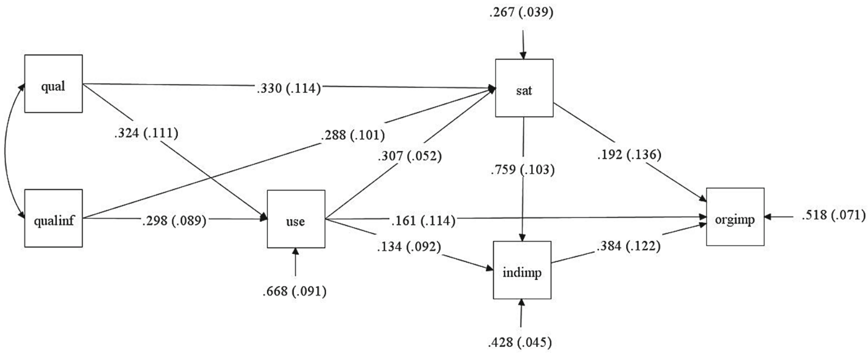

Fig. 4. Multi-group Structural IS Success Model – staff group sub-model

Chi-Square Test of Model Fit = 35.413, with 8° of freedom and p-level = 0.000. Scaling Correction Factor for MLR estimation method = 1.1570. Chi-Square contribution from student group is 22.017 and from staff group is 13.396. Comparative fit indices CFI/TLI are respectively 0.987 and 0.955. The RMSEA (Root Mean Square Error of Approximation) equals 0.095 (0.064–0.128). The SRMR (Standardized Root Mean Square Residual) equals 0.030.

Because of unequal group sizes, the standard error of the estimates was calculated using residual parametric Bollen-Stine bootstrap method with 500 bootstrap draws. In students' group, in comparison to staff group, there are relatively stronger relationships between System Quality and User Satisfaction (r = 0.515), System Quality and System Use (r = 0.599). The User Satisfaction has also a stronger relationship with Organizational Impact (r = 0.314).

In staff group, there is significant and stronger relationship between Information Quality and System Use (r = 0.298) and Information Quality and User Satisfaction (r = 0.288). System Use has also the significant and relatively strong relationship with Organizational Impact (r = 0.161).

The above results give the answers to RQ1 and RQ4.

5.3 Mediation Analysis

The path model contains several indirect paths and provides the answers to RQ2 and RQ3. Table 3 contains the significant parameters of total and specific indirect effects within the students' group.

Table 3. Mediation analysis of IS Success Model – student group

Effects from qual to orgimp			
	Estimate	Std. Err.	P-level
Total effect	0.446	0.032	0.000
qual-sat-orgimp specific indirect effect	0.162	0.030	0.000
qual-use-sat-orgimp specific indirect effect	0.057	0.012	0.000
qual-use-indimp-orgimp specific indirect effect	0.033	0.010	0.000
qual-sat-indimp-orgimp specific indirect effect	0.139	0.02	0.000
qual-use-sat-indimp-orgimp indirect effect	0.049	0.01	0.000
Effects from qualinf to orgimp			
	Estimate	Std. Err.	P-level
Total effect	0.094	0.026	0.000
qualinf-sat-orgimp specific indirect effect	0.038	0.014	0.009

The qual-orgimp and qualinf-orgimp total effects are significant for the students' group. The strongest specific indirect effect is related to qual-sat-orgimp and qual-sat-indimp-orgimp paths. Therefore, the User Satisfaction and Individual Impact significantly explain respectively the 36.3% and 31.2% of total effect in the relationship between Service Quality and Organizational Impact. On the other hand, the total effect for qualinf-orgimp is much weaker, but User Satisfaction explains the 40.4% of total effect between Information Quality and Organizational Impact.

Table 4 presents the significant parameters of total and specific indirect effects within the staff group.

Table 4. Mediation analysis of IS Success Model – staff group

Effects from qual to orgimp			
	Estimate	Std. Err.	P-level
Total effect	0.276	0.069	0.000
qual-sat-indimp-orgimp specific indirect effect	0.096	0.041	0.018
qual-use-sat-indimp-orgimp indirect effect	0.029	0.014	0.040
Effects from qualif to orgimp			
	Estimate	Std. Err.	P-level
Total effect	0.247	0.072	0.000
qualinf-sat-indimp-orgimp specific indirect effect	0.084	0.035	0.016

The qual-orgimp and qualinf-orgimp total effects are significant for the staff group. The strongest specific indirect effect is related to qual-sat-indimp-orgimp and qual-use-sat-indimp-orgimp paths. Therefore, the User Satisfaction/Individual Impact and System Use/User Satisfaction/Individual Impact significantly explains respectively the 34.8% and 10.51% of total effect in the relationship between Service Quality and Organizational Impact. The total effect for qualinf-orgimp is similar and User Satisfaction and Individual Impact explains the 34.0% of total effect between Information Quality and Organizational Impact among staff group.

The focal dependent variable of the Updated IS Success Model, as is given in Fig. 2, has direct feedback loop to User Satisfaction and System Use. The novelty of this model is to estimate parameters for non-recursive models. In order to solve simultaneous equation system with feedback loop, the stability indices were computed. The stability index is computed as the maximum modulus of the eigenvalues for the matrix of coefficients on endogenous variables predicting other endogenous variables. The results are stable if the eigenvalues of the coefficient matrix lie inside the unit circle [4]. However, the eigenvalue stability condition analysis of simultaneous equation systems showed that the stability index in the student group was equal to 6.601 and in the staff' group was equal to 5.192. Both sub-models (for students and staff groups) do not satisfy stability condition, therefore parameter estimations were unstable, and sub-models could not be estimated. For this reason, we were unable to evaluate the differences represented in both models. It should be, however, noted that it is unclear whether inability of Updated IS Success Model estimation was caused by the model itself or the character of our data. This opens the research direction which we are going to explore in the future.

6 Conclusions and Limitations

Original DeLone and McLean IS Success Model and Updated DeLone and McLean IS Success Model are very interesting theoretical frameworks for the measurement of components of IS perceptual effects of use. The Updated IS Success Model with feedback loop, although very interesting from a conceptual point of view, it was not correctly estimated in our study due to stability problems (stability index above 1). Service Quality was not used in the updated model because of specificity of the system, however, it would have no impact on instability of the model. As already stated, we want to explore this issue on the other data collections. We are going to examine what causes the model instability, the data or the model attributes (non-recursiveness).

Having the results of original USOS IS Success Model (both sub-models), we can conclude that among the students the system quality is the key factor that shapes students' satisfaction with USOS and USOS use, whereas among the staff members it is the information quality of USOS that has a crucial role for staff satisfaction and use of USOS (answers to RQ1 and RQ4). Students' satisfaction depends more on general characteristics of the system (adaptation, easiness of use, key features, system reliability). Among the staff members, user satisfaction is more related to informational content (completeness, timeliness, accuracy, understanding and information security). In both groups individual impact is significantly related to satisfaction and system use.

Finally, in the students' group, organizational impact is (in comparison to the staff group) more linked to satisfaction and individual impact. On the other hand, in the staff group organizational impact depends on system use (answer to RQ2).

The tested propositions were verified. Satisfaction with the system and use significantly explain (mediate) the relationship between the perceived system and information quality with individual and organizational effects (answer to RQ3). In the students' group there is a stronger relationship between system quality and satisfaction, while in the staff group, there is a stronger influence of information quality on satisfaction with the use of the USOS system.

The presented study has several limitations and we propose some suggestions for further research. Although, the USOS has relatively long tradition at universities, no excessive research was undertaken to assess the functionality and satisfaction with the system. Further development of domain-specific theories in the area of university information system are needed to be more grounded into empirical research and specifically SEM modelling. The sources of failure of non-recursive model estimation are not identified yet. It might be due to either one-university sample specificity, or specification error of theoretical model.

The proposed model was estimated on relatively large sample taken from only one university (Cracow University of Economics). Higher education system in Poland is very diverse (private and public universities of economics, general universities, polytechnics, etc.), therefore national complex sample is needed to ensure external validity of the model. Also, both student and staff samples need to be stratified due to possible heterogeneity of both populations. Students' needs and USOS use may be related to the enrolment status (full time vs. part time), experience in use (freshmen vs. graduates). Staff member should be divided at least into lecturers (scientists) and support staff (front-office and back-office). However, having in mind the level of standardization and comparability of USOS systems across universities, the results show some insightful and fruitful hints for identification of determinants of its individual and organizational impact.

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