

Acceptance of a new reporting platform for work experience reporting in an Engineering discipline

Abstract

Technology has become crucial to the success of learning design, and more so in the recent years. The success of technological solutions depends on its acceptance within the target community of users, which in most cases is the student community it is meant to serve; but when it succeeds, it can be a great enabler of learning. A department in a University decided to migrate from the paper based approach submission of students' vacation work report to electronic based submission. Adapting this technology platform to continue to meet student needs is important, and so, it is necessary to understand the students' perception of the new submission system. Students were requested to complete questionnaires related to their perception of the system relative to the traditional system in order to guide the future evolution. The basic Technology Acceptance Model (TAM) was used to elicit students' changeover experience. Results suggest that the changeover is acceptable to the students, and the basic TAM hypotheses postulated seem empirically supported. Moreover, it seems the category of students that have used the previous paper based submission appreciated the shift more than those that had little contact with the old system.

Keywords

TAM, LMS, vacation report, Structural Equation Modelling (SEM)

1. Introduction

The advent of the digital social media era and the related solutions has been transforming the learning environment. Technology has created opportunities for learning that enable the use of electronic platforms and tools in creating flexible and user-friendly learning environments that is well adapted to the students' diverse needs. Many learning institutions have also been migrating from the traditional mortar and brick and paper based learning solutions to electronic platforms.

Technology has been driving changes in education and also changing teaching styles and approaches. This is creating a shift from the traditional classroom style into a class space style, providing a lot more flexibility in how students consume information and how they expect study materials and teaching to be delivered. This has affected not only the didactics of teaching itself, but also how many other aspects of learning are planned and implemented.

Engineering students all over the world are mandated to acquire some industry related experience during the period of their training. The students are usually requested afterwards to submit different kinds of written reports and probably log-books detailing what was learnt during such industry exposure and how they have been able to apply the learnings they acquired in classes and during practicals before such industry training experience was undertaken. In the case department studied here, the students usually produce such reports in the form of long written essays and then submit hard copies of such.

In the last two years, the department decided to change the model of submission. One of the goals of the submission is to make all such reports project based such that students report along the lines of projects they were involved in during such industry learning experience as opposed to writing documents of their daily chores in the industry. This is to help to focus on learning as derived from such experience, which usually comes in the form of participation in group (or individual) projects. Another goal was to generate the report in such a way that is easy to collect learning meta-data that can be used to evaluate the process of industry learning and improve the classroom learning and preparation process. In addition, this should help to further structure the organisation of the modules presented to students in the engineering program and have a view of how often and where each of the techniques learnt in the modules are applied in the industry. Hence, effort was made to standardise the report such that a portion is completed through an online form posted via google document, while a short descriptive report is further submitted online. It is anticipated that such migration might create some temporary discomfort among the students who have to

learn a new way of documenting and submitting their reports, but it is believed that the benefit of the new submission system should outweigh this inconvenience.

After the new platform has been implemented, it was decided to check the level of acceptance of the new platform among the students. In order to achieve this, the students were requested to complete questionnaires detailing their opinion of the new submission system relative to the traditional system. The questionnaire was made of two main parts. The first part was based a general qualitative section where the respondent biodata and the general opinion of the new platform was obtained. The second section is based on the most basic Technology Acceptance Model (TAM). This model, in its basic form, assumes that two main factors are related to the level of acceptance of a new technology: the perceived usefulness of the technology; the perceived ease of use of the technology being introduced. Both affect the behavioral intention to use, which might eventually lead to the use of the technology. In this study, measurement scales were adapted from some published TAM models and used to study how this popular model possibly explains the attitude of the students towards the new platform deployed for the management of their vacation work report administration.

The general structure of this paper is as follows: the context of the research was presented in the first section. This is followed by a brief review of literature around the TAM in general and its use in understanding acceptance of learning platforms in particular. The third section discusses the how the measurement scale was developed and how the structural model was analysed. This was then followed by the final section, which contains findings from the study and how the work may be advanced in the future.

2. Literature Review

Technology acceptance model (TAM) is a popular model that has been credited to Davis (1989) and was said to be an extension of Ajzen and Fishbein's (1980) theory of Reasoned Action (TRA). Davis' (1989) TAM was developed to predict user acceptance of computer systems. The basic model develops and validates measurement scales for two latent variables: perceived usefulness and perceived ease of use, which were hypothesized to be fundamental determinants of user acceptance. This model has been modified and applied by researchers in diverse areas where the acceptance of other types of technology solutions like banking solutions, medical solutions, e-commerce solutions, internet of things, supply chain solutions, and a host of others.

One area where technology solutions seem to be continuously deployed rapidly today is in the development of learning solutions. It is not surprising; therefore, that many authors have adopted the use of TAM to measure the level of adoption of educational technology in many different contexts. The different transitional contexts of the acceptance of educational technology would be the focus of this review.

Ekuaase-Anwasedo, Noguera and Dumas (2017) studied student experience of transition from Blackboard to Moodle during a natural disaster. Extended TAM was used to assess the level of reception of the new technology platform by students in the presence of environmental difficulties. External variables included in the study include the effects of Post Traumatic Stress Disorder (PTSD), depression and anxiety, being external variables believed to influence both the perceived usefulness and perceived ease of use factors of the TAM model. They opined that these external variables have the capability to cause cognitive dysfunction and impair learning and decision-making. They proposed further hypotheses to be tested in some future models.

Cheng and Yuen (2018) conducted a longitudinal study of the intention of students to continue to use a Learning Management System (LMS) in a primary school. They used a two stage model: TAM and expectation-confirmation model. A total of 1182 learners from 25 schools were involved, and Structural Equation Modelling (SEM) was used for analysis. They concluded that while perceived ease of use is not a main factor at the initial stage of use, it becomes an important one as usage progresses. They formulated a set of eight hypotheses that were tested with SEM using five performance metrics. The study was conducted in three stages: before the introduction, three months after the introduction and 6 months after the introduction. They concluded that getting students to form positive beliefs related to perceived usefulness and perceived ease of use of an LMS is critical in ensuring the continuance use of LMSs in secondary schools.

Song and Kong (2017) investigated student acceptance of a statistical learning platform with blended learning facilities. They used mixed research method with 102 participants involved in the study. The research provided insight into further customisation of the learning platform for improved acceptance and the development of necessary analytics that could provide relevant insight into the use and importance of diverse components of the LMS. They proposed 11 hypotheses that were tested using SEM. They concluded that the design of the relevant digital resources integrated with the associated support is vital in the development of the learning solutions.

Abdullah and Toycan (2018) used a two-step approach to study, first the technology readiness of learners for their learning platform and then secondly, the level of acceptance of the platform in a developing economy. They used a

hypothesised TAM model with convenience sampling during which 516 students participated in the first phase and 256 participated in the second. SEM was used to test the factor relationship. The readiness factors considered include technological, human resource, content, educational, leadership and cultural. For the second stage, the basic TAM model including perceived usefulness, perceived ease of use, attitude towards use and behavioural intent to use were considered. For the first part, they found that all items have strong correlation with e-learning implementation. Five hypotheses were formulated for the TAM model and were tested, and all the hypotheses seem supported by the data collected.

Stockless (2017) studied the adoption of LMS in K-12 schools amongst the teachers. The objectives were to identify the factors that influence the acceptability of the LMS by teachers, to see if teachers' ICT use influences their intention to use the LMS; and finally, and to understand whether teachers' ICT use influences their perception of the affordances of LMS educational features. He justified the study based on previous findings that teachers have significant challenges integrating ICT into their curriculum. This was attributed to lack of continuous training for teachers, not considering ICT inclusion to be of value, and lack of pedagogical models of ICT inclusion. The research approach was Design-By-Research and TAM model was used in testing the necessary hypotheses. Two external variables, ICT use and affordability, were added to the TAM model and eleven hypotheses were formulated, following which SPSS and SAS were used respectively for the descriptive and path analyses of the data collected. They also used Principal Component Analysis (PCA) and Principal Axis Factoring (PAF) to reduce the number of factors identified, and they were able to recover the same principal factors as TAM. They found that usefulness dimension is a good predictor of the attitude towards use and the intention to use the technological tool, while ease of use seemed not to be much of a concern. The external factors were found not to be too much of a concern in determining the intention to use the system.

Ifinedo, Pyke and Anwar (2018) studied how the effects of the moderating variable of external support affect the student's perception of usefulness and usability of the Moodle as a learning platform. They did a cross-sectional survey and collected data from 126 undergraduate students. They separated formative constructs from reflective constructs of study and proposed four hypotheses to test based on a modified TAM. They concluded that practitioners need to pay more attention to student's intrinsic factors as these have implications in the acceptability of the LMS as well as the learning process.

Nagy (2018) studied factors that drive the acceptance of video learning technology in the Moodle learning environment. She used a modified TAM model with the inclusion of an additional factor: internet self-efficacy. She formulated 13 hypotheses and showed how different factors influence adoption of the technology and the learning outcome either directly or through some mediating effects. It was concluded that Perceived usefulness and attitude exert the strongest influence on video usage, whereas perceived ease of use has little effect.

Bazelais, Doleck and Lemay (2018) studied the acceptance of an online learning technology platform among students at a pre-university science college. They used a modified TAM and suggested how the technology could be adapted for further development to enhance learning and motivate acceptance and usage. They concluded that both perceived usefulness and perceived ease of use have influence on the students' intention to use the technology.

A good summary of various studies on the acceptance of LMS in Sub-Saharan context with classification of papers based on diverse logics and techniques is Bervell and Umar (2017). They surveyed diverse databases and used various classification schemes.

2.1 Hypotheses

The relative influence of the various factors of the TAM has been well documented in literature. The following hypotheses were formulated

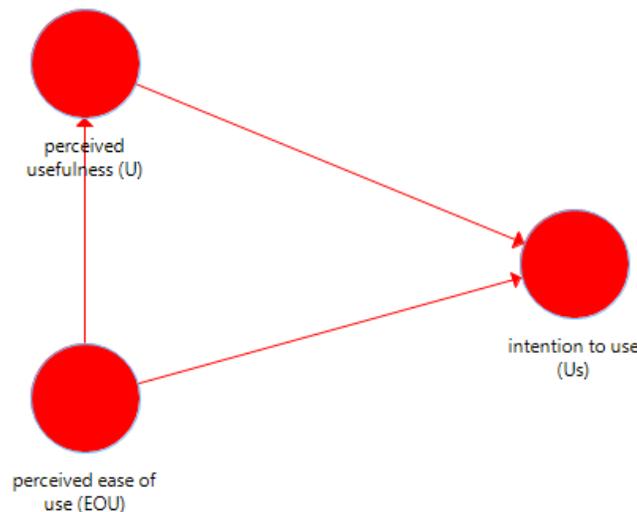


Figure 1: Proposed structural model

As proposed by Davis (1989), many other studies seem to have supported the hypothesis that the user's perceived ease of use of technology usually influences their perceived usefulness of the technology. Stockless (2018), for instance, confirms the same, and proposes that perceived usefulness seems directly influenced by the perceived ease of use amongst the users. This is the first hypothesis to be tested in this study and is stated therefore as:

H₁: Perceived ease of use directly influences perceived usefulness

Many authors seem to have confirmed that perceived ease of use influences the intention to use the technology itself (Abdullan and Toycan, 2018; Song and Kong, 2017). This leads to the second hypothesis that the students' perception of ease of use of the submission system will influence their intention to use it.

H₂: Perceived ease of use directly influences intention to use

It is also believed that the feeling that the technology is useful for the work to be done tends to motivate the users to want to use the technology. This has been supported by a number of authors (Abdullay and Toycan, 2018; Stockless, 2018; Ifinedo, Pyke and Anwar, 2018). This leads to the third hypothesis that:

H₃: Perceived usefulness directly influences intention to use

3. Methodology

It can be observed that TAM seems the standard model for most authors analysing the acceptance of technologies, and the SEM is the most common technique employed. This is not random because of the power of SEM in testing multiple hypotheses simultaneously. The basic Technology Acceptance Model (TAM) has three main constructs: perceived usefulness, perceived ease of use and intention to use. All models of TAM have been built around these three main constructs and their modifications and/or extensions.

3.1 Data Collection

For the purpose of this study, the three main constructs were operationalised. The questionnaire was made of two sections. The first section contains the demographic information of the respondents and other qualitative questions that could be used to triangulate the items in section 2 and well as other categorical variables that can be used to interpret the context of the respondents. The original questionnaire is shown in the appendix.

In the second section of the questionnaire, measurement items for the structural model were adapted from of Stockless (2017), Ifinedo, Pyke and Anwal (2018), Song and Kong (2017), Abu-Danbou (2013) and Gefen and Straub (2000). A seven point Likert scale was used with 1 corresponding to strongly disagree and 7 corresponding to strongly agree to measure perceived usefulness, perceived ease of use and behavioural intention to use the new submission system. The questionnaires were taken to classes for students to respond. A total of 62 valid responses

were received. The responses were then analysed. The main concern is the limited number of response received, but since the model was identified, we progressed with the analysis.

3.2 System features ranking

In the qualitative section, the students were asked to rate five characteristics of the submission systems in the order of their preference, with 1 being the most liked characteristic and 5 the least liked characteristic. The summary average ranking of the five characteristics and the relative importance of each is shown in Table 1 indicating that the most liked feature is the ability to save work and continue later on the system is the most pleasant characteristic while being able to track one’s work after submission is considered the least needful.

Table 1: Relative ranking of system features

Platform Characteristic	Average	Rank
Being able to save work and continue later	2,61	1
Not needing to print when submitting, hence, saving cost and time	2,93	4
Not needing to come to the office to submit physically	2,74	2
Being able to work anywhere on the document online	2,76	3
Ability to track one’s work after submission	3,94	5

3.3 Reliability of measurement scale used

The measurement model of each of the factors was tested for internal consistency using Cronbach’s alpha, rho A, and average variance extracted (AVE). All these values are within the acceptable region as can be seen in Table 2 and the Cronbach’s alpha can be seen to be higher than the 0.7 minimum value and AVE values are also greater than 0.5 as advised by (Hair et al, 2017) for all factors considered.

Table 2: Reliability test of measurement items

	Cronbach's Alpha	rho_A	Composite Reliability	Average Variance Extracted (AVE)
ease of use	0.789	0.814	0.863	0.612
intention to use	0.895	0.909	0.922	0.705
percieved usef...	0.810	0.815	0.913	0.840

3.4 Extraction of factor structure

The factor structure of the model was tested next. Statistical Package for Social Sciences (SPSS) version 25 was used for dimension reduction. Principal Component Analysis (PCA) was used to determine the items that loaded together on the constructs. The total number of items was 18. The Kaiser- Meyer- Olkin (KMO) value was checked to ensure if the sample size adequate and the Bartlett’s test of sphericity tested if the correlations were sufficient. The value for KMO was greater than 0.5 showing that the sample size was adequate. The Barlett’s test of sphericity showed a significance value less than $p = 0.05$ meaning that there was sufficient number of correlations for the items for factor analysis. This is shown in table 3 below

Table 3: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.733
Bartlett's Test of Sphericity	Approx. Chi-Square	355.656
	df	55
	Sig.	.000

The scree plot, shown in Figure 2, was also generated using the 18 items on the measurement scale to see if they support the three-factor structure. The scree indicated that three of the principal components have eigenvalues

greater than one, although the third is just marginally greater than 1, and the fourth is close to the third, howbeit, less than 1. This suggests that the three-factor structure proposed from the items may be supported.

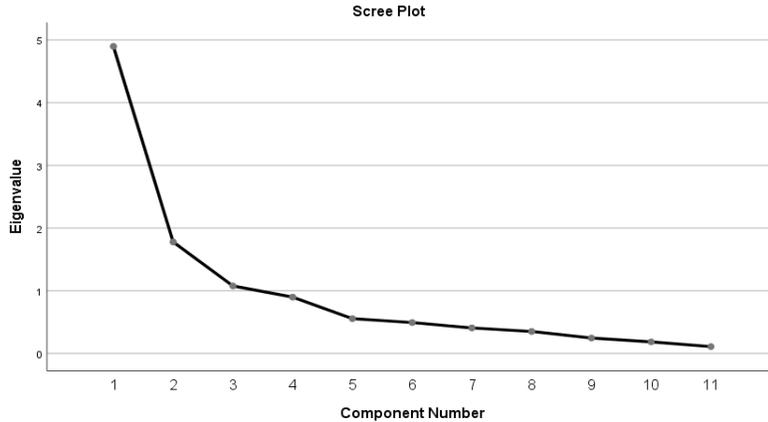


Figure 2: Scree plot of the principal components and their Eigen values

The rotated component matrix also conveyed how the items were loaded on to the factors after the varimax rotation. These variables were used in Confirmatory Factor analysis (CFA) that was used to test the suitability of the model.

Table 4 shows the cross loadings for the constructs. The initial measurement model had 18 variables out of which 7 variables were deleted before a clean structure was obtained. A total of 11 items were retained, and the final item cross loadings is shown in Table 4 using Principal Component Analysis (PCA) with varimax rotation and Kaizer normalization. The rotation converged in 5 iterations.

Table 4: Rotated component matrix

	Component		
	1	2	3
Us1	.851		
Us5	.801		
Us4	.798		
Us2	.775		
Us3	.742		
EoU3		.848	
EoU2		.819	
EoU5		.715	
EoU4		.640	
U5			.873
U4			.806

3.5 Model structure and path weights

SmartPLS 3 software was used for assessing the reflective measurement model created for Technology acceptance. The analysis involved testing the model's ability to predict the given data. The path coefficients were obtained after running the PLS-SEM algorithm. Figure 3 shows the structural path coefficients that were obtained for the relationships among the factors.

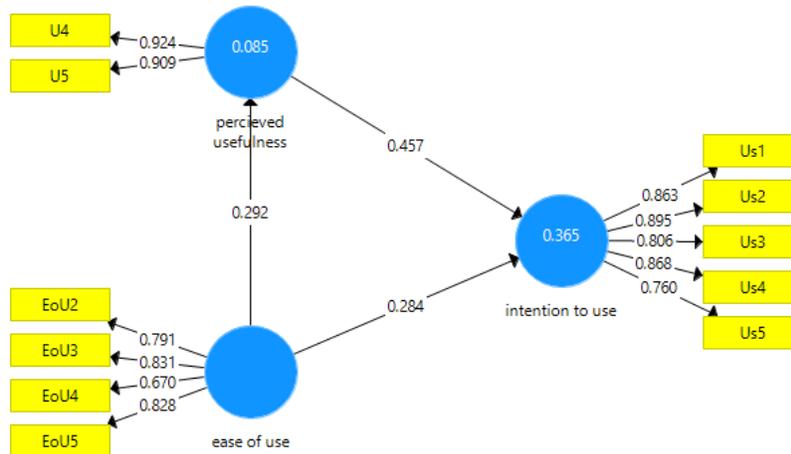


Figure 3: Final model structure with path weights

4. Results and discussion

The results showed that the model resembled complementary mediation because both the direct effect and the indirect effect were pointing in the same direction and significant. There was a positive relationship between ease of use and intention to use (0.284). Ease of use also affected intention to use via a mediating variable (perceived usefulness) and the relationship was positive (0.133). The R^2 values obtained for the endogenous variables intention to use and perceived usefulness were 0.365 and 0.085. The values were low but Cohen (1988) says that for behavioural sciences the values 0.02 were considered weak, 0.13 moderate and 0.26 large effects. Table 5 shown below shows p- values, mean and t- values for the TAM obtained.

Table 5: Parameter tests for path coefficients

Path Coefficients

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
ease of use -> intention to use	0.284	0.295	0.122	2.330	0.020
ease of use -> perceived usefulness	0.292	0.318	0.110	2.656	0.008
percieved usefulness -> intention to use	0.457	0.457	0.116	3.945	0.000

This results support the hypotheses postulated at the beginning of the study. The first hypothesis, H1 is that the students’ perception about the ease of use of the submission platform directly influences their perception about their perceived usefulness. The hypothesis seems supported, and the path coefficient is seen to be 0.292. In the same manner, it can be seen that the second and the third hypotheses, which are that both the perceived ease of use and perceived usefulness of the learning system influences the intention of the students to use the submission system. There has been much such support for research, although a few have noted in their case that the perceived ease of use may not really have any influence on the students’ decision to use learning platforms.

It can be observed that after the factor extraction, only two items measuring perceived usefulness were left and we would have preferred a minimum of three, but it can also be seen that the beta coefficients for U4 and U5 are also high, both being greater than 0.9.

Conclusion

The acceptance of the new submission platform for the submission of undergraduate students' vacation work report. The Technology Acceptance Model (TAM) adapted and a Structural Equation Model was developed. The result indicated that the TAM model hypotheses were supported by the data collected. This suggests that perceived ease of use and perceived usefulness are important factors to consider in engendering acceptability of learning management solutions. The qualitative ranking of the features of the submission system also indicated that the ability to work, save and return to continue is about the most desirable feature of the system. Such information is useful in guiding the future development of the platform. It is recommended that an expanded system would be developed to see the effects of other moderating variables like mobile app capability, real-time data capture in log-form, and other such technology enhancement capabilities on the acceptance of the learning system.

References

- Abdullah, S. M., Toycan M., Analysis of the Factors for the Successful E-Learning Services Adoption from Education Providers' and Students' Perspectives: A case study of Private Universities in Northern Iraq, *EURASIA Journal of Mathematics, Science and Technology Education*, 14(3):1097-1109, 2018.
- Abu-Dalbouh H.M., A Questionnaire Approach Based on the Technology Acceptance Model for Mobile Tracking on Patient Progress Applications, *Journal of Computer Science* 9 (6): 763-770, 2013
- Ajzen, I., Fishbein, M., *Understanding attitudes and predicting social behavior*, Englewood Cliffs, NJ: Prentice-Hall, 1980.
- Bazelais, P., Doleck, T., and Lemay D.J., (2018), Investigating the predictive power of TAM: A case study of CEGEP students' intentions to use online learning technologies, *Education and Information Technology*, Volume 23, Issue 1, pp 93–111
- Bervell B., and Umar I. N., A Decade of LMS Acceptance and Adoption Research in Sub-Sahara African Higher Education: A Systematic Review of Models, Methodologies, Milestones and Main Challenges, *EURASIA Journal of Mathematics, Science and Technology Education*, 2017 13(11):7269-7286, 2017
- Davis, F. D., Perceived usefulness, perceived ease of use, and user acceptance of information technology, *MIS Quarterly*, 13 (3): 319–340, 1989.
- Cheng, M. and Yuen A.H.K., Student continuance of learning management system use: A longitudinal exploration, *Computers & Education* 120 (2018) 241–253
- Ekuase-Anwansedo, A., Noguera, J., Dumas, B., Transitioning from Blackboard to Moodle amidst Natural Disaster: Faculty and Students perceptions, *Proceedings of Special Interest Group on University and College Computing Services, SIGUCCS'17*, October 1–4, 2017, Seattle, WA, USA, pp 19-22, 2017.
- Gefen D. and Straub D., The Relative Importance of Perceived Ease of Use in IS Adoption: A Study of E-Commerce Adoption, *Journal of the Association of Information systems*, 1-28, 2000.
- Hair Jr, J. F., Hult, G. T. M., Ringle, C. and Sarstedt, M., *A primer on partial least squares structural equation modeling (PLS-SEM)*, Sage Publications, 2016.
- Ifinedo P., Pyke J., Anwar, A., Business undergraduates' perceived use outcomes of Moodle in a blended learning environment: The roles of usability factors and external support, *Telematics and Informatics* 35, 93–102, 2018
- Jacob Cohen-Statistical Power Analysis for the Behavioral Sciences-Routledge, 1988.
- Nagy J. T., Evaluation of Online Video Usage and Learning Satisfaction: An Extension of the Technology Acceptance Model, *International Review of Research in Open and Distributed Learning*, 19 (1), 2018
- Song Y., and Kong S-C., Investigating Students' Acceptance of a Statistics Learning Platform Using Technology Acceptance Model, *Journal of Educational Computing Research* 2017, Vol. 55(6) 865–897, 2017
- Stockless Alain, Acceptance of learning management system: The case of secondary school teachers, *Education Information and Technology*, 2018, Volume 23, Issue 3, pp 1101–1121|

Appendix 1

Questionnaire items for study

1=strongly agree, 2=somewhat agree, 3=agree, 4=neutral, 5=somewhat disagree, 6=disagree, 7=strongly disagree							
Perceived usefulness of medium							
Online submission improves time productivity of the submission process	1	2	3	4	5	6	7
Online submission improves flexibility of the submission process	1	2	3	4	5	6	7
Online submission helps in saving cost of submission	1	2	3	4	5	6	7
Online submission improves document visibility even after submission	1	2	3	4	5	6	7
Online submission improves interactive feedback mechanism between lecturer and students	1	2	3	4	5	6	7
The use of questionnaires as opposed to long essay make the completion process easier	1	2	3	4	5	6	7
Perceived ease of Use							
Once understood, it is easy to use the submission process	1	2	3	4	5	6	7
It is not difficult to understand the submission process even if one has not used it before	1	2	3	4	5	6	7
The submission screens are designed in such manner that one can logically follow through	1	2	3	4	5	6	7
The number of questionnaire items are not too many	1	2	3	4	5	6	7
The questionnaire screens are user friendly	1	2	3	4	5	6	7
General satisfaction and intention to use							
The online submission process is a necessary intervention	1	2	3	4	5	6	7
I prefer the current online submission process	1	2	3	4	5	6	7
I would prefer to continue with online submission than revert to handing in paper documents	1	2	3	4	5	6	7
I am actually happy an online system was introduced	1	2	3	4	5	6	7
I like the questionnaire part of the submission	1	2	3	4	5	6	7
I like the documentation upload part of the submission	1	2	3	4	5	6	7
I like having to provide my opinion of where I worked	1	2	3	4	5	6	7

Bibliographies

Olufemi Adetunji is a Senior Lecturer in the department of Industrial and Systems Engineering at the University of Pretoria, Pretoria, South Africa. He earned his Bachelors in Agricultural Engineering and his Masters in Industrial and Production Engineering from the University of Ibadan Nigeria. He also had a Post Graduate Diploma in Computer Science form the University of the Witwatersrand, Johannesburg, and his doctorate in Industrial and Systems Engineering from the University of Pretoria, Pretoria, both in South Africa. He is professionally certified in SCOR-P by the Supply Chain Council, certified in CPIM and CSCP by APICS, certified in SAP ERP systems by SAP, and has a green belt in lean six sigma. He has published several journal and conference papers. Dr. Adetunji has also conducted research and process improvement projects in diverse industries including Finance, Education,

Manufacturing and Information Systems. His teaching and research interest is in the application of models to the design and operation of Manufacturing Planning Systems and Supply Chain Engineering.

Catherine Maware is currently a fulltime PhD student at the University of Pretoria in the department of Industrial and Systems Engineering. She holds a Btech (hons) in Production Engineering from Chinhoyi University of Technology and a Master of Engineering in Manufacturing Systems and Operations Management from National University of Science and Technology (Zimbabwe). She has served as a lecturer at Chinhoyi University of Technology and has taught courses such as quality management, operations management and manufacturing Technology. She has published in international journals and conferences. She is also a member of Zimbabwe Institute of Engineers (ZIE).