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The Enriched UTAUT Model for the Acceptance of Software Engineering Tools in Academic Education

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ABSTRACT
This article provides an enriched technology acceptance model explaining the impact of both classic and additional variables on software engineering tools acceptance within Information Systems Development courses. Two novel, domain-specific variables were identified (i.e., Professional Training Diffusion and Model Interchange). Statistical verification of the proposed model and study regarding the influence of the variables on students' intention to use specific tools were conducted—providing users with enhanced means of selecting optimal software for real-life projects.

KEYWORDS
Academic education; computer-aided software engineering (CASE) tools; model interchange (MI); professional training diffusion (PTD); systems analysis and design (SAND); unified theory of acceptance and use of technology (UTAUT)

Introduction

The Unified Theory of Acceptance and Use of Technology (UTAUT; Venkatesh, Morris, Davis, & Davis, 2003) attracted the attention of numerous scholars within the information technology (IT)/information systems (IS) fields—becoming one of the leading IS theories of IT and software acceptance nowadays. In the classic UTAUT research model, four major independent variables were introduced: performance expectancy (PE), effort expectancy (EE), social influence (SI), as well as facilitating conditions (FC). The model also introduces and considers four moderators (i.e., gender, age, experience, and voluntariness of use). The classic UTAUT model was a successful proposition in comparison to other theoretical acceptance models; therefore, it was selected as the base research model in this article. UTAUT is claimed to raise the bar to 70% in terms of explaining technology adoption success (Schaper & Pervan, 2007), while popular alternative models like Technology Acceptance Model (TAM) or TAM2 proved to be effective in 30% and 40% of cases, respectively (Oye, Iahad, & Rahim, 2014).

There are two major motivations behind taking up this research. Primarily, experts and those involved in the teaching process reported a number of issues and challenges regarding handling multiple modeling notations using different tools. Such challenges appear on a repetitive basis both within the teaching process and in practice. It is their neglect by technology acceptance literature that provides further motivation for conducting this study. Long-standing experience in teaching courses related to Systems Analysis and Design (SAND) at an academic level, along with extensive support from the Computer-Aided Software Engineering (CASE) tool, constituted a substantial background for initiating this research. SAND courses offered to both regular and extramural students are built mainly around Unified Modeling Language (UML) and CASE tools. Since substantial difficulties in applying methods and tools effectively in parallel were widespread, the authors were inspired to reveal the actual reasons for this phenomenon by conducting an extensive study incorporating the UTAUT model.

While theories for the acceptance and use of technologies provide invaluable background for explaining technological successes, the variables of the classic UTAUT model could not address the aforementioned observations completely. Moreover, the literature review included in the related research section shows there is a research gap regarding the acceptance surveying of IS development (ISD) with CASE tools. The literature review, with respect to university teaching, revealed that while the bulk of the added value concentrates on challenges regarding e-learning as well as Massive Open Online Courses (MOOCs), the techniques, methods, and tools of SAND had not been subjected to adequate examination. Therefore, this field has been waiting for the scientific investigation accomplished in this article.

As a result of this observation, three main goals for this research were formulated:

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- The identification and introduction of additional variables that address specific students' requirements, needs, and the determinants regarding CASE tool acceptance within SAND courses at a university level;
- The elaboration of the enriched, domain-specific UTAUT model that explains the impact of both classic and additional variables on the level of acceptance of CASE tools; and
- The comprehensive evaluation and verification of the enriched model proposed by the authors using statistical methods.

The challenge regarding the adequacy of the classic UTAUT model and the search for new domain-specific variables that would better explain CASE tools acceptance studies underwent in-depth analysis based on both experts' input and relevant literature review. The preliminary survey included discussions, interviews, and brainstorming with CASE and SAND-proficient lecturers, students, practitioners, and consultants. These creative actions were confronted with scrupulous analysis of domain-related body of knowledge. As a result, the shortlist of the proposals for the enriched UTAUT variables was precisely reviewed and assessed. Such preliminary research revealed that future users require tools that are universal and multi-notational in nature. Combining multiple techniques within a single CASE tool increases its value in areas such as engineering, aerospace, or military. Moreover, in order to use its resources effectively, it is vital for a company to interchange models created using a CASE tool with a number of related IT solutions, code generators, and business process engines deployed within the company. Ipso facto, both strictly interconnected research paths led the authors to the ultimate selection of two new variables for the developed and proposed enriched UTAUT model (i.e., Professional Training Diffusion [PTD] and Model Interchange [MI]).

The preliminary research enabled argumentative selection of a CASE tool being studied empirically—Enterprise Architect (EA) by Sparx Systems. While EA might be regarded as one of the leading CASE tools on the market, it is worth pointing out that it fulfills the condition of CASE tool universality and has a functional similarity to the whole family of CASE tools. In particular, the features that allow this particular tool to be classified as a CASE tool include the creation of basic SAND models, establishing a relationship between the requirements and the models, the development of top-level design, the development of functional and process description, and finally, the development of test cases (Tomar, 2011). Therefore, EA served as a subject of research with a legitimate intent to generalize the outputs of the research process onto the whole family of CASE tools.

The EA tool had a primary impact on the SAND course. In subsequent semesters, the students had a chance to re-integrate their CASE tool-related professional skills within such courses as object-oriented programming, databases, systems design, or business process modeling/workflow management. Consequently, students taking part in the survey possessed the knowledge as well as the skills required to evaluate a selected CASE tool and compare it with competing products. The acceptance of software by an individual user has a prevailing influence on its later purchase and adoption in some rudimentary IT-related activities in business. Therefore, the identification of the variables that have the strongest influence on behavioral intention to a certain degree determines the prerequisites, development process, and future sales strategy of the specific software class. The acceptance of CASE tools research results may be of great value to future professionals who may consider implementing the methods in question in everyday IT practice.

This study comprises five main sections. After the introduction, a comparative analysis of related research regarding different applications of the UTAUT model and its extensions in SAND and ISD courses at an academic level is presented. Next, the research methods are introduced, including the concept of the enriched UTAUT model and 12 research hypotheses. Subsequently, a research sample is described, the model evaluated, and the hypotheses verified. The final section concludes the research along with a discussion of the study's constraints and lays out potential for future research based on the contents of the article.

Related research

Software acceptance models, including the UTAUT, are interdisciplinary in nature. The models mainly include elements of business informatics, statistics, psychology, and sociology. A number of alternative models have been proposed so far—not including their numerous modifications. Apart from the UTAUT, the following models are considered significant: TAM (Davis, Bagozzi, & Warshaw, 1989) along with its subsequent major releases (i.e., TAM2; Venkatesh & Davis, 2000; and TAM3; Venkatesh & Bala, 2008); Theory of Planned Behavior (TPB; Ajzen, 1991); Innovation Diffusion Theory (IDT; Moore & Benbasat, 1991); Motivational Model (Davis, Bagozzi, & Warshaw, 1992); Combined TAM/TPB (C-TAM-TPB; Taylor & Todd, 1995); as well as Social Cognitive Theory (SCT; Compeau & Higgins, 1995).

Nevertheless, the UTAUT itself has inspired many researchers to carry out studies of user acceptance of IT and software. The versatility of research contributions may be categorized into two main research domains:

- Applications of the classic UTAUT research model in a number of areas, including technology, software, and business; and
- Enhancing and extending the classic UTAUT model by supplementing major variables and/or moderators with domain-specific independent variables or moderators.

The study performed by Williams, Rana, Dwivedi, and Lal (2011) revealed the UTAUT (along with its modifications) constituted the most popular model of IT/IS technology acceptance research resulting in 870 citations. However, only 43 of the citations are related to publications with the empirical application of this theoretical model in the four major categories proposed by Lee, Kozar, and Larsen (2003; i.e., communications systems, general-purpose systems, specialized business systems, as well as office systems). The theory is still considered a solid one and used nowadays: Sticking to the methodology used to perform the aforementioned study, by the end of March 2016, the number of citations related to the original UTAUT article reached as many as 3560 citations recognized by the Thomson Reuters Web of Science. The research presented in this article fits into the group of studies with empirical applications. Numerous proposals encouraged Venkatesh to add another level of complexity to the UTAUT itself. As a result, Venkatesh, Thong, and Xu (2012) proposed the UTAUT2 model that introduced some new constructs such as hedonic motivation, price value, and habit.

Special attention in the article has been placed on UTAUT applications within university-level teaching. The existing body of knowledge takes into account, first and foremost, application areas such as the improvement of the teaching process, the implementation of IT solutions in teaching—just to mention interactive whiteboards and electronic libraries—active learning, e-learning (along with MOOCs), mobile learning, or assessing the higher education environment. Marques, Villate, and Carvalho (2011) verified the adequacy of the UTAUT model with respect to applying information technologies in pedagogical processes in higher education. UTAUT validation in this educational context has been provided by Wong, Teo, and Russo (2013). The article is an example of a classic UTAUT model application with regard to interactive whiteboard acceptance. Marchewka, Liu, and Kostiwa (2014) applied the primary UTAUT model to understand student perceptions using the Blackboard web-management tool, containing a number of functionalities such as an online discussion board, course content management, auto-marked quizzes and exams, or grade maintenance. The results of the research aimed at evaluating the course satisfaction of students with respect to active learning have been presented by Taneja (2009). Of all teaching technologies, it is mostly e-learning that attracts UTAUT research—such as educational webcast adoption (Giannakos & Vlamos, 2011), ease of use and usefulness of webinars in an open distance learning environment (van der Merwe & van Heerden, 2013), or mobile learning adoption (Prieto, Miguelanez, & Garcia-Penalvo, 2014). Phahlane and Kekwaletswe (2014) developed a UTAUT-based model that is utilized to analyze the use of management IS (MIS) in the higher education environment in South African institutions. In their study, the authors introduced five variables that are hypothesized to positively influence both the UTAUT PE and EE (i.e., user characteristics, fit characteristics, system characteristics, management characteristics, and organizational characteristics). The research is aimed at assisting decision makers in directing investment by illustrating what areas of MIS the users find useful and where improvements can be made.

As stated before, a number of studies have introduced enhancements to the classic UTAUT model. Roca, Chiu, and Martinez (2006) introduced a series of extensions to the model, proving that learner satisfaction is shaped by such variables as perceived quality, usability, and control, without being significantly affected by subjective norms. On the other hand, Sorebo, Halvari, Gulli, and Kristiansen (2009) included user satisfaction and perceived usefulness as independent variables. The latter factor is dependent on the confirmation of teachers' expectations and perceived competence. Similar studies and the relevant model itself have been the subjects of a series of improvements published in recent years. With regards to e-learning adaptation, Sumak, Polancic, and Hericko (2010) analyzed the intention behavior of an open source e-learning platform: Moodle. The study confirmed that PE and SI have a significant impact on students' intention to use Moodle. Xiong, Tripathi, Nguyen, and Najjar (2014) performed a literature review aimed at investigating what potential factors affect the adoption of MOOCs by students. As a result, the authors have extended the classic UTAUT by introducing an additional variable: human capital. This is an intention of e-learning use that is the subject of a survey by Alrawashdeh, Muhairat and Alqatawnah (2012) as well. The proposed model is significantly different compared to the classic UTAUT model. The authors abandoned the use of any moderators. However, they described interchangeably

two independent variables—PE and EE—with system enjoyment and system interactivity. Additionally, the study involved investigating the relevance of system flexibility with respect to shaping behavioral intentions. Another example of the UTAUT application for university teaching is the advanced research of the acceptance of electronic library use, as presented in Tibenderana and Ogao (2008) by using the modified model SOUTAUT—Service Oriented UTAUT. The original model was modified by introducing new essential variables (i.e., relevance and expected benefits). It is the latter variable in particular that is the novel contribution of research carried out. The extensive studies of the authors have confirmed the strong influence of the behavior (use of the library service to be exact) on the expected benefits. In this area of the research, the business school students' intention to use tablets was analyzed and explained (Anderson, Schwager, & Kerns, 2006) on the basis of the UTAUT model. It revealed the strong influence of the PE on the students' final preferences, while the other variables had a minor impact on intentions.

As stated before, SAND-dedicated technologies have not been extensively researched in respect of acceptance theories. Having said that, the value of MI was recognized in subject-related literature. For instance, Lundell, Lings, Persson, and Mattsson (2006) stressed the impossibility of exchanging model information between tools can cause the risks of significantly reduced flexibility and a tool lock-in. The limited interoperability of Architecture of Integrated IS (ARIS) was mentioned by Kern and Kuhne (2007). The authors point out that the reuse of models is in general offered only by ARIS-specific import and export interfaces. Since the software development lifecycle in particular requires the interoperability of different modeling services, Blanc, Gervais, and Sriplakich (2005) proposed an architecture and a prototype enabling the services of different tools to be connected. On the other hand, the issue of multi-notational CASE tool capability was raised primarily in respect of requirement engineering (Day & Joyce, 2000; Roy, Kealey, & Amyot, 2006).

Research methods

The research methods underlying this article include publication research, observation, modeling, and questionnaire surveying. Based upon the data gathered within the research process, a multi-aspect quantitative analysis was carried out. The research was conducted strictly in accordance with the UTAUT. Thus, the structure and content of the relevant questionnaire form was formulated to support individual UTAUT variables together with the authors' extensions.

Tool selection

Almost from its inception, IT-oriented education has relied heavily on tool support. While CASE tools became an indispensable part of SAND courses, software vendors responded to this demand by offering a vast selection of CASE tools. The majority of them provide professional support for the UML and Rational Unified Process (RUP)— the essential methodological background for SAND courses, although nowadays experiencing tough competition from the Agile approach. In fact, there are several dozen IS modeling tools that both support the UML and offer functionality—entitling the software to be classified as CASE tools listed in directories such as Martinig and Associates (2014). The UML Vendor Directory Listing (Object Management Group [OMG], 2012) itself includes UML-oriented modeling software from 60 different vendors. It was the EA that was pre-selected and recommended by instructors for the CASE tool acceptance research. Pre-selection was performed by staff actively engaged in SAND teaching/professional training—considering a rich set of criteria, including 24 items. Four main criteria were formulated around the scope of the methodological support for well-known modern techniques and languages:

- scale of UML 2.4 support,
- scale of OMG Systems Modeling Language (SysML) 1.4 support,
- scale of Business Process Model and Notation (BPMN) 2.0 support, and
- number of languages and database schemas supported by the code generation feature.

Additionally, 20 minor criteria were set and taken into account. The precisely studied criteria (being also candidates for enriched UTAUT variables) included both those of a technical- and market-related nature (Marcinkowski & Wrycza, 2015). The former group comprises first and foremost: the intuitiveness of the tool interface, model transformation features, as well as the viability of client-server and cloud-based tool implementations. On the other hand, market-related determinants under consideration included the total cost of ownership, the tool's market share, and the quality of training content provided by CASE vendors.

Data gathering

Data gathering involved two closely related stages: The first may be classified as a pilot study and was dedicated to develop and enunciate research questions supporting individual variables included in the model as well as

verify the quality of the questions and the questionnaire itself. The second, which provided the foundation for this article, was launched after optimizing the questionnaire form (which involved, in particular, broadening the list of questions that may be used to perform the segmentation of the targeted research group and rephrasing selected domain questions). Bearing the nature of academic teaching in mind, the stages were initiated in one-semester intervals. As stated previously, in order to qualify potential participants for the survey, the respondents had to achieve an adequate competence level to provide reliable feedback. In particular, each of the respondents had to be proficient in CASE tools in conjunction with applying such standards and techniques as UML, SysML and Yourdon Systems Method.

The questionnaire was distributed among participants using Google Forms. At the pilot study stage, the authors collected 93 sets of answers, all of which proved to be valid. The actual study stage involved 198 collected questionnaires, of which 196 were approved after verifying the data gathered and eliminating incomplete/invalid sets of answers. Twenty-nine questions were presented to the respondents—24 of them were domain-specific, while the remaining five were administrative in nature. The domain-specific questions were addressed using a 7-point Likert scale. Consistent with the original UTAUT study, gender was recorded as a binary variable while both age and IT experience were noted as a continuous variable. Survey participants could introduce the values into the questionnaire form with decimal precision. Additionally, the questionnaire study participants were expected to specify the type of university and mode of study (regular and extramural)—both on a binary scale.

Modified UTAUT model

The proposed research model includes six independent variables. Four of the variables are taken directly from the classic UTAUT model (i.e., PE, EE, SI, and FC). Considerations of the research domain led to the introduction of two additional variables—PTD and MI—tailored to the description of CASE tools. Based on preliminary research addressed in the introduction to this study, PTD was recognized as an important factor in CASE tool acceptance. It depicts the perceived flexibility and expressiveness of the tool in question in terms of modeling notations supported as well as problem areas that may benefit from introducing the tool within the teaching process and further professional business practice. In fact, it may be considered a specific variable for multi-standard CASE tools that enables the use of numerous standards in tandem, interchanging modeling constructs, and creating robust models. CASE tools used for this study evolved to a package of over 20 modeling techniques (including UML, BPMN, and SysML) that may be expanded to include new roles and new teaching courses. The second independent variable enhancing the classic UTAUT model—MI—concentrates on the capability of the tool to integrate seamlessly with external tools in the company; in particular, with other modeling-oriented tools as well as software that is able to interpret XML-based export models in areas that go beyond modeling. This feature becomes crucial—especially when a company decides to integrate CASE tools with specially designed transformation/simulation-oriented environments.

The data were collected taking into account three UTAUT moderators: gender, age, and IT usage experience. The fourth of the primary UTAUT moderators (i.e., voluntariness of use) was not included in the model due to the fact that EA was selected as a primary tool supporting the courses on offer. At this stage of the research, the significance of the impact of individual moderators within the sample collected was not subject to analysis. The modified UTAUT model is presented in Figure 1.

Each of the variables included in the modified UTAUT model was supported by a set of three to four research questions. Thus, a quantitative analysis of the influences among the variables was made possible. The research questions that the participants in the survey were provided with—along with their abbreviated codenames and assignment to individual variables—are included in Appendix 1.

Research hypotheses

With regard to the enriched UTAUT model, 12 hypotheses were posed for verification. While six of them result directly from original Venkatesh work and have to be re-evaluated in terms of significance due to possible interrelations with newly introduced variables, hypotheses H4 and H5 were formulated in order to verify the direct effect of additional variables on behavioral intention. Since PTD and MI may also have an indirect impact on behavioral intention through other variables, additional hypotheses—namely H6, H8, H11, and H12—were posed to verify the significance of such relations:

H1: The students' PE will have a positive effect on the behavioral intention to use the EA tool;

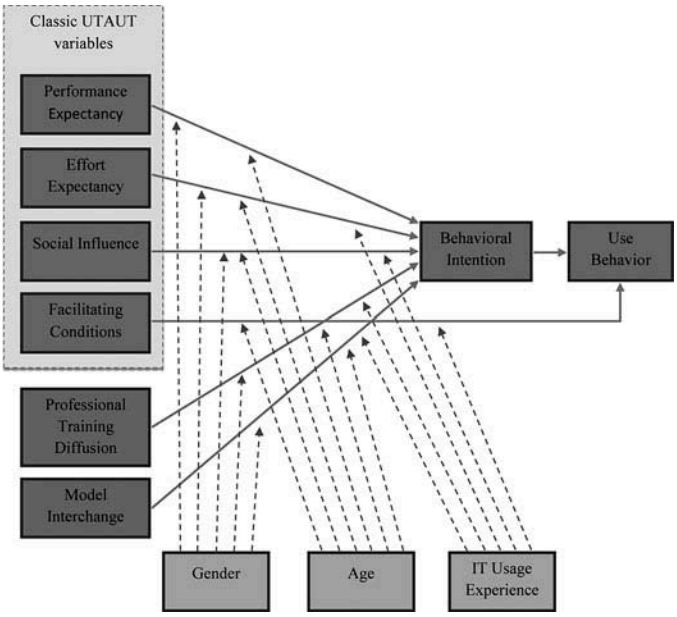

Figure 1. Preliminary version of enhanced UTAUT model. Source: Own work based on Venkatesh et al. (2003).

H2: The students' EE will have a positive effect on the behavioral intention to use the EA tool;

H3: The SI will have a positive effect on the behavioral intention to use the EA tool;

H4: The PTD will have a positive effect on the behavioral intention to use the EA tool;

H5: The MI capability will have a positive effect on the behavioral intention to use the EA tool;

H6: The PTD will have a positive effect on FC that support the use of the EA tool;

H7: The FC will have a positive effect on students' EE regarding the use of the EA tool;

H8: The MI capability will have a positive effect on students' EE regarding the use of the EA tool;

H9: The students' EE will have a positive effect on students' PE regarding the use of the EA tool;

H10: SI will have a positive effect on students' PE regarding the use of the EA tool;

H11: PTD will have a positive effect on students' PE regarding the use of the EA tool; and

H12: The MI capability will have a positive effect on students' PE regarding the use of the EA tool.

The UTAUT-EA research model is depicted in Figure 2. The model includes independent and dependent variables, and visualizes the research hypotheses among them. The variables proposed by the authors along with their relationships with other variables (both direct and indirect) were distinguished in the model.

Selected research results and discussion

Sample descriptions

As a result of the data gathering and validation process, 196 complete questionnaires were collected. Since the study addressed the preferences of students, most of the survey participants were in their early 20s (see Figure 3). The age of participants ranged from 20 to 49 (with an average of 24.6 years and the standard deviation was 4.3). A typical student under this survey had 6.2 years of IT usage experience that involved performing tasks such as programming, database implementation, computer networking, or hardware issue resolving (standard deviation: 4.8). Such an average experience in these tasks compared with the average respondent's age might seem relatively high. Nevertheless, the survey was conducted exclusively among MIS students who had tied their previous

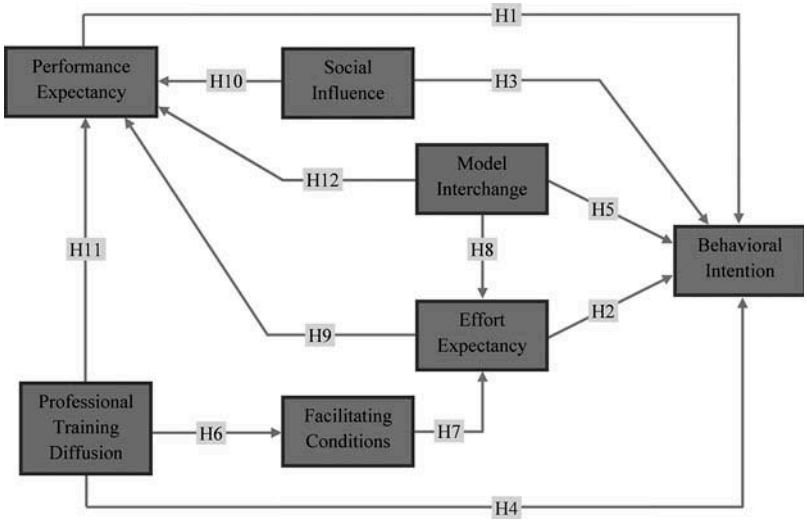

Figure 2. UTAUT-EA model.

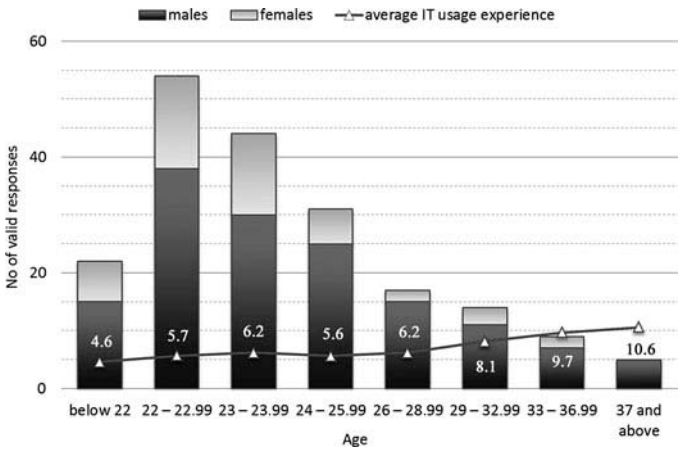

Figure 3. Distribution of survey participants in terms of gender, age, and average IT usage experience.

education and practice with the Information and Communication Technologies industry. IT is among the least feminized high-volume specializations in Polish higher education, hence 74.5% of the sample (146 participants) were male.

It is worth pointing out that IT is gaining popularity among female students. Women were more strongly represented within the lowest age groups of the study (i.e., below 22; 22–22.99, as well as 23–23.99) than among older students (see Figure 3). Statistical analysis of raw data reveals that female students constituted respectively 31.8%, 29.6% and 31.8% of those surveyed within aforementioned age groups. Professional IT usage experience in relation to age was spread relatively evenly across all age groups— from 21.9% to 27.6% of a participant's lifespan.

The respondents of this survey were studying at both public and private universities founded in the Pomeranian region, Poland. All the respondents took part in SAND courses heavily supported by the EA CASE tool. A total of 45.9% participants taking part in the survey originated from the public institutions (see Table 1), mostly regular students (32.7% total). Due to the organization of the Polish academic education system, private universities offer, first and foremost, extramural studies. In result, 77 responses were provided by extramural students from private universities, with 26 from regular students of this educational sector. It is worth pointing out that extramural students were usually employed in IT companies; therefore, they have had valuable professional experience in systems development supported by CASE tools.

Data reliability

The questionnaire and the individual questions included in it must be assessed from the angle of the

Table 1. Classification of survey participants—sample according to type of university as well as mode of study.

	Mode of study					
	Regular		Extramural		Σ	
Type of university	number of valid responses	%	number of valid responses	%	number of valid responses	%
Public	64	32.7	26	13.3	90	45.9
Private	29	14.8	77	39.3	106	54.1
Σ	93	47.4	103	52.6	196	100.0

Table 2. Data reliability.

Variable	Cronbach's Alpha
PE	0.840
EE	0.730
SI	0.643
FC	0.613
PTD	0.813
MI	0.826
BI	0.859

pertinence of question selection and proper formulation and the consistency of each question groups supporting individual variables. One of the most widely-applied methods of such an evaluation is the calculation of Cronbach's Alpha coefficients for each variable that was assigned a group of three to four specific questions in the current research.

The Cronbach's Alpha values for all the factors were between 0.613 and 0.859 (see Table 2)—meeting the acceptable threshold of 0.6 (Hair & Black, 2009; Kaiser, 1974; Sekaran & Bougie, 2013). In four cases (PE, PTD, MI, as well as BI), Cronbach's Alpha was at 0.8+, which is commonly considered a good reliability. It is worth pointing out that Cronbach's Alpha coefficients exceeding 0.9 in some cases may indicate the redundancy of individual questions, which is considered a negative state of affairs.

Model elaboration and validation

The results of the model hypotheses verification are presented in Table 3. It contains a whole range of hypotheses verifying the relationships between individual variables. Results before removing irrelevant variables from the model (as a result of rejecting individual hypotheses) as well as results for the final model are presented. The confirmation of individual hypotheses was examined on the basis of their significance levels ($p < 0.05$ were accepted). Significance levels below the 0.001 threshold are considered very significant, between 0.001 and 0.01 are strongly significant, while significance levels more than 0.01 but still not exceeding rejection threshold are seen as significant. Therefore, it appeared that the following hypotheses were found to be very significant: H5, H6, H8, H9, and H10; H1 was found to be strongly significant, while H7 was classified as significant. On the other hand, the hypotheses H2, H3, H4, H11, and H12 were rejected due to the fact that their significance levels exceeded the predefined threshold. Relationships related to the latter group were removed from calculations evaluating the final UTAUT-EA model.

Table 3. Hypotheses verification results.

		Significance		
Hypothesis	Interconnection	Before removing irrelevant variables	After removing irrelevant variables	Result of verification
H1	PE (+) BI	0.146	0.002	Accepted
H2	EE (-) BI	0.678	N/A	Rejected
H3	SI (-) BI	0.408	N/A	Rejected
H4	PTD (-) BI	0.903	N/A	Rejected
H5	MI (+) BI	0.036	<0.001	Accepted
H6	PTD (+) FC	<0.001	<0.001	Accepted
H7	FC (+) EE	0.072	0.048	Accepted
H8	MI (+) EE	<0.001	<0.001	Accepted
H9	EE (+) PE	<0.001	<0.001	Accepted
H10	SI (+) PE	<0.001	<0.001	Accepted
H11	PTD (-) PE	0.597	N/A	Rejected
H12	MI (-) PE	0.542	N/A	Rejected

Improving the research model by removing irrelevant variables from the preliminary model may be considered to be a standard procedure in the case of robust models, as irrelevant variables interfere and influence the other variables as well as having a negative impact on the model quality.

Enriched UTAUT model

Taking into account the results of the hypotheses verification presented above, the final UTAUT-EA model took the following final form (Figure 4).

As presented in Figure 4, mixed support was noted for enriched UTAUT constructs; while most of the hypotheses were supported, some variables influenced the behavioral intention to use CASE tools only indirectly. When no significant support for the individual hypotheses was found, the accompanying relationships were drawn using dotted lines. Both authors' variables contributed to explaining the behavioral intention. In fact, it was one of the newly introduced variables—MI—that had the greatest impact on students' intention to use CASE tools (H5), as depicted by both the β-coefficient of 0.53 and the very significant impact (***) on the latter. Combined with the fact that the first of the hypotheses (H1) revealed that PE has a very significant direct impact on students' intention to use CASE tools, and, at the same time, with no support for EE having a direct impact on behavioral intention (H2) having been

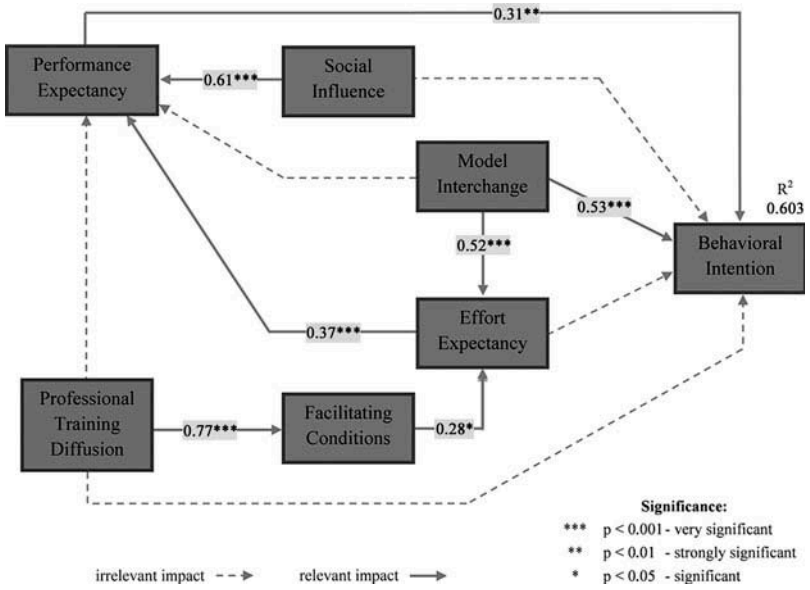

Figure 4. Final UTAUT-EA model.

noted, users tended to value the features and functionality of the tools more than the usability. Still, technical refinement required to successfully manage, share, and interconnect the CASE tool's deliverables across a company is expected to be a standard feature of the tool and does not additionally contribute to the subjective appraisal of own competences and market value with respect to a student mastering the tool (H12). Such a functionality has, however, a very significant impact on the EE (H8).

With regards to the second introduced variable—PTD—the expressiveness and potential to use the tool universally across courses is a valuable argument for university staff to promote its application within the university infrastructure and create conditions that might be conducive to this purpose (H6). The latter naturally has an impact on students' EE (H7). On the other hand, PTD does not have a significant impact on students' PE (H11), nor directly influences behavioral intention (H4). Based on these findings, one is entitled to conclude that future IT professionals considering the trade-off between strict specialization and universality opt for the former.

The UTAUT-EA was the subject of an overall model assessment using confirmatory factor analyses (CFAs). Four fit indices were applied: minimum discrepancy divided by its degrees of freedom (CMIN/DF), root mean square of error approximation (RMSEA), goodness of fit index (GFI), and comparative fit index (CFI).

As presented in Table 4, the CMIN/DF fit index met the threshold of 2.0 stated by Byrne (2010). The GFI value was above the 0.8 threshold (Bollen, 2005), while RMSEA's value of 0.065 indicates a reasonable error of approximation. Browne and Cudeck (1992) introduced the rule of thumb for accepting values below 0.08. The measure in discussion should ideally be less than 0.05. Moreover, the CFI value was above the 0.9 threshold (Smith & McMillan, 2001). Hence, the UTAUT-EA model meets all applied fitness indices.

Table 4. Fit indices of the model.

Fit index	Recommended value	Result of verification
CMIN/DF	<2.000	1.817
RMSEA	<0.080	0.065
GFI	>0.800	0.830
CFI	>0.900	0.910

Conclusions and future work

The authors investigated the students' behavioral intention to accept the CASE tool at university with the main goal of elaborating the enriched UTAUT model proposed by the authors, which explains the impact of both classic and newly introduced variables (i.e., MI and PTD) on the acceptance level of CASE tools. Thus, the research contributed to the development of a domain-specific UTAUT-EA model by utilizing previous studies and including verified novel relationships between individual variables. The result of this research may be primarily useful for two groups of professionals: academic teachers of SAND/ISD and system developers working within the IS field.

The outcomes of this research based on the enriched domain-specific UTAUT model have shown that the new proposed independent variable—MI—has a powerful

influence on behavioral intention. The influence of the second proposed variable—PTD—is indirect, as it significantly supports the FC for using CASE tools. The impact of classic independent variables on behavioral intention was evaluated as well. It was found that behavioral intention is directly explained first and foremost by PE. Surprisingly, neither EE nor SI had a direct influence on behavioral intention within this study. Nevertheless, both these independent variables had a very strong influence on PE.

The results of the survey have already been put into practice. The analyses substantially contributed to the development of the curriculum of the new master studies at the University of Gdansk, Poland— Business Informatics—having been discussed and then taken into account during the development of the new academic program and related syllabi. The variables proposed by the authors increase the explanation power of CASE tools acceptance studies and tailor the UTAUT to the demands and requirements of the ISD area. Therefore, potential users of CASE tools are provided with enhanced means of selecting optimal software for supporting their projects, while the vendors are endowed with improved reference models for developing and marketing their solutions.

As far as future work is concerned, there are still a number of research challenges and problems that could lead to improvement of the enriched UTAUT model proposed in this article. First and foremost, at this stage of research, the authors concentrated strictly on the main variables of the domain-specific UTAUT model. Nevertheless, the original Venkatesh research took into account four additional constructs that are posited to moderate the impact of variables on usage intention and behavior (i.e., gender, age, experience, and voluntariness of use). Data gathered during research process may facilitate a quantitative analysis based upon the first three moderators. The results of such an analysis might be presented in future articles.

Additionally, the cultural aspect of CASE tools use could be researched on the basis of Hofstede's cultural dimensions theory. Straub, Keil, and Brenner (1997) pointed out that cultural dimensions can affect technology acceptance in a significant way. Based on the results of the pilot survey, the sample collected might be considered homogenous with regards to the cultural aspect. Thus, investigating CASE tool acceptance taking into account Hofstede's research requires collecting additional data as well as introducing additional moderators to the UTAUT-EA model.

The data gathered could also be subjected to some more in-depth statistical analyses. Since Cronbach's Alpha data reliability evaluation is a matter of more and more frequent criticism (Schmitt, 1996; Sijtsma, 2009), additional techniques might be applied to measure reliability—such as the Omega coefficient (Dunn, Baguley, & Brunsden, 2013).

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Appendix 1

Variable	Abbrev.	Questions included in the questionnaire
Performance Expectancy	PE1	Proficiency in using EA shall increase my professional competences regarding information systems modelling
	PE2	Proficiency in using EA enables me to achieve higher grades within university modelling-related courses
	PE3	Deployment of EA increases my productivity with regard to system documentation development with UML and other visual modelling languages
Effort Expectancy	EE1	I mastered EA easily
	EE2	EA manual is helpful for acquiring technical skills with this tool
	EE3	EA interface enables efficient elaboration of UML diagrams
	EE4	Practically every user may become proficient in using EA
Social Influence	SI1	University instructors recommend EA as an efficient information systems modelling tool
	SI2	Browsing professional discussion groups and other sources indicates that EA is popular in business, in particular in the IT domain
	SI3	Contacts with students from foreign universities confirmed their EA application
Facilitating Conditions	FC1	University laboratories enable the use of EA
	FC2	EA tool has moderate hardware requirements
	FC3	Documentation formats used in my professional work and education are compatible with EA
	FC4	In the case of technical problems I can get professional support from the instructor, participants of student forum or software producer
Professional Training Diffusion	PTD1	EA enables the development of models using diverse notations and standards
	PTD2	EA may be used to model problem areas within other IT-related courses
	PTD3	EA may be used to model problem areas within other quantitative and business courses
	PTD4	EA may be useful in writing diploma theses
Model Interchange	MI1	Export and import functionality of diagrams and models using XML within EA meets my needs
	MI2	EA facilitates integration of the developed system documentations with other IT tools used in the company
	MI3	Projects prepared by using EA may be implemented in different tool versions and editions with regard to backward compatibility
Behavioral Intention	BI1	I intend to use EA further for at least 6 months
	BI2	I would use EA to support systems modelling even if this particular software was not recommended by my instructors
	BI3	Taking into account the functionality of alternative CASE tools I am familiar with, I plan to keep using EA for my professional work