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Investigation of moderator factors in e-business adoption: A quantitative meta-analysis of moderating effects on the drivers of intention and behavior

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Abstract. E-business technology is becoming one of the most important global markets where e-business solutions will have to adapt to new technologies. The main objective in this study was to synthesize existing knowledge in the field of e-business technology acceptance and to understand differences in Technology Acceptance Model (TAM) related causal effect sizes for different e-business contexts. A quantitative meta-analysis of existing empirical research about factors affecting e-business adoption was conducted using 89 published papers that provided empirical data about causal relationships. A moderator analysis was carried out to investigate the moderating effect of four factors: consumer type, device type, continent and respondent type. The results of the study showed a moderating effect for all four proposed factors in almost all TAM-related causal paths. The study also showed that TAM is the most common theory being applied in e-business adoption research.

Keywords: e-business acceptance; meta-analysis; moderator factors analysis; TAM; UTAUT; B2C; B2B

1. Introduction

E-business has become a very popular way of conducting business over the last two decades, as the economic and social world has evolved through the rapid development of the internet and information and communication technologies (ICT). Progress in the development and adoption of e-business technology is already visible all over the world – from the point of view of customers as well as suppliers. Although online purchases were minimal before 2009, they had already been influenced by the internet; Forrester estimates that 43% of purchases in the USA were previously influenced by personal research on the internet and then later completed off-line. After 2009, online retail sales began to grow, and according to Forrester's predictions, more than half of all purchases will be made online [1]. 2011, for example, was a strong year for e-commerce in the USA, as total US retail and travel-related e-commerce reached $256 billion, up 12%

from 2010 [2]. For the first quarter of 2012, the published results of measurements in US retail e-commerce revealed that online retail spending reached $44.3 billion, which is 17% higher in comparison with the year 2011 [3]. In Europe, the percentage of individuals using the internet for ordering goods and services increased from 36% to 50% over the years 2009-2014 [4].

In the past few years, evolving web and mobile technologies have enabled e-businesses to reach various new markets and move into the mobile world. Now that mobile devices, such as smartphones, laptops, and tablet computers are becoming very popular with users, it is expected that mobile business will become a market with significant potential [5]. A recent study of mobile commerce usage across five European markets (France, Germany, Italy, Spain and United Kingdom) showed that the mobile retail audience has nearly doubled over the past year, with 1 in 6 smartphone users accessing online retail sites and apps on their device. In addition, 1 in 8 smartphone users actually completed a retail transaction on their phones [6]. In 2014, 47% of online retail traffic and 33% of online retail orders came from smartphones and tablets [7]. According to the results of a recently published survey, a significant year-over-year gains were seen in e-commerce and mobile commerce during the third quarter of 2015 across different sectors, which can largely be attributed to consumers shopping on their smartphones [8]. Similar results were shown in a recent Gartner's study, which predicts that by 2017, customers' mobile engagement behavior will drive mobile commerce revenue in the U.S. to 50 percent of U.S. digital commerce revenue [9]. According to The Goldman Sachs Group Inc, by 2018, mobile commerce sales on smartphones and tablets will reach 47% of all web sales [10].

Contemporary e-business technology has also been enabling organizations to move into global markets. Because of globalization, Gartner expects that 80% of North American and European online sellers will expand into Brazil, Russia, India, Africa, Japan and China [11]. The global mobile commerce is expected to reach $850 billion in 2018 with Asia as a leading region being followed by North America, Western Europe and Eastern Europe [12]. Organizations that want to provide goods and services globally online will have to understand the cultural differences of individuals living in different countries. E-business solutions will have to be built with serious attention given to a variety of factors - such as trust - that can have a significant impact on the end user's decision of whether they will make a purchase online or not. End users must recognize the value in these new resources if they are to accept them [13].

E-business acceptance has been addressed by many researchers, primarily via quantitative empirical studies about the factors that influence an end user's decision to accept and use a certain e-business technology. Individual studies usually focus on a certain type of e-business technology that is used in a certain geographical area. Furthermore, the respondents that appear in empirical research are usually either students or "real" e-business users. Studies that investigate the large number of factors affecting a user's behavioral intentions when using a certain technology are more rare. For example, in existing literature, only few studies can be found that use respondents from multiple cultural areas.

The aim of this study is to investigate the convergence (or divergence) of TAM-related causal relationships across different e-business type and cultural settings in order to provide an objective picture about the results of the factors affecting e-business acceptance in recent years. By investigating quantitative data from existing empirical

research, the main purpose of this study was to identify factors with a moderating role (for example e-business type, device type, etc.) in the causal relationships between TAM-related factors. Recently, Zhang et al. [5] conducted a meta-analysis of mobile commerce adoption and the moderating effect of culture, where the authors investigated the moderating effect on mobile commerce adoption. However, our study deals with the acceptance of different e-business technology types and investigates additional factors with a moderating role, such as device type, respondent type, and continent.

This paper is organized as follows. Section 2 provides some definitions of e-business and different classifications, while also providing some research questions. Section 3 describes the research methodology, including the research model, the data collection process and data analysis. The subsequent section presents the results of causal effect size analysis. In Section 5, we discuss the results and implications of this study. In Section 6, the limitations of this study are presented and the last section concludes this study together with directions and ideas for future research.

2. Backgrounds

Trends show that consumers have already been recognizing the benefits of doing business on-line, and that e-business has spread into many industries, including banking, finance, insurance, tourism, entertainment, healthcare, education, etc. The organizations in all types of industries are starting to recognize the potential of e-commerce and are launching new sites or upgrading their existing sites with new or improved online sales capabilities. Beside buying and selling products, e-business interactions include all sorts of collaboration between business partners. The main objective of e-business is to increase the added value to the consumer and to improve cost efficiency by getting the right products to the right place in the right time [14].

To fully integrate end-to-end processes, core and support e-business processes are usually performed through web and other channel technologies [15]. End users access and adopt both e-business and mobile business (or m-business) technologies, since online shopping can be conducted wherever there is internet access [16]. E-business can also be classified according to the consumer type involved in the process: business-to-business (B2B), business-to-consumer (B2C), business-to-employee (B2E), consumer-to-consumer (C2C), business-to-government (B2G), etc.

E-commerce is a subset of e-business and refers to obtaining useful information and purchasing products and services between companies and consumers using electronic technology such as intranets, extranets and the internet, [17–19]. E-commerce can also be defined as the selling and buying of products using ICT [14]. E-commerce not only facilitates transactions over the internet, but also enables the creation and continuing development of online relationships. However, when shopping online, consumers can still be concerned about the security, privacy, download time, delivery of purchased products and services, etc. [13]. Mobile commerce (or m-commerce) is a way of conducting the sales of goods, services, and content via wireless devices, without time or space limitations [20, 21].

In the IT acceptance literature, different theoretical models have been used to explain factors affecting the user's behavioral intentions and usage behavior in the technology

adoption process. In existing studies in the field of IT acceptance, such theoretical models are either validated or extended with specific factors in order to explain the influences on a user's behavior while using a specific technology. Studies that attempt to model technology adoption usually use acceptance models, such as the technology acceptance model (TAM), as a ground theory for designing the research model. Davis [22] proposed the TAM model, which explains the causal links between end user's beliefs and the users' attitudes, intentions, and actual usage of the system. According to the base TAM model, the end user's behavioral intention (BI) is influenced by two factors: the perceived ease of use (PEOU), and perceived usefulness (PU). Because of its understandability and simplicity, TAM has become one of the most widely used technology acceptance theories in IS research. The meta-analysis conducted by King and He [23] confirmed TAM as a powerful and robust predictive model in IT acceptance research.

Existing e-business acceptance studies have been applied to different e-business technology types. Most of the existing studies focus on different products, leading to different acceptance behaviors among users [24]. Since e-business can be accessible globally, it is important to understand the differences in causal effect sizes regarding different culture types. Very few existing studies are aimed at studying e-business acceptance by implying a respondent sample from different countries. A study conducted by Gumussoy and Calisir [25] for example, collected empirical data from users in 40 different countries, although the authors did not analyze differences in perspectives on the acceptance of e-business technology in relation to different geographical locations.

Software in general as well as e-business software and its acceptance depends on user's perceptions about quality. To develop quality solutions, developers must take care of different aspects of the quality in the software development lifecycles. For the purposes of software quality assessment, different static and dynamic techniques, primarily quality metrics can be used. Furthermore, since e-business solutions usually combine different independent applications and processes, there is a big chance for the need to build a solution that's able to integrate heterogeneous systems. Consequently, consistency of applied analysis reached by language independency of applied tools must be considered and used [26]. An important characteristic of static analysis tools is their consistent applicability during all phases in the development of e-business solutions. The SSQSA framework presented in [27] is a set of static quality software analyzers that has all prerequisites to be successfully applied in quality assessment of e-business solutions.

It is somehow impossible for a single study to explain the impact of individual factors on the user's BI and actual usage of a particular technology in a different technology type and cultural context. Furthermore, researchers have to limit the number of variables in their research mode. As the number of existing studies grows, the knowledge about the impact of individual factors is enhanced. There are methods, which can be used to study evidence from results in existing empirical research. The main objective of this study is to systematically collect empirical data from existing e-business acceptance literature and to conduct a meta-analysis of the causal effect sizes of individual factors influencing user's behavioral intentions and usage of different e-business technology types.

3. Research methodology

This study involved several discrete activities, which will be discussed in the following subsections. A systematic literature review (SLR) was conducted in order to gain all relevant quantitative data about e-business acceptance from existing literature. A meta-analysis of causal effect sizes was conducted in order to summarize, evaluate and analyze moderator effect sizes.

3.1. Research model

This study is limited to empirical studies, conducted over the last 15 years, reporting the results of multiple regressions or structural equation modeling when explaining the causal effects of different factors on user's behavioral intentions and actual usage of e-business technologies. First, we wanted to analyze whether causal effect sizes of TAM-related factors analyzed in existing studies vary between different e-business consumer types, device types and continent settings.

As previously mentioned, there are different types of e-business related to the type of parties being involved. B2B includes online interactions between business organizations or partners, where B2C involves interaction between organizations and their customers. B2B solutions can differ from B2C solutions in their goals and ways of conducting online business. In B2C settings, successful online business can be a result of user's personal experience when buying or selling online, which can be influenced by several user's characteristics and factors such as perceived design quality, perceived risk, etc. First, we wanted to know, if there is a difference in factors and their impact on accepting e-business solutions related to the type of consumers. Accordingly, we formulated the following research question:

RQ_1: *What is the influence of the consumer type on the effect sizes of causal relationships between TAM-related factors?*

Today, users expect access to online business regardless of time, place or device. Mobile e-business using smartphones and tablets is becoming a routine for consumers. This can also be a result of user's several year e-business experience and the fact that they want to be mobile. Though, there can be differences in e-business solutions which were optimized for desktop computers and solutions appropriate for mobile devices. When implementing e-business solutions, e-business providers have to understand factors related to the type of device a consumer uses. Therefore, we formulated the next research question:

RQ_2: *What is the influence of the device type on the effect sizes of causal relationships between TAM-related factors?*

E-business is a business without borders and can be conducted anywhere in the world. However, there are cultural differences that need to be considered when moving business across borders. During the design and development of e-business solutions,

consumer's context and location will have to be understood and considered. Quality user's experience can be a result of sophisticated services based on his or her location when doing online business. User's location services will inform the e-business provider how to engage the user in order to fully satisfy his or her needs. To understand, whether there are differences in factors affecting the user's e-business acceptance related to the culture or place that he or she is from, we formulated the following research question:

RQ_3: *What is the influence of the continent (geographic area) on the effect sizes of causal relationships between TAM-related factors?*

In academic research, researchers often use students as respondents in their studies because of convenience and availability. The generalizability of the results in studies, where students are used as respondents, is often questionable. We therefore wanted to analyze if the causal effect sizes between individual TAM-related constructs vary between different respondent types. Accordingly, the last research question was formulated:

RQ_4: *Is it possible to use students in e-business acceptance studies as surrogates for "real" e-business users?*

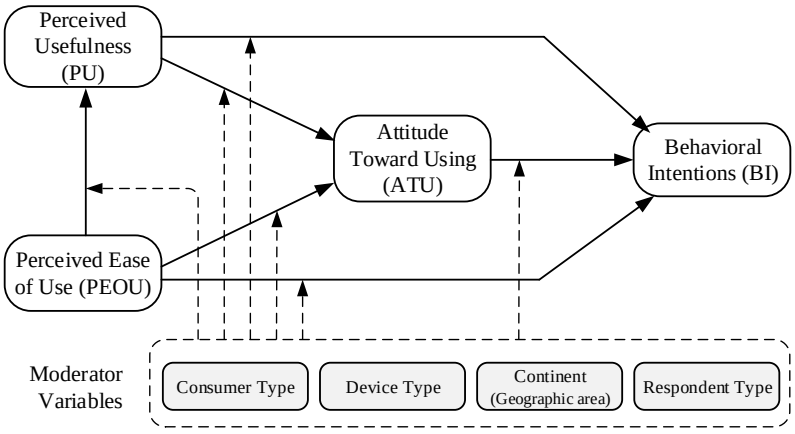

Fig. 1. Research Model

The relevant outcomes for this study were causal relationships between factors from different IT acceptance theories (like TAM, unified theory of acceptance and use of technology - UTAUT, etc.) as well as causal relationships between factors, which are commonly used to extend the basic IT acceptance theoretical model. Since the TAM model is the most common theory being applied in technology acceptance research, we expected to get enough relevant quantitative data about the causal relationships between TAM-related constructs. Therefore, our research model was based on the TAM model (see Fig. 1).

Since this study incorporated a population of e-business technology users in different e-business and consumer type settings, where users connect to e-business services through different channels, we proposed the following four moderating variables (see

Fig. 1): consumer type, device type, respondent type and continent (geographic area). At first, we wanted to understand the differences in the size of the impact for individual factors in user's perceptions when using B2C technology in comparison with B2B technology. Next, we wanted to understand differences in user's perceptions when connecting to e-business services, either using a stationary device through standard internet connection and protocols or through mobile technologies. The "Continent (geographic area)" variable was proposed as a variable with a moderating impact on causal relationships between individual TAM factors because we wanted to analyze differences about the acceptance of e-business technology in different geographical settings. Finally, the moderator variable "Respondent type" was proposed to investigate whether the factors' impacts of individual TAM-related factors are different for students or not.

3.2. Systematic literature review

The SLR process followed procedures proposed by Kitchenham and Charters [28], which were applied and reported in existing studies [29, 30]. Two independent researchers searched for relevant studies using digital libraries (like Science Direct, ACM Portal, IEEE Explore, Google Scholar, Emerald, etc.) and publicly available search engines (Google, Yahoo, etc.). The primary sources, which were found to be relevant, were then additionally checked for other relevant references. The final list of relevant studies was constructed and stored in a Mendeley database by a third researcher, who reviewed the search results of the two researchers by applying several inclusion and quality assessment criteria:

- The study should be published in a peer reviewed journal or conference proceedings.
- The paper should provide complete information about: (1) the theory that was used for designing the study, (2) the method that was used to collect empirical data, (3) the data analysis method.
- The study must use an IT acceptance theory (like TAM, UTAUT, etc.) as a ground theory for study design.
- The paper reports information about causal relationships analysis results in terms of effect size (ß) and the significance level of the causal effect between individual variables.
- E-business technology type and consumer type are clearly defined. and
- The sample is clearly described, together with information about the sampling process.

In the coding process, quantitative data was extracted by two independent researchers, who reviewed the studies and filled out a form with the following data: the title of the paper, the journal/conference proceedings title; the year of publication; the continent (geographical data about where the study was conducted), IT acceptance theory (TAM, UTAUT, etc., or Other, if the authors evaluated their own theory), sample

size, respondent type (students, non-students), device type (stationary/mobile/interactive TV), and consumer type (B2C, B2B, C2C, etc.). Information about the causal relationships assessed in the study was recorded with the following data: independent variable, dependent variable, coefficient size (ß), and significance level (*, **, ***, NS). A third researcher – the supervisor reviewed data of both researches, corrected possible inconsistencies and created a final record of data, used in the following analysis.

3.3. Data analysis

The statistical analysis of causal effect sizes was based on a database containing 907 records about causal relationships, evaluated in the SLR process. First, descriptive statistics were used to analyze the samples, which were used to analyze TAM-related paths. For different sample types, the following statistics were assessed: number of samples, minimum sample size, maximum sample size, average sample size and cumulative sample size. Next, descriptive statistics were used to describe the causal effect sizes of individual TAM related causal paths in general. The same descriptive statistics have also been estimated in relation to different sample types.

A meta-analysis was conducted in order to statistically analyze and integrate findings from multiple studies. Although a meta-analysis has been a common statistical method applied in other research domains like medicine, in the past few years meta-analyses have also been recognized as a rigorous and robust statistical method in the field of software engineering. The meta-analysis in this study was conducted on a "random-effect" basis, because individual studies were taken from populations with varying effect sizes. To test the degree of heterogeneity, the metrics Q and I^2 were assessed. Hedges' g statistic was the metric that was used to describe the differences in the arithmetic means of individual studies in relation to the different sample types.

4. Results

In the SLR process, 89 papers were found to be relevant for our study, as listed in Table 1. 81 papers were published in a journal and eight in conference proceedings. Table 1 provides data extracted in the coding process about continent, acceptance theory, sample size, respondent type, e-business type, device type and consumer type.

Table 1. E-business acceptance literature review

Study	Continent	Theory	Sample size	Respondent type	Device type	Consumer type
[31]	N. America	TAM, TPB	172	non-students	stationary	B2C
[32]	N. America	TAM	274/266	students + non-students	stationary	B2C
[33]	N. America	TAM	253	non-students	stationary	B2C
[34]	Asia	TAM	114	non-students	stationary	B2C
[35]	Oceania	TAM	392	non-students	stationary	B2C
[17]	Asia	TRA, TAM	212	non-students	stationary	B2C

Study	Continent	Theory	Sample size	Respondent type	Device type	Consumer type
[36]	N. America	TAM	281	non-students	stationary	B2C
[13]	N. America	TAM, IDT	253	non-students	stationary	B2C
[37]	N. America	TAM	118	non-students	mobile	B2B
[38]	Europe	TAM	240	non-students	stationary	B2C
[39]	Asia	TAM, TRA	886/115	non-students	interact. TV	B2C
[40]	Asia	TRA, TAM	478	non-students	stationary	B2C
[41]	Asia	UTAUT	196	non-students	stationary	B2B
[42]	Asia	TAM, IDT	310	non-students	mobile	B2C
[43]	Asia	TPB, Other	201	non-students	stationary	B2C
[44]	Africa	TPB	126	non-students	stationary	B2C
[45]	Asia	TAM	243	students	stationary	B2C
[46]	Europe	TAM	497	non-students	stationary	B2C
[47]	Asia	TAM	174	non-students	stationary	B2B
[48]	N. America	TAM	78	students	stationary	B2C
[49]	Asia	TAM	942	non-students	stationary	B2C
[50]	Europe	TAM, IDT	542	non-students	mobile	B2C
[51]	Asia	TAM	139	students	stationary	C2C
[52]	Asia	TAM, TPB	202	non-students	mobile	B2C
[53]	Asia	TAM, TTF	388	non-students	stationary	B2B
[54]	Asia	TAM	86	non-students	mobile	B2B
[55]	Europe	TPB	675	non-students	stationary	B2C
[56]	Global	TAM	312	non-students	stationary	B2C
[57]	Asia	TAM	204	non-students	stationary	B2C
[58]	N. America	TAM	298	students	stationary	B2C
[59]	Asia	TAM, IS success	170	non-students	stationary	B2B
[60]	Asia	TAM, TPB	386	non-students	stationary	B2C
[61]	Asia	TAM	495	non-students	stationary	B2C
[62]	Asia	TAM	103	students	stationary	B2C
[63]	N. America	TAM	266	non-students	stationary	B2C
[64]	Asia	TAM	270	students	stationary	B2C
[65]	Europe	TAM	360	non-students	mobile	B2C
[66]	Asia	TAM, UTAUT	296	non-students	mobile	B2C
[25]	Global	TAM, TPB, IDT	156	non-students	stationary	B2B
[67]	Europe	TAM	100	students	stationary	B2C
[68]	N. America	TAM	134	students	stationary	B2B
[69]	Europe	Other	101	non-students	stationary	B2B
[21]	Asia	TAM	269/118/151	students + non-students	mobile	B2C
[70]	Asia	TTF, UTAUT	250	students + non-students	mobile	B2C
[71]	Europe	TAM	588/255	non-students	stationary	B2C
[72]	N. America	TPB, UTAUT	122	students	mobile	B2C
[73]	Europe/Asia	TAM, TPB	232/386	students	stationary	B2C
[74]	Asia	TAM, TPB	316	non-students	stationary	B2B
[75]	N. America	Other	224	non-students	stationary	B2B
[76]	Asia	TAM, TTF	227/251	non-students	stationary	C2C
[77]	Global	TAM	195	non-students	stationary	B2B
[78]	N. America	TRA, UTAUT	322	students	stationary	B2C

Study	Continent	Theory	Sample size	Respondent type	Device type	Consumer type
[79]	Oceania	TRA	383	non-students	stationary	B2C
[80]	Europe	TAM	1447	non-students	mobile	B2C
[24]	Asia	Other	217	students	stationary	B2C
[81]	Asia	TAM, TTF	240	non-students	mobile	B2C
[82]	Asia	TAM	52/52	students/students	stationary	B2C
[83]	Asia	TAM	NA	non-students	stationary	B2C
[16]	N. America	UTAUT, TAM	598	non-students	stationary	B2C
[84]	Asia	TAM	284	non-students	stationary	B2B
[85]	Asia	Other	327	students	stationary	B2C
[86]	Europe	UTAUT	1083	non-students	stationary	B2C
[87]	Asia	TAM	128	students + non-students	stationary	B2C
[88]	Oceania	TAM	603	non-students	mobile	B2C
[89]	Asia	UTAUT, TTF	271	non-students	stationary	B2B
[90]	N. America/Africa	TAM, TPB	118/201	users	stationary	B2C
[91]	N. America	TAM	125	students	stationary	B2C
[92]	Asia	TAM	262/262	users	mobile	B2C
[93]	Europe	TAM	124	users	stationary	B2C
[94]	Asia	UTAUT	140	users	mobile	B2C
[95]	Asia	TAM	262	students	mobile	B2C
[96]	Asia	TAM	1532	users	stationary	B2C
[97]	Europe	TAM	835/1177	users	mobile	B2C
[98]	Asia	TAM	436	users	stationary	B2C
[99]	Asia	TAM	361	students	mobile	B2C
[100]	Asia	TAM	156	users	mobile	B2C
[101]	Asia	UTAUT	574/246	students	stationary	B2C
[102]	Europe	UTAUT	249	students	stationary	B2C
[103]	Asia	TAM	402	users	mobile	B2C
[104]	Europe	TAM	439	users	mobile	B2C
[105]	Africa		252	users	mobile	B2C
CONFERENCE PAPERS						
[106]	Europe	TAM, IDT, TPB	948	non-students	mobile	B2C
[107]	N. America	TAM	162	non-students	stationary	B2B
[108]	Europe	TAM	623	non-students	stationary	B2C
[109]	Asia	TAM	214	non-students	stationary	C2C
[110]	Asia	TAM, Other	341	non-students	stationary	B2C
[111]	Asia	UTAUT	186	students	mobile	B2C
[112]	Asia	TAM	314	non-students	stationary	B2C
[113]	Asia	TAM, Other	231	non-students	mobile	B2C

Table 2 summarizes the following statistics about different sample types: number of samples, minimum sample size, maximum sample size, average sample size and cumulative sample size. The statistics provided in Table 2 also reveal the distribution of the studies in relation to different sample types. It should be emphasized that the cumulative number of samples is greater than the number of all papers identified in the SLR process. This outcome is normal because several papers were reporting multiple studies (see Table 1).

Table 2. Sample statistics for different consumer type, device type, user type and continent

Sample type		N of samples	MIN sample size	MAX sample size	AVE sample size	Cumulative sample size
Consumer Type	B2C	80	52	1532	371	29276
	B2B	14	86	316	185	2587
	C2C	4	139	251	208	831
Device Type	stationary	70	52	1532	305	21021
	mobile	26	118	1447	410	10672
	interactive	2	115	886	501	1001
Respondent Type	students	24	52	574	218	4355
	non-students	70	86	1447	378	22690
	students +	4	128	269	216	647
Continent	Africa	3	126	252	193	579
	Asia	52	52	1532	302	15413
	Europe	20	100	1447	543	10863
	Global	3	156	312	221	663
	North	17	78	598	223	3798
	Oceania	3	383	603	459	1378
Overall		98	52	1532	337	32694

4.1. Causal effect size analysis

Table 3. Summary of path coefficients between TAM constructs

	PEOU→ATU	PU→ATU	ATU→BI	PEOU→BI	PU→BI	PEOU→PU	BI→U
Number of samples	29	33	28	39	57	56	9
Cumulative sample size	12194	12981	11762	12484	18694	18129	1301
Mean	0,232	0,422	0,513	0,176	0,316	0,469	0,473
Median	0,267	0,410	0,516	0,177	0,280	0,455	0,399
Stand. Deviation	0,189	0,203	0,211	0,094	0,213	0,213	0,251
Minimum	-0,184	0,100	0,071	-0,014	-0,190	-0,173	0,121
Maximum	0,724	0,880	0,960	0,389	0,847	0,950	0,890

Table 3 provides a summary about TAM-related causal relationships from existing e-business acceptance research. Although the causal path PU→U was analyzed in existing literature, the number of studies that analyzed this causal relationship is minimal. Therefore, the causal relationship PU→U was taken out of the moderator analysis. According to the summary, the strongest effects can be found in the following causal relationships: ATU→BI, BI→U, PEOU→PU and PU→ATU. The smallest mean size was assessed for the causal relationship PEOU→BI.

Subsequently, the coefficient sizes between TAM-related factors in relation to different samples types were analyzed. According to the statistics provided in Table 3,

only nine studies have analyzed the impact of BI on U. Therefore, the causal relationship BI→U in relation to different samples types could not be analyzed in this study.

The box-plot diagrams in Figs. 2-7 show the intervals of the causal effect sizes of the six analyzed causal relationships for different sample types. When comparing the effect sizes in different causal relationships for students and non-students, the effect sizes mostly overlap. However, a difference was found in the case of PEOU→ATU and PEOU→BI, where the effect size was larger for students. The perceptions of students when using an e-business technology are very close to those of non-students.

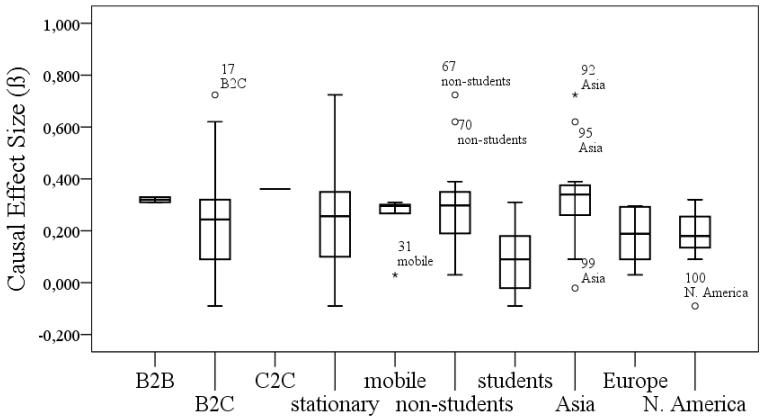

Fig. 2. PEOU → ATU

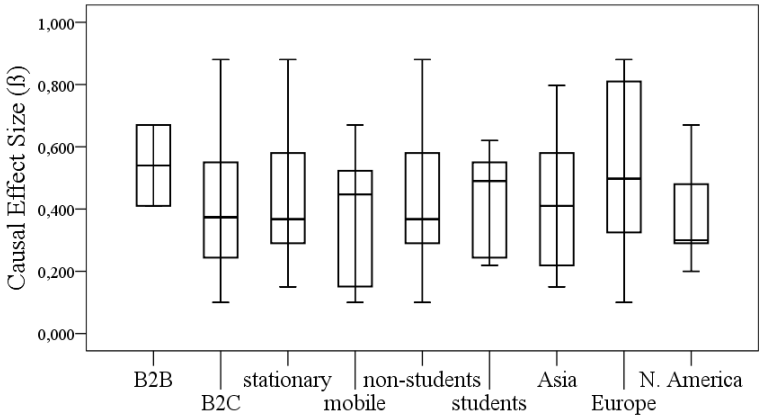

Fig. 3. PU → ATU

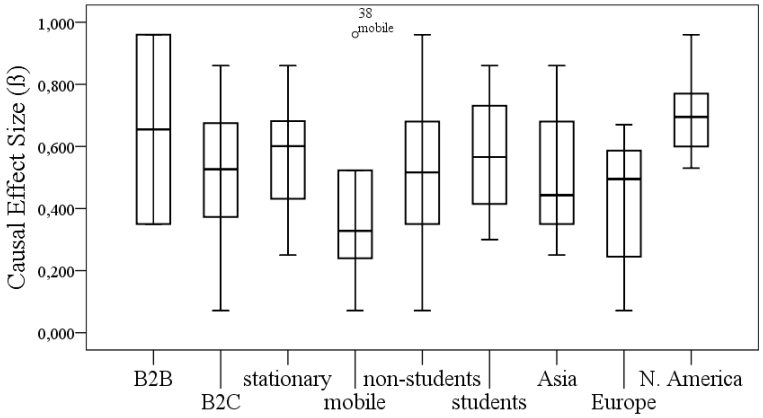

Fig. 4. ATU → BI

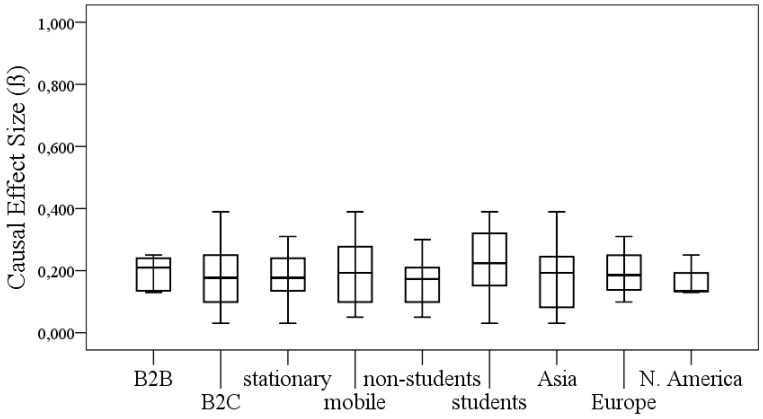

Fig. 5. PEOU → BI

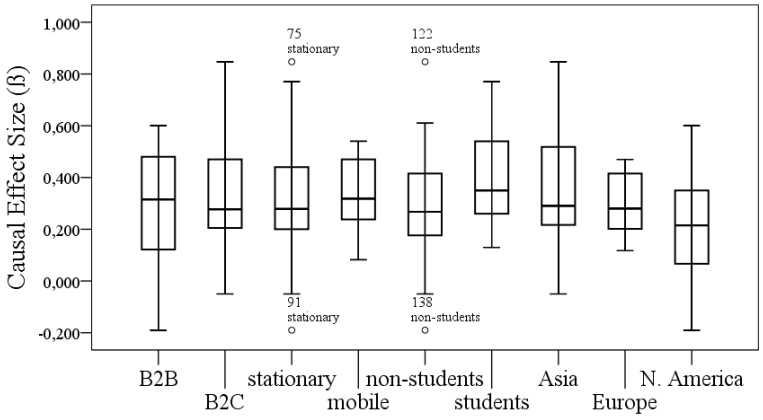

Fig. 6. PU → BI

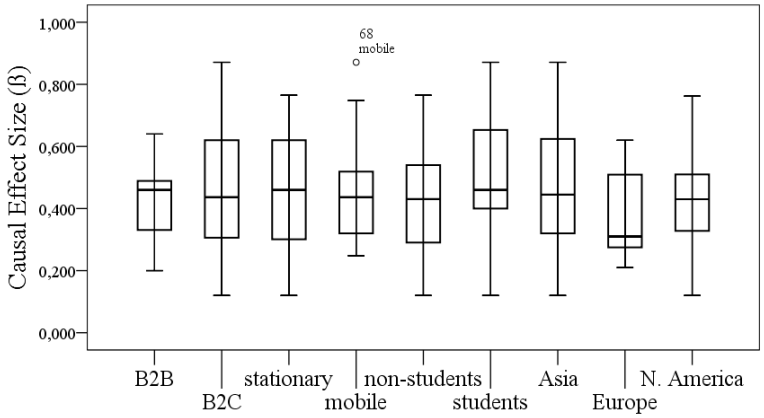

Fig. 7. PEOU → PU

4.2. Moderator analysis

The meta-analysis was conducted for TAM-related causal relationships. Prior to conducting the meta-analysis, records with insufficient data were excluded. Thus, we excluded causal relationships from studies for which the authors did not provide information about the sample size and information about the significance level. It is not uncommon for authors to fail to provide full information about the results of the structural models.

Table 4. Summary of the effect size of path coefficients

	PEOU→ATU	PU→ATU	ATU→BI	PEOU→BI	PU→BI	PEOU→ PU
Number of samples	29	33	28	39	57	56
Total sample size	12194	12981	11762	12484	18694	18129
Hedges' *g*	0,482	1,046	1,341	0,363	0,688	1,194
Standard error	0,075	0,103	0,119	0,030	0,057	0,074
Variance	0,006	0,011	0,014	0,001	0,003	0,006
95% Lower limit	0,336	0,845	1,107	0,304	0,575	1,049
95% Higher limit	0,629	1,248	1,575	0,421	0,800	1,340
Z	6,443	10,158	11,240	12,142	11,978	16,083
p (effect size)	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001
Heterogeneity test (*Q*)	411,048	822,946	775,596	88,658	689,015	952,215
df (*Q*)	28	32	27	38	55	54
p (heterogeneity)	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001
I^2	93,18%	96,11%	96,52%	57,14%	92,02%	94,33%

The meta-analysis of causal effect sizes was conducted on a "random effects" basis. The underlying assumption was that every study included was taken from a population that is likely to have a different effect size to any other study included in the meta-

analysis. In order to validate the use of a random effects analytics base, the heterogeneity test Q was assessed. Because the Q statistic can exhibit a poor ability to detect true heterogeneity among studies when the meta-analysis includes a small number of studies, we additionally evaluated the heterogeneity with the metric I^2. The I^2 measures the extent of true heterogeneity, where the I^2 index can be interpreted as the percentage of total variability in a set of effect sizes due to true heterogeneity – the intra-study variability [114].

Table 4 summarizes the estimation of the effect sizes of individual TAM-related path coefficients together with the results of heterogeneity tests. Q estimates for all path coefficients were significant and exceeded the minimum value - df (*Q*), resulting in a rejection of the null hypothesis about homogeneity for all paths. According to the I^2 estimates and the classification proposed by Higgins et al. [115], high heterogeneity was confirmed in all causal paths with the exception of the causal path PEOU→BI, where heterogeneity was moderate. The results from both heterogeneity tests confirmed the random-effects model as an appropriate basis for conducting the meta-analysis.

In the following subsections, the moderator analysis is discussed, in which the combined effect sizes (Hedges' g) for six causal paths for different sample types were assessed together with standard error, variance, confidence intervals, Z-values and p-values.

Consumer type

Table 5. Effect sizes with "consumer type" as a moderator variable

	Number of studies	Hedges' g	Standard error	Variance	95% Conf. interval Low	High	Z	p
PEOU→ATU								
B2B	2	0,684	0,102	0,010	0,484	0,884	6,715	0,000
B2C	26	0,458	0,008	0,006	0,301	0,614	5,724	0,000
PU→ATU								
B2B	2	1,310	0,447	0,200	0,442	2,196	2,947	0,003
B2C	30	1,043	0,110	0,012	0,828	1,259	9,485	0,000
ATU→BI								
B2B	2	3,744	3,033	9,202	-2,201	9,690	1,234	0,217
B2C	25	1,287	0,122	0,015	1,049	1,526	10,572	0,000
PEOU→BI								
B2B	7	0,358	0,056	0,003	0,248	0,467	6,410	0,000
B2C	30	0,374	0,034	0,001	0,308	0,441	11,043	0,000
PU→BI								
B2B	10	0,795	0,213	0,045	0,378	1,213	3,737	0,000
B2C	42	0,635	0,059	0,004	0,518	0,751	10,687	0,000
PEOU→PU								
B2B	11	0,936	0,191	0,037	0,562	1,311	4,897	0,000
B2C	42	1,194	0,079	0,006	1,038	1,350	15,018	0,000

First, studies were clustered according to consumer type. Table 5 shows that the effect sizes were significant for both consumer types. Although the effects measured for

PU→ATU and ATU→BI were large for both consumer types, we can see that the effect is larger in the case of B2B e-business technology. A medium effect size was assessed for the path PU→BI for both consumer types. On the other hand, PEOU can have a larger impact on PU in the case of B2C e-business technology.

Device type

Next, studies were labeled according to the device, which is used by end users to connect to e-business technology and services. The estimated effect sizes were close for all causal paths and for both device types with one exception (see Table 6). The effect size estimation for the causal path PU→ATU shows a large effect in the case of doing e-business using a stationary device and a medium effect for mobile users.

Table 6. Effect sizes with "Device type" as moderator variable

	Number of studies	Hedges' g	Standard error	Variance	95% Conf. interval Low	High	Z	p
PEOU→ATU								
stationary	22	0,531	0,097	0,009	0,341	0,722	5,465	0,000
mobile	5	0,489	0,144	0,021	0,207	0,772	3,396	0,001
PU→ATU								
stationary	25	1,101	0,131	0,017	0,844	1,359	8,379	0,000
mobile	6	0,901	0,235	0,055	0,441	1,361	3,837	0,000
ATU→BI								
stationary	22	1,377	0,115	0,013	1,151	1,602	11,964	0,000
mobile	6	1,130	0,241	0,058	0,659	1,602	4,699	0,000
PEOU→BI								
stationary	22	0,371	0,032	0,001	0,309	0,433	11,757	0,000
mobile	17	0,372	0,054	0,003	0,266	0,479	6,844	0,000
PU→BI								
stationary	37	0,705	0,077	0,006	0,555	0,856	9,186	0,000
mobile	17	0,738	0,088	0,008	0,566	0,910	8,407	0,000
PEOU→PU								
stationary	37	1,178	0,098	0,010	0,985	1,370	11,998	0,000
mobile	16	1,111	0,109	0,012	0,987	1,325	10,325	0,000

Continent

Additionally, to study the moderating role of the culture/continent in causal relationships, studies were labeled based on the continent where the individual study was conducted and/or e-business technology was carried out (see Table 7). Effect size estimations for the relationship PEOU→ATU show that the effect is larger for users from Asia than for users from Europe or North America. Perceived usefulness has a large effect on users' attitudes when using an e-business technology in Asia and especially in Europe. A difference in the effect size estimations was also found for the paths PEOU→BI and PEOU→PU. Statistics show that PEOU can have a larger influence on a user's PU for users from Asia and North America.

Table 7. Effect sizes with "continent" as moderator variable

	Number of studies	Hedges' g	Standard error	Variance	95% Conf. interval Low	High	Z	p
PEOU→ATU								
Asia	14	0,654	0,127	0,016	0,404	0,904	5,132	0,000
Europe	6	0,375	0,116	0,013	0,149	0,602	3,243	0,001
North America	7	0,339	0,111	0,012	0,120	0,557	3,039	0,002
PU→ATU								
Asia	16	0,971	0,137	0,019	0,702	1,239	7,084	0,000
Europe	6	1,569	0,347	0,121	0,888	2,249	4,515	0,000
North America	9	0,874	0,129	0,017	0,621	1,126	6,774	0,000
ATU→BI								
Asia	14	1,190	0,147	0,021	0,903	1,478	8,120	0,000
Europe	7	0,993	0,215	0,046	0,572	1,415	4,619	0,000
North America	6	2,335	0,327	0,107	1,695	2,976	7,146	0,000
PEOU→BI								
Asia	25	0,366	0,043	0,002	0,282	0,450	8,531	0,000
Europe	8	0,379	0,053	0,003	0,276	0,482	7,195	0,000
North America	3	0,341	0,099	0,010	0,148	0,534	3,460	0,001
PU→BI								
Asia	37	0,735	0,073	0,005	0,593	0,877	10,122	0,000
Europe	7	0,637	0,128	0,016	0,386	0,888	4,974	0,000
North America	9	0,403	0,137	0,019	0,134	0,672	2,940	0,003
PEOU→PU								
Asia	35	1,312	0,100	0,010	1,116	1,508	13,106	0,000
Europe	7	0,879	0,130	0,017	0,625	1,133	6,789	0,000
North America	10	1,074	0,176	0,031	0,728	1,420	6,087	0,000

Respondent type

Table 8 lists the estimated effect sizes for different respondent types. The effect sizes were significant for both respondent types for all causal paths. Effect size estimations were very similar for both respondent types for all causal paths with the exception of relationships PEOU→ATU and PEOU→BI. The effect size of PEOU on ATU was small for students and medium for non-students. In case of PEOU→BI the effect size of PEOU on BI was small for non-students and medium for students.

Table 8. Effect sizes with "respondent type" as moderator variable

	Number of studies	Hedges'g	Standard error	Variance	95% Conf. interval Low	High	Z	p
PEOU→ATU								
non-students	24	0,541	0,081	0,007	0,382	0,700	6,673	0,000
students	5	0,142	0,020	-0,136	0,420	1,01	0,317	0,000
PU→ATU								
non-students	27	1,060	0,116	0,013	0,833	1,288	9,135	0,000
students	6	0,972	0,186	0,035	0,607	1,337	5,224	0,000

ATU→BI								
non-students	24	1,317	0,129	0,017	1,065	1,569	10,244	0,000
students	4	1,485	0,296	0,087	0,906	2,064	5,025	0,000
PEOU→BI								
non-students	27	0,335	0,031	0,001	0,265	0,386	10,500	0,000
students	12	0,482	0,066	0,004	0,352	0,612	7,255	0,000
PU→BI								
non-students	40	0,624	0,065	0,004	0,497	0,751	9,643	0,000
students	16	0,866	0,122	0,015	0,627	1,105	7,109	0,000
PEOU→PU								
non-students	37	1,077	0,081	0,007	0,919	1,236	13,316	0,000
students	18	1,505	0,185	0,034	1,143	1,867	8,147	0,000

Summary

Table 9 provides an interpretation of the effect sizes estimated in this study, according to the categories proposed by Kampenes et al. [116]. This interpretation reveals that, in general, a user's attitude can have a similar impact on a user's intentions to use an e-business technology for different respondent and device types in both e-business technology type settings. However, the impact was higher for users from Asia when compared to users from Europe and North America. The perceived ease of use can have a medium impact on the user's attitude towards using e-business technology in different e-business and device type settings. However, for the same causal relationship, a small effect size was identified in case of students and users that come from North America.

Table 9. The interpretation summary of effect sizes for moderator variables

	PEOU→ATU	PU→ATU	ATU→BI	PEOU→BI	PU→BI	PEOU →PU
E-business type						
B2B	M	L	L	S	M	M
B2C	M	L	L	S	M	L
Device type						
stationary	M	L	L	S	M	L
mobile	M	M	L	S	M	L
Continent						
Asia	M	M	L	S	M	L
Europe	M	L	M	M	M	M
North America	S	M	L	S	M	L
Respondent type						
non-students	M	L	L	S	M	L
students	S	L	L	M	M	L
Overall	M	L	L	M	M	L

Notes: S – Small size, M – Medium size, L – Large size

The differences in effect sizes were found for relationship between perceived usefulness and a user's attitude toward using. Although the sizes of the effect were similar for both consumer type and respondent type settings, this was not the case for different device types and geographic areas or continents. It seems that perceived

usefulness can have a larger impact on user's attitude for students from Europe that connect to e-business using a stationary device. Differences in effect sizes were also found in the case of the relationship between perceived ease of use and behavioral intentions. Although the effect size was mostly small for different sample types in case of the relationship between perceived ease of use and behavioral intention, a medium effect for this relationship was found in the case of users from Europe and students as respondent types. The perceived usefulness has a medium effect on user's intentions to use an e-business technology. The perceived ease of use can have different effect on perceived usefulness for different e-business technology type settings, where the effect can be bigger for B2C type. Furthermore, it seems that this effect is a bit smaller for European users when comparing with users from Asia and North America.

4.3. Threats to validity

As in all empirical studies, there are threats to the validity of the results that need to be identified and discussed. Because quantitative data was collected from existing literature; there is a threat of invalid data published in existing works. Our study primarily analyzed papers that were published in quality peer-reviewed journals and conference proceedings. However, we have to rely upon the quality of the reviewing process that the papers went through before being published.

To minimize the threat to the validity of empirical data that was assessed in the SLR process, two independent researchers conducted a search for relevant literature and a third researcher compared the results of both researchers and constructed a final list of papers. Additionally, to overcome the possibility of errors in the coding process, two independent researchers performed a review of relevant literature and built two separate databases of causal relationships. A third researcher built the final database by comparing two databases and checking for differences in the data. If differences were found, the researcher repeated the review and corrected the mistakes in the final version of the empirical data.

5. Discussion and implications

The meta-analysis of the causal effect sizes showed that a user's attitude can have a large impact on user intentions for employing an e-business technology for different respondent and device types in both e-business technology type settings. The results show that a user's attitude can be more significantly influenced by perceived usefulness rather than the perceived ease of use. A similar difference was also found for these two factors with regard to user's intentions to use a certain e-business technology.

In terms of the moderating effect of different e-business consumer types (RQ1), the difference in effect sizes was only shown for the relationship between perceived ease of use and perceived usefulness, where the effect was larger for the B2C type of e-business technology. This suggests that in order for an e-business technology to be accepted, especially in B2C technology settings, it must provide appropriate services and characteristics, which the end user recognizes as valuable for their daily work. This

difference also shows that researchers must be cautious when generalizing B2C study results to other e-business type contexts and vice versa.

The search for moderators in terms of the device type being used to connect to e-business technologies (RQ2) showed differences in the relationship between perceived usefulness and user's attitude toward using e-business technology, where the effect size was smaller for mobile users. Therefore, the results of the mobile business acceptance study can be generalized to other e-business type contexts, but with special care.

When it comes to the moderating effect of different continents (RQ3), this study showed differences for almost all TAM-related causal relationships with exception of the relationship between perceived usefulness and behavioral intentions. This result shows that cultural differences are very important for the e-business adoption process and must be considered very carefully.

The moderator analysis for respondent type (RQ4) showed differences for two causal relationship. Perceived ease of use can have a larger impact on user's attitude toward using e-business technology for real e-business users when comparing with students. Contrary, the impact of the perceived ease of use on user's intentions to use e-business technology can be larger for students compared to real users. Although minimal differences were identified in causal relationships for different respondent types, we can conclude that students are appropriate respondents in an e-business acceptance study. However, researchers must be careful with generalization of results when conducting e-business acceptance studies using students as respondents.

The findings of this study have several implications. For e-business technology developers and service providers the moderator analysis has shown that the effect size of individual factors varies in relation to different continents and cultural settings. E-business service providers and other organizations that plan to move their solutions to the global market must therefore understand these differences. These results also call for more studies that will analyze the cultural differences in the e-business adoption process. Although there are few attempts at studying the factors that influence e-business acceptance in multiple-cultural settings, there is a lack of research that would analyze differences between factor effects for different cultures in more detail. For researchers, students can be used as surrogates for real e-business users when investigating factors that influence the end user's acceptance and use of an e-business technology. This study also showed that in existing literature there is little evidence regarding a user's behavioral intentions for predicting the actual usage of an e-business technology. To analyze this relationship we would need a larger sample. Therefore, future research needs to address this causal relationship in order to better explain whether a user's intentions can lead to the actual usage of an e-business technology.

6. Limitations

This study has some limitations that need to be discussed. The meta-analysis conducted in this study embraced empirical evidence from existing literature. Because of the limited number of studies in existing literature, the search for moderating factors was limited to two e-business consumer types: B2B and B2C. When sufficient empirical evidence from studies about e-business adoption for other consumer type contexts like

C2C or B2E becomes available, more studies about the influence of consumer type on e-business adoption can be made.

Next, because of the limited space of evidence, samples in this study were classified into cultural types according to the continent from which the sample originated. Because of the lack of existing literature, the moderator analysis about the cultural influence was limited to three continents: Asia, Northern America and Europe. Because there were too little studies analyzing e-business adoption in other continents, like Africa, Australia, etc., the differences in causal effect sizes for these cultural settings could not be analyzed. However, this study enriches previous attempts at conducting a meta-analysis in the field of e-business. The meta-analysis conducted by Zhang et al. [5] for example, analyzed the moderating effect of culture for eastern and western cultural settings. We believe that in the future, cultural differences should be analyzed in more detail. For example, Asia is the world's largest, most populous, and consequently most culturally diverse continent. When there is enough evidence in existing literature, the moderating effect of culture type on e-business adoption should be analyzed on a national level.

7. Conclusion & future work

So far, e-business acceptance has been recognized as an important field by academics, where the interest in research has been growing over the past few years. Trends in the e-business industry show that e-business technology is going to be one of the most important global markets. E-business is moving to the mobile world. Future technologies (like interactive television, for example) will improve the reach of e-businesses and lift the user experience to new levels. E-business solutions will have to adapt to new technologies and e-business solution providers will have to understand the important factors driving new e-business settings.

This study combined and analyzed empirical data from existing e-business acceptance literature. The main objective in this study was to analyze the effect sizes of TAM-related factors and to identify the moderating effect of consumer type, device type, respondent type and continent in these causal relationships. The qualitative analysis conducted in the systematic literature review of 89 papers about e-business acceptance produced 907 records about causal relationships, which represented the basis for conducting a quantitative meta-analysis. The moderating factors analysis showed differences in causal effect sizes across different continents and for different e-business type and device type settings. A minimal moderating effect was found for different respondent types, indicating that students can be used as surrogates for real e-business users in e-business acceptance studies.

Additional research is needed that will analyze the moderating role for other classes of e-business technology types (C2C, B2E, B2G, etc.), device types (for example interactive TV), and continents (South America, Africa, Oceania, etc.). This study also showed that there is room for further research about factors and causal relationships proposed by other acceptance theories like UTAUT [117] or the extended version of UTAUT [118]. It is evident that for these new acceptance theories, there is a need for empirical validation in the field of e-business acceptance.

In our future research, we also plan to conduct a meta-analysis of external factors when the number of e-business acceptance studies provides a sufficient body of evidence regarding the causal impacts of external factors that affect user's intentions to use an e-business technology. Furthermore, we will search for other moderating factors.

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