DOI: 10.2478/orga-2018-0010

DE GRUYTER OPEN

Factors Affecting the Intentions to Use RFID Subcutaneous Microchip Implants for Healthcare Purposes

Borut WERBER, Alenka BAGGIA, Anja ŽNIDARŠIČ

University of Maribor, Faculty of Organizational Sciences, Kidričeva cesta 55a, SI-4000 Kranj, Slovenia
borut.werber@fov.uni-mb.si, alenka.baggia@fov.uni-mb.si, anja.znidarsic@fov.uni-mb.si

Background and Purpose: While there are many studies regarding the adoption of Radio Frequency Identification Devices (RFID), only a few of them deal with RFID subcutaneous microchip (RFID-SM) usage by individuals. After the first *in vivo* tests conducted on volunteers from 1998 to 2000, the use of RFID-SM in healthcare remains limited. This study examines the likelihood of adopting RFID-SM in healthcare from the end user's point of view.
Design/Methodology/Approach: The aim of this paper is to develop and evaluate the model for analysing the acceptance of RFID-SM adoption. An extended Technology Acceptance Model (TAM) for RFID-SM adoption is proposed and empirically tested in a cross-sectional study. Online survey was conducted using a convenience sample of 531 respondents. In addition to the three original components of TAM (Perceived Usefulness, Perceived Ease of Use, and Behavioural Intentions to Use), three external variables (Health Concerns, Perceived Trust, and Age) were also included in the model. The model was validated with confirmatory factor analysis and structural equation modeling techniques.
Results: Perceived Usefulness has a significant impact on behavioural intentions to adopt RFID-SM in the future, while the influence of Perceived Ease of Use is not significant. The most influential external variable is Perceived Trust, indicating the lack of confidence in personal data security ensured by the state and other institutions. As expected, Health Concerns factor has a negative effect on the Perceived Trust and Perceived Usefulness of RFID-SM.
Conclusion: The results of the empirical study prove that all external variables considered in the model significantly influence the RFID-SM adoption. The Perceived Ease of Use is irrelevant to the attitude towards the RFID-SM adoption. In addition to the proposed model, the analysis of gathered data shows that the positive attitude toward the use of RFID-SM in healthcare is rising.

Keywords: *healthcare; microchip; RFID, TAM, SEM, Slovenia*

1 Introduction

The healthcare sector faces a constant pressure to improve its service and provide error-free processes with patient-centred approaches on a daily basis. Even though the expertise, management, and technology are prepared for the implementation of advanced technological solutions, issues of individual perception and willingness to adopt new technologies remain. Radio Frequency Identification Devices (RFID) chip implants for humans are no longer a notion from science fiction. Despite the lack of information (Ip, Michael, & Michael, 2008) and traceability issues (van Oranje-Nassau et al., 2009), RFID microchips have been used for various purposes (Alghamdi, Van Schyndel, & Khalil, 2014; Liao, Lin, & Liao, 2011; Meyer, Chansue, & Monticelli, 2006). General willingness to adopt an RFID implant is slowly rising (Perakslis, Michael, Michael, & Gable, 2014). Healthcare issues were among the first to have legitimate reasons to introduce and test the RFID system for human identification (Cheng-Ju et al., 2004), where the highest acceptance of RFID implant applications is for lifesaving purposes (Rotter, Daskala, & Compano, 2008).

Received: December 22, 2017; revised: February 22, 2018; accepted: March 30, 2018

Most of researches on RFID adoption are focused on organizational perspectives, as well as management and employee readiness (Cao, Jones, & Sheng, 2014; Chong & Chan, 2012a; J. a Fisher & Monahan, 2008; Lee & Shim, 2007; Lu, Lin, & Tzeng, 2013; Matta, Koonce, & Jeyaraj, 2012; Yazici, 2014). Only a few studies focus on individual or end user perspectives (Katz & Rice, 2009), therefore individual's perception of the RFID usage and an individual's willingness to adopt the RFID microchip implants seem to be neglected in the literature.

In this paper, the main viewpoint is focused to the end user, and it is argued that personal attitudes influence the acceptance of RFID subcutaneous microchip (RFID-SM) technology. The aim of the study is to investigate the attitude of potential RFID-SM users and applicability of a modified Technology Acceptance Model (TAM) to predict the individual's intention to use RFID-SM for healthcare purposes. According to previous studies on RFID acceptance, the basic TAM model was extended with three additional external variables, Health Concerns (HC), Perceived Trust (PT) (Garbarino & Johnson, 1999; Mou & Cohen, 2016; Smith, 2008; Suh & Han, 2002; Tung, Chang, & Chou, 2008; I.-L. Wu & Chen, 2005) and Age (Burton-Jones & Hubona, 2006; Morris & Venkatesh, 2000).

2 RFID benefits, challenges and adoption in healthcare

RFID-enabled healthcare applications have been an interesting area of research in recent years (Fosso Wamba, Anand, & Carter, 2013; Yao, Chu, & Li, 2012). Organizations in the healthcare industry are applying the technology to gain a competitive over their competitors (Chong & Chan, 2012b). Two major trends in usage of human RFID microchip implants in healthcare exist (Bauer, 2007): (a) improving of independent living and continuum of care, and (b) more proactive and less reactive healthcare system.

RFID enables and supports processes in different areas of healthcare, drug administration system (Peris-Lopez, Orfila, Mitrokotsa, & van der Lubbe, 2011), medical tool tracking (Parlak, Sarcevic, Marsic, & Burd, 2012), patient and staff management (Hu, Ong, Zhu, Liu, & Song, 2014; Z.-Y. Wu, Chen, & Wu, 2013) and alternative healing techniques (Lin & Lin, 2013); where each has it own significant benefits and issues. The most promising RFID applications in healthcare are (van Oranje-Nassau et al., 2009): (a) tracking assets and people (Basham, 2014; Bergmann et al., 2012; Farra et al., 2012), (b) identification of patients (J. A. Fisher & Monahan, 2011), (c) automatic data collection and transfer (Amendola, Lodato, Manzari, Occhiuzzi, & Marrocco, 2014; Talpur & Shaikh, 2014; Tsirmpas, Rompas, Fokou, & Koutsouris, 2015), (d) sensors for monitoring of patients (Occhiuzzi, Vallese, Amendola, Manzari, & Marrocco, 2014).

RFID technology enables different beneficial usages, from being a memory storage device, enabling quick scanning, and processing large amounts of data (Mehrjerdi, 2011), to higher level advantages, such as time saving or optimization of processes (Adhiarna, Hwang, Park, & Rho, 2013) or even to study social network interactions (Pachucki, Ozer, Barrat, & Cattuto, 2015). Despite its benefits, ethical, security and privacy issues should be considered (Gasson & Koops, 2013; Masters & Michael, 2007; Monahan & Fisher, 2010) in order to achieve a higher level of RFID acceptance in healthcare applications (Safkhani, Bagheri, & Naderi, 2014; Z.-Y. Wu et al., 2013).

The basic TAM has been used to identify the level of RFID acceptance in diverse healthcare applications (Carr, Zhang, Klopping, & Min, 2010; Zailani, Iranmanesh, Nikbin, & Beng, 2014). The TAM model is the most frequently used theoretical approach to study societal responses to novel technologies (Venkatesh & Davis, 2000). Despite its relative simplicity, TAM accounts for 30 – 40% of information technology (IT) acceptance and predicts a substantial portion of the use or acceptance of health IT (Holden & Karsh, 2010). Recently, attempts to extend UTAUT (Venkatesh, Morris, Davis, & Davis, 2003), the upgraded version of TAM, to research the individual's viewpoint of technology adoption are presented (e.g. Nysveen & Pedersen (2016).

3 Methods

3.1 Study design and participants

The cross-sectional study was performed as a web survey used to collect data about attitudes toward RFID-SM usage in Slovenia. In the period from January to March 2014 we received 649 responses. Two different channels were used to reach respondents: a) an email was sent to members of researchers' social networks (22% of responses) and b) an invitation was posted on the faculty web page and the web pages of several public media organizations (78% of responses). To include younger and older respondents, a primary school and a retirement home were also invited to participate. The age of respondents ranges from 12 to 90 years.

3.2 Questionnaire development and variables

The TAM-based extended model presented in Figure 1 was used as a basis for questionnaire development. The extended model includes all three basic components of TAM (Venkatesh & Davis, 2000): Perceived Ease of Use (PEU), Perceived Usefulness (PU) and Behavioural Intention to Use (BIU) and adds the personal factors of Perceived Trust

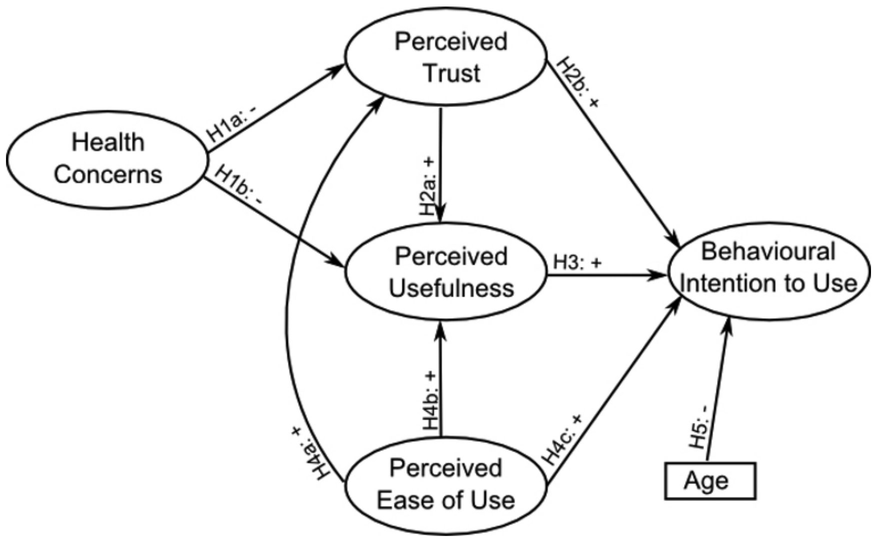

Figure 1: The extended TAM for analysing the behaviour intentions to adopt the RFID-SM

(PT) and Health Concerns (HC). In Figure 1, the hypothesized relationships among variables are presented with arrows, where a plus sign (+) represents positive impact and a minus sign (-) negative impact.

The questionnaire items were proposed based on the literature review and introduced during interviews with 10 volunteer candidates (6 of the volunteers were prone to RFID-SM implants, and 4 were not in favour). The items included in the final questionnaire items be found in Table 1. The item "implanting RFID-SM is a painful procedure" within the external variable HC was removed from the model, based on a standard loading lower than 0.5 in Confirmatory Factor Analysis (CFA).

Items of HC, PT, and PEU, as well as the last item of PU, were measured on a 5-point scale of agreement ("strongly disagree" to "strongly agree"), while the first six items of PU were measured on a 5-point scale of acceptability ("very bad idea" to "very good idea").

Proposed based on several medical research papers (Foster & Jaeger, 2007; Katz & Rice, 2009; Rotter et al., 2008; van der Togt, Bakker, & Jaspers, 2011), the component HC refers to four possible threats of RFID-SM usage: the possibility of movement in the body, affect on emotional behaviour, health threats due to possible allergies, and health threats because of impacts on the nervous system. Although a number of factors ifluences individual's trust (Bansal, Zahedi, & Gefen, 2015), items of the component PT were restructured from previous research (Smith, 2008). PT refers to an individual's trust that the state, banks and healthcare systems will be able to ensure security and protection of human rights in the fields of identification, tracking and archiving of personal data, financial transactions, and patient data on treatments and organ donation. The items of PEU (proposed based on previous research (Davis, 1989)) were: a) the continuous availability of RFID-SM, b) the microchip cannot be lost or stolen (according feedback from the interviews), and c) microchip can simultaneously integrate multiple functions. Five items of PU were adopted from previous research (Katz & Rice, 2009), while two items, on storing information about organ donation and a general statement on saving lives in different medical conditions, were added. BIU (defined according to the feedback from the interviews) included items regarding whether respondents would have an RFID-SM inserted for healthcare purposes, for identification purposes, for shopping and payment, and for everyday home usage. Special attention was given to the assurance that the microchip would not allow GPS positioning and tracking. Age was included in the model as a predictor variable of BIU since younger people are more prone to adopt new technologies (Burton-Jones & Hubona, 2006; Morris & Venkatesh, 2000), while in general older people tend to use healthcare facilities more often (Srakar, Hren, & Prevolnik Rupel, 2016).

3.3 Statistical methods

First, data were screened for missing patterns, since not all of 649 responses were suitable for the analysis. Namely, 44 respondents did not answer any of the questions , while 74 respondents did not answer any of the sociodemographic questions or at least one construct. This means that our sample consists of 531 respondents, where 475 of them were completely observed on variables of interest.

The percentages of missing data for individual variables vary from 1% to 5%, while the percentages of casewise missingness rates range from 0% to 73% with the average percentage equalling 3%. Since missing data can result in severe bias and misleading results in the study (Horton & Kleinman, 2007) multiple imputations (MI) were used to improve the validity of the results (Mackinnon, 2010).

Furthermore, the type of missing mechanism was assessed with Little's test (Little, 1988) carried out in R-package *BaylorEdPsych* (Beaujean, 2012). The result ($x^2 = 624.253, df = 619, p = .433$) show that data on 531 respondents appear to be Missing Completely At Random (MCAR). Even in the case of MCAR, the MI method is more efficient than complete case analysis (White & Carlin, 2010).

MI ($m = 20$) were used in the analysis of the dataset with missing values, which is a multistep procedure, where (a) missing data were imputed multiple times, (b) CFA and the Structural Equation Modeling (SEM) model was run on all imputed data sets, and (c) results were combined. All analyses were performed using R. MI were performed using the *Amelia* package (Honaker, King, & Blackwell, 2011), while CFA and SEM were conducted using *semTools* (Pornprasertmanit et al., 2015) and *lavaan* (Y Rosseel, 2012) packages. All variables from the model, including sociodemographic questions, were used to impute missing data. According to a comparison of the mean values and standard deviations of the complete dataset (not reported here) and the imputed one (Table 1) an assessment of imputation integrity was confirmed.

Cronbach's alpha coefficients were calculated for each of the five subscales in our TAM on imputed datasets: 0.849 for HC; 0.928 for PT; 0.884 for PEU; 0.932 for PU, and 0.920 for BIU. All the values exceeded the level of 0.8 (Kline, 2011), which indicates that the subscales of the survey questionnaire exhibited high internal reliability.

The construct validity of each scale was assessed using CFA and was evaluated via the convergent validity and the discriminant validity. The convergent validity should be examined based on three concepts (Fornell & Larcker, 1981; Koufteros, 1999):

- Estimates of the standardized factor loadings should exceed 0.5 (or even 0.7).
- Composite Reliability (*CR*) for each latent variable should exceed 0.7.
- Average Variance Extracted (*AVE*), which measures the amount of the common variance between the indicators and their construct in relation to the amount of variance attributable to measurement error for each latent variable, should exceed 0.5.

In order to investigate the discriminant validity of the measurement model, the square root of *AVE* of each latent variable was compared to the correlations between the latent variables, where the values of the square root of *AVE* for the corresponding latent variable have to be greater than corresponding correlations between latent variables to confirm discriminant validity. In addition, to confirm that the two scales do not correlate, the correction for attenuation of the correlation due to measurement error was calculated (Crocker & Algina, 2008), where (according to rule of thumb) values below 0.85 indicates that discriminant validity exists between two scales.

In the final step, SEM was used to test the predicted relationships among the constructs of the extended TAM. Since there are endogenous (dependent) binary variables in the model, the robust Weighted Least Squares Mean and Variance-adjusted (*WLSMV*) estimation in the *lavaan* package was used to test the proposed SEM hypotheses. The *WLSMV* estimator uses Diagonally Weighted Least Squares (*DWLS*) to estimate the model parameters and the full weight matrix to compute the robust standard errors, mean-adjusted and variance-adjusted test statistics (Yves Rosseel, 2014).

The sample size of 531 is more than sufficient to achieve the statistical power necessary for SEM with three or more measured items per latent variable. It also clearly satisfies Loehlin's rule of thumb (Siddiqui, 2013), which states that the sample size should be at least 50 more than eight times the number of measured items in the model (which is equal to 242 in our case). An ideal sample size-to-parameters ratio would be 20:1 (Kline, 2011). Our sample size meets this stricter criterion since the ratio of our sample size-to-parameters is 22:1.

In order to assess the fit of the measurement model and the structural model, the overall fit was examined based on various sets of commonly-used fit indices. Since x^2 statistics itself is sensitive to the sample size, the ratio of x^2/df, which should be lower than 3 (Teo & Zhou, 2014), was used. The values of the Tucker Lewis Index (*TLI*), also known as Non-Normed Fit Index (*NNFI*), and Comparative Fit Index (*CFI*) should be at least 0.9 (Koufteros, 1999). The Root Mean Square Error of Approximation (*RMSEA*) value should be below 0.06 (Teo & Zhou, 2014), while the more precise interpretation of the *RMSEA* suggests that the values below 0.05 are declared as "good" and the values below 0.08 as "mediocre" (MacCallum, Browne, & Sugawara, 1996).

The values of standardized path coefficients (β) and corresponding z-values reflect the relationships among the latent variables in terms of the magnitude and statistical significance. For every endogenous latent variable, the coefficient of determination R^2 is also calculated, for which the predictive capability of the model is satisfactory if R^2 is more than 0.1 (Escobar-Rodriguez & Monge-Lozano, 2012).

4 Results

The sample consists of 57% of females and 43% of males. Among the respondents, 12% are in the primary school, 11% are in the secondary school, and 12% are at the university. More than half of the respondents (51%) are employed, while 7% are pensioners, and 7% are unemployed. The age of the respondents ranges from 12 to 90 years, with an average age 33.6 years (SD = 15.1).

4.1 Descriptive statistics

First, descriptive statistics were calculated for five model components as well as for 23 measured items. The results of MI are listed in Table 1.

It can be seen from Table 1 that the means of MI items measured on the 5-point scale ranged from 2.396 to 3.810. Standard deviations of all MI items are in the range from 1.157 to 1.417, indicating a fairly narrow spread of scores around the means. The standard deviations of the model components vary from 1.014 to 1.221. The values of skewness are in the interval from -1.158 to 1.359, while the values of kurtosis are in the range from -1.950 to 0.699, indicating that data are fairly normally distributed (not reported here).

The means of three components are 3.216 for HC, 3.613 for PEU, and 3.334 for PU, which indicate that the overall response could be classified as positive. The mean of PT is equal to 2.572, which indicates that the average perceived trust on security issues assured by state, banks, and healthcare system is rather low.

Five items of BIU were measured as dichotomous variables. Therefore, in Table 1 only the percentage of the respondents that answered positively on the individual item are presented. The highest proportion of the respondents (44%) would insert an RFID-SM for health care purposes, such as identification, storage of medical data, information on organ donation, etc.

4.2 Analysis of the measurement model

The unstandardized and standardized factor loadings together with corresponding z-values for each measured item are presented in Table 2. All standardized factor loadings for MI exceed a threshold of 0.5 for convergent validity, while 91% exceed the stricter threshold of 0.7. The examination of z-values reveals that they exceed the critical value at the 1% significance level for each of the estimated factor loadings.

The values of CR and AVE for all five latent variables of the model are presented in Table 3. All values of CR easily fulfil the criterion that CR has to be greater than 0.7, since the lowest CR value for MI equals 0.802 (for the latent variable HC). The AVE values for all five latent variables are above the desired threshold of 0.5, since the lowest value of AVE is equal to 0.508 (for the latent variable HC). The obtained results prove the convergent validity of the set of latent variables and corresponding measured items in the measurement model.

All the values of the square root of AVE for the corresponding latent variable are greater than corresponding correlations between latent variables (not reported here). The correlations corrected for attenuation (presented in the lower triangular part of the right panel of Table 3) among the latent variables are all lower than 0.85. We can conclude that the measured items have more in common with the latent variable that they are associated with than they do with other latent variables of the model. Therefore, the discriminant validity can be confirmed.

In our measurement model, the obtained value of χ^2/df = 1.715 (χ^2 = 377.340, df = 220) is lower than 3, and both TLI = 0.940 and CFI = 0.948 are greater than 0.9. The $RMSEA$ is equal to 0.037, and the upper bound of 90% confidence interval of $RMSEA$ (0.030, 0.043) is lower than 0.05. Based on the whole set of the calculated fit indices, it could be concluded that the measurement model fits the sample data reasonably well.

4.3 Evaluation of the structural model and results of hypotheses testing

The structural model was tested based on the MI dataset, which provides more accurate and less biased results in comparison to the complete case dataset. The results and conclusions of both datasets are consistent. Therefore, details of the model based on complete cases are not reported here. First, the goodness-of-fit of the SEM was tested. The results show that the model has a good fit according to the following indices: χ^2/df = 1.752 (χ^2 = 425.677, df = 243), TLI = 0.933, CFI = 0.941, and $RMSEA$ = 0.038 with its 90% confidence interval (0.032, 0.044).

Figure 2 shows the evaluated structural model: values of standardized path coefficients (β) (and corresponding z-values), which reflect the relationships among the latent variables in terms of the magnitude and the statistical significance. For every endogenous latent variable, the coefficient of determination (R^2) is also calculated.

The predictive capability of the model is satisfactory because all the values of R^2 are higher than 0.1 (the smallest value is 0.294 for the variable PT). Based on the values of the standardized path coefficients and the corresponding z-values, each of the nine hypotheses (graphically represented in Figure 2) was supported or rejected.

According to the TAM theory, three positive relationships exist: the positive impact of both PU and PEU on BIU (hypotheses H3 and H4c in our model), and the positive impact of PEU to PU (H4b). Our results show that we can support the hypotheses H3 and H4b, while we cannot

Table 1: Descriptive statistics of the model components for MI

Model component	Item	MI (m = 20, N = 531)	
		Mean	*SD*
Health Concerns	Subcutaneous microchips can be threatening to my health because of the possibility of movement in my body. **(HC1)**	3.067	1.228
(HC)	Subcutaneous microchips may affect my emotional behaviour (control of human behaviour, etc.). **(HC2)**	3.270	1.344
	Subcutaneous microchips can be threatening to my health because of possible allergies. **(HC3)**	3.289	1.187
	Subcutaneous microchips can be threatening to my health because of their impact on the nervous system. **(HC4)**	3.269	1.164
Perceived Trust	The state will ensure the security and the protection of human rights (security of identity documents, passport, identity theft, tracking via GPS, no records should be archived without the consent of the person observed). **(PT1)**	2.396	1.310
(PT)	Banks will provide security (payment, discretion of operation, transactions, etc.). **(PT2)**	2.600	1.308
	The healthcare system will provide security (personal data, medical data, information on treatments, organ donation, etc.). **(PT3)**	2.729	1.337
Perceived Usefulness	Subcutaneous microchips could be used:		
	for monitoring the health of the user, e.g. pulse or blood pressure. **(PU1)**	3.594	1.227
(PU)	for warning about potential health problems or complications (e.g. diabetes). **(PU2)**	3.779	1.157
	for storing medical info for accident or emergency. **(PU3)**	3.215	1.305
	for personalized health info. **(PU4)**	3.810	1.157
	for storing information about organ donation. **(PU5)**	3.424	1.314
	Users of the subcutaneous microchips should have lower health insurance premiums. **(PU6)**	3.591	1.338
	Subcutaneous microchips may save your life (e.g. unconsciousness, cardiac pacemaker, sugar detector, insulin dispenser, etc.). **(PU7)**	3.460	1.352
Perceived Ease of Use	Subcutaneous microchips are always available. **(PEU1)**	3.077	1.308
	Subcutaneous microchips cannot be lost. **(PEU2)**	3.179	1.344
(PEU)	Subcutaneous microchips cannot be stolen (high-security protection). **(PEU3)**	3.037	1.417
	Subcutaneous microchips can integrate multiple functions at the same time. **(PEU4)**	3.572	1.235
	Would you insert a subcutaneous microchip:	**Percentage of positive responses**	
Behavioural Intention to Use	for healthcare purposes (identification, storage of medical data, information on organ donation, etc.)?	44%	
	for identification purposes (ID card, passport, driving licence, etc.)?	28%	
(BIU)	for shopping and payment (debit cards, credit cards, profit cards, etc.)?	22%	
	for everyday home usage (unlocking house or apartment, car, computer, mobile phone, etc.)?	26%	
	if you were assured that GPS positioning and tracking were not possible?	35%	

Table 2: Parameter estimates, error terms and z-values for the measurement model (based on MI)

-[a] Indicates a parameter fixed at 1 in the original solution.

Fit indices: x^2 = 377.340, df = 220, x^2/df = 1.715, TLI = 0.940, CFI = 0.948, RMSEA = 0.037, 90% confidence interval for RMSEA = (0.030, 0.043)

	MI (*m* = 20, *N* = 531)			
Latent Variable	**Unstd. Factor Loading**	**Std. Error**	***z*-value**	**Std. Factor Loading**
Health Concerns (HC)	1	-[a]	-[a]	0.731
	1.358	0.130	10.461	0.907
	1.098	0.096	11.422	0.830
	0.779	0.082	9.544	0.601
Perceived Trust (PT)	1	-[a]	-[a]	0,792
	1.174	0.075	15.666	0.932
	1.254	0.088	14.268	0.973
Perceived Ease of Use (PEU)	1	-[a]	-[a]	0,856
	0.949	0.064	14.875	0.861
	0.880	0.078	11.319	0.708
	0.946	0.062	15.148	0.859
Perceived Usefulness (PU)	1	-[a]	-[a]	0.849
	1.040	0.050	21.001	0.867
	1.094	0.072	15.126	0.902
	0.980	0.068	14.426	0.836
	0.945	0.073	13.001	0.785
	0.870	0.087	10.018	0.685
	0.875	0.068	12.952	0.790
Behavioural Intention to Use (BIU)	1	-[a]	-[a]	0.905
	1.023	0.038	26.926	0.926
	0.999	0.040	25.252	0.905
	1.023	0.037	25.918	0.926
	0.962	0.039	24.545	0.871

Table 3: Composite Reliability (CR), Average Variance Extracted (AVE), square root of AVE (on the diagonal) and correlations corrected for attenuation among the latent variables of the model

	MI (*m* = 20, *N* = 531)						
Constr.	***CR***	***AVE***	**Correlations corrected for attenuation**				
			HC	**PT**	**PEU**	**PU**	**BIU**
HC	0.802	0.508	**0.713**				
PT	0.883	0.718	-0.405	**0.847**			
PEU	0.847	0.582	-0.494	0.480	**0.763**		
PU	0.888	0.533	-0.517	0.596	0.710	**0.730**	
BIU	0.959	0.822	-0.491	0.628	0.464	0.596	**0.907**

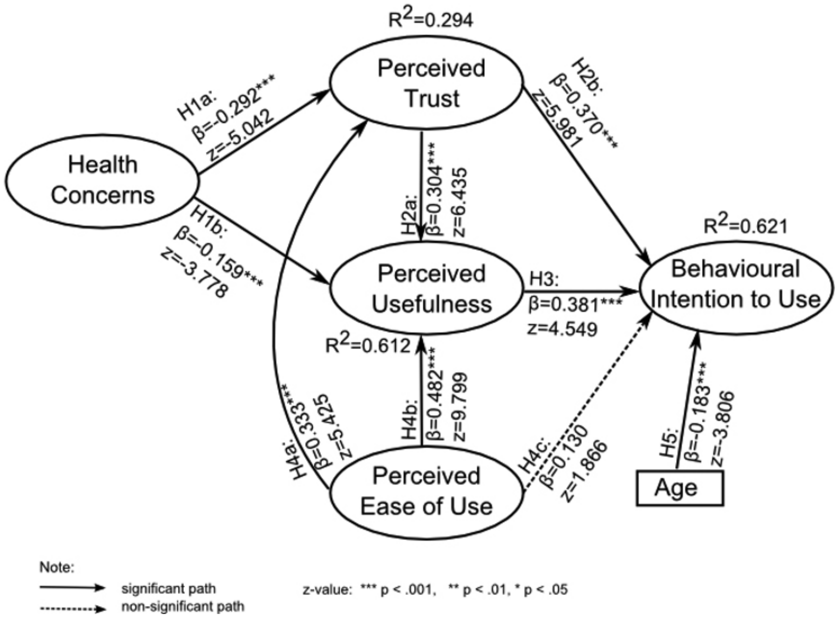

Figure 2: The structural model of relationships among the TAM model components (for MI)

support the hypothesis H4c.

According to the value of β, the impact of PEU on PU is the strongest in the model. The variable PU has three significant predictors that can explain 61% of its total variance: PEU, PT and HC. Furthermore, it was determined that PU, PEU together with the external variable PT explain 62% of the total variance of BIU.

Hypotheses H1a and H1b assumed a negative impact of HC on PT and PU. According to the results, both hypotheses (H1a and H1b) can be confirmed. In addition, HC have a higher negative impact on PT than on PU.

Based on the results we can also confirm that, in contrast to HC, PT has a positive impact on PU (H2a) as well as on BIU (H2b).

According to the confirmation of the hypothesis H5 we can also conclude that age, the additional external variable, has a negative impact on the BIU.

5 Discussion

The aim of the study was to research the attitude of potential RFID-SM users, and further, to study the applicability of a modified TAM to predict the individual's intention to use RFID-SM for healthcare purposes. For several years, there have been no technological barriers keeping this technology from being introduced in Europe. Nevertheless, concerns among potential users about privacy issues, personal data security, implants' impact on health and similar concerns persist. To include all of these issues, and to determine the "important others" of the RFID-SM acceptance, as suggested by previous research (Holden & Karsh, 2010), we have extended the original TAM model with three external variables, i.e. Health Concerns, Perceived Trust and Age.

The results of the model evaluation with SEM showed that our extended TAM meets all the criteria of both the data and the objective pursued. Except one, all proposed hypotheses were accepted.

The highest proportion of the respondents from the MI dataset (Table 1) would primarily consider using the RFID-SM for healthcare purposes (44%), rather than for personal identification (28%), home use (26%) or shopping and payment (22%). With the assurance that there is no possibility of GPS positioning and tracking, the number of potential users increases (35%). This indicates that traceability and privacy issues influence their decision and are therefore a vital factor to consider.

Perceived Trust has a positive impact on Perceived Usefulness and on Behavioural Intention to Use RFID-SM. From the perspective of RFID-SM introducers and/or manufacturers, this is one of the most important factors, because it is difficult to increase or improve the Perceived Trust. The respondents (Table 1) declare that they do not trust that the state (M = 2.396) the banks (M = 2.600) and healthcare system (M = 2.729) can provide the appropriate level of safety and security related to RFID-SM usage. This could be explained by negative experiences of individuals (stolen identity, credit card scanning, frauds etc.) or situations in which state authorities used methods of monitoring people without their knowledge for state security reasons. In addition, most citizens do not realize that new passports already have installed RFID microchips with their fingerprints or even more personal data, depending on the state of origin. Our results on Perceived Trust are similar to Chong & Chan (2012a), who found that confidence is relevant in the case of RFID introduction in the healthcare sector, although their study was focused on employees' viewpoints. In the research of the Near Field Communication (NFC) adoption Dutot (2015) confirmed a positive influence of Trust on Perceived Usefulness, while positive impact on Perceived Ease of Use was not confirmed. Here, we would like to emphasize that we confirmed the proposed (reverse) positive impact of Perceived Ease of Use on Perceived Trust which was stated due to the simplicity of RFID-SM usage. The influence of Perceived Ease of Use on Behavioural Intention to Use is not statistically significant. We could explain this deviation from original TAM with the fact, that the RFID-SM is a technology that does not require any interference of the user once implanted; therefore, the Perceived Ease of Use is not a relevant for the intention to use RFID-SM for healthcare purposes.

While previous research (Carr et al., 2010) found no relationship between the factors Perceived Ease of Use and Intention to Use, our results show that Perceived Ease of Use positively influences Perceived Usefulness as well as Perceived Trust. Similar to Perceived Trust, the strong influence of Perceived Ease of Use on several other variables could indicate its general importance for the acceptance of the proposed technology.

Health Concerns negatively influence the Perceived Usefulness and Perceived Trust. In the concept of Health Concerns, dangers and fears that potential users perceive as threats to their health from the use of RFID-SM, are included. Although the Food and Drug Administration (FDA) approved the use of RFID-SM in 2004 (FDA Approves Implantable Chip, 2004), the majority of the respondents remain sceptical and afraid of negative side effects. The sceptisizm and fear could be aligned with previous research by Albrecht, Pramann, & von Jan (2014), which emphasizes the side effects of the RFID microchip implants.

The relationship of Age to the Behavioural Intention to Use an RFID-SM was analysed. Our results showed that Age has a negative impact on Behavioural Intention to Use RFID-SM. The older a potential user is, the less likely he/she is to consider the possible use of RFID-SM. Young people are always in favour of new technology and ignore the possible side effects, while older potential users are more critical toward innovations and are more concerned about their health.

5.1 Limitations

From 649 respondents, 82% provided answers to the items in the proposed model. Since not all of the responses were complete, we included all those respondents who provided at least sociodemographic characteristics and response to at least one construct and used MI to simulate missing data. For non-respondents, we cannot determine the reasons for not completing the survey.

Although, a part of respondents was recruited through authors' social networks, we believe that the impact of authors' social network can be neglected due to the relatively small percentage of those responses (22%). In addition, two thirds of authors of this paper are not prone to RFID-SM implants.

We assumed differences among respondents depending on their age, and the analysis of the research model confirmed that. The new research design should take special care to include more a representative sample of older people, e.g. a paper survey for those who have no internet access or personal interview could be included.

On some job positions, the use of RFID-SM can be obligatory (e.g. special police forces for narcotics with access to highly secured data) in order to control access and ensure traceability. Therefore, the attitude of those employees toward RFID-SM usage have to be explored.

To the best of our knowledge, RFID-SM is not included in any law on medical implants in Europe, but its usage was approved in USA by FDA in December 2004 (FDA, 2004). Three years later, a bill was signed by governor of California, prohibiting forcing employees to receive RFID-SM implants against their will (Jones, 2007). Since legislation issues were not the aim of this paper is not to study, we propose that more studies from this perspective should be conducted.

6 Conclusions

This study has proposed an extended TAM model to examine the intentions to use RFID-SM implants in healthcare. The results of SEM tests confirmed all our hypotheses except one, which indicates, that the Perceived Ease of Use is not a relevant predictor of RFID-SM usage for healthcare purposes. There is a pool of potential users that supports the possibility of implementing RFID-SM in healthcare since almost half of participants in our study indicated their intention to use microchips for healthcare reasons. According to previous studies (Smith, 2008), almost a quarter of students agreed that they would be implanted with RFID-SM; the share of potential users in our study is double that. Our study indicates that a lack of trust presents a significant obstacle for adoption. Therefore, effort must be focused on gaining the trust of potential users. Laws and the general culture among providers must be raised to such level that the trust in state and healthcare system would be not problematic. The obligatory use of microchips cannot be considered. It should be the free choice of users that accept such technology. More research must be done to prove the reliability and harmlessness of RFID-SM and its technical possibilities to enhance patients' health. New secured systems must be developed to secure the use of microchip and prevent the possibility of its unconventional use or misuse. In our opinion, future research should be focused on the willingness to adopt the RFID-SM technology for joint general identification (ID card, passport, driver's licence, health insurance), which would replace the diversity of identification cards currently used. Technology and knowledge are obviously not a limit.

Literature

Adhiarna, N., Hwang, Y. M., Park, M. J., & Rho, J. J. (2013). An integrated framework for RFID adoption and diffusion with a stage-scale-scope cubicle model: A case of Indonesia. *International Journal of Information Management*, 33(2), 378–389. https://doi.org/10.1016/j.ijinfomgt.2012.10.001

Albrecht, U. V., Pramann, O., & von Jan, U. (2014). Synopsis for health apps--transparency for trust and decision making. In M. Househ, E. Borycki, & A. Kushniruk (Eds.), *Social Media and Mobile Technologies for Healthcare*, (pp. 94–108). Hershey, PA: IGI Global. https://doi.org/10.2196/jmir.2981

Alghamdi, S., Van Schyndel, R., & Khalil, I. (2014). Accurate positioning using long range active RFID technology to assist visually impaired people. *Journal of Network and Computer Applications*, 41, 135–147. https://doi.org/10.1016/j.jnca.2013.10.015

Amendola, S., Lodato, R., Manzari, S., Occhiuzzi, C., & Marrocco, G. (2014). RFID Technology for IoT-based Personal Healthcare in SmartSpaces. *IEEE Internet of Things Journal*, 1(2), 144–152. https://doi.org/10.1109/JIOT.2014.2313981

FDA Approves Implantable Chip (2004). In *Health Data Management*. Retrieved from https://www.highbeam.com/doc/1G1-125963847.html

Bansal, G., Zahedi, F. M., & Gefen, D. (2015). Do context and personality matter? Trust and privacy concerns in disclosing private information online. *Information & Management*, 53(1), 1–21. https://doi.org/10.1016/j.im.2015.08.001

Basham, R. (2014). Surveilling the Elderly: Emerging Demographic Needs and Social Implications of RFID Chip Technology Use. In M.G Michael & K. Michael (Eds.), *Uberveillance and the Social Implications of Microchip Implants: Emerging Technologies* (pp. 169–171). Hershey, PA: IGI Global. https://doi.org/10.4018/978-1-4666-4582-0.ch007

Bauer, K. A. (2007). Wired Patients: Implantable Microchips and Biosensors in Patient Care. *Cambridge Quarterly of Healthcare Ethics*, 16(3), 281–290. https://doi.org/10.1017/S0963180107070314

Beaujean, A. A. (2012). *BaylorEdPsych: R Package for Baylor University Educational Psychology Quantitative Courses. R package version 0.5*. Retrieved from http://cran.r-project.org/package=BaylorEdPsych

Bergmann, G., Graichen, F., Dymke, J., Rohlmann, A., Duda, G. N., & Damm, P. (2012). High-tech hip implant for wireless temperature measurements in vivo. *PLoS ONE*, 7(8), 1–7. https://doi.org/10.1371/journal.pone.0043489

Burton-Jones, A., & Hubona, G. S. (2006). The mediation of external variables in the technology acceptance model. *Information & Management*, 43(6), 706–717. https://doi.org/10.1016/j.im.2006.03.007

Cao, Q., Jones, D. R., & Sheng, H. (2014). Contained nomadic information environments: Technology, organization, and environment influences on adoption of hospital RFID patient tracking. *Information & Management*, 51(2), 225–239. https://doi.org/10.1016/j.im.2013.11.007

Carr, A. S., Zhang, M., Klopping, I., & Min, H. (2010). RFID Technology: Implications for Healthcare Organizations. *American Journal of Business*, 25(2), 25–40. https://doi.org/10.1108/19355181201000008

Cheng-Ju, L., Li, L., Shi-Zong, C., Chi Chen, W., Chun-Huang, H., Chen, X.-M., & Networking, S. and C. (2004). *Mobile healthcare service system using RFID.* IEEE International Conference on Networking, Sensing and Control 2004 (pp. 1014–1019). Taiwan: IEEE. https://doi.org/10.1109/ICNSC.2004.1297086

Chong, A. Y.-L., & Chan, F. (2012a). Understanding the Acceptance of RFID in the Healthcare Industry: Extending the TAM Model. In K. H. Chan, F. Lettice, & A. O. Durowoju (Eds.) *Decision-Making for Supply Chain Integration: Supply Chain Integration* (pp. 105–122). London: Springer London. https://doi.org/10.1007/978-1-4471-4033-7_6

Chong, A. Y.-L., & Chan, F. (2012b). Structural equation modelling for multi-stage analysis on Radio Frequency Identification (RFID) diffusion in the health care industry. Ex*pert Systems with Applications*, 39(10), 8645–8654. https://doi.org/10.1016/j.eswa.2012.01.201

Crocker, L. M., & Algina, J. (2008). *Introduction to classical and modern test theory*. Mason, Ohio: Cengage Learning.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance. *MIS Quarterly*, 13(3), 319–339. https://doi.org/10.2307/249008

Dutot, V. (2015). Factors influencing Near Field Communication (NFC) adoption: An extended TAM approach. *The Journal of High Technology Management Research*, 26(1), 45–57. https://doi.org/10.1016/j.hitech.2015.04.005

Escobar-Rodriguez, T., & Monge-Lozano, P. (2012). The acceptance of Moodle technology by business administration students. *Computers & Education*, 58(4), 1085–1093. https://doi.org/10.1016/j.compedu.2011.11.012

Farra, R., Sheppard, N. F., McCabe, L., Neer, R. M., Anderson, J. M., Santini, J. T., Cima, M.J., & Langer, R.

(2012). First-in-Human Testing of a Wirelessly Controlled Drug Delivery Microchip. *Science Translational Medicine*, 4(122), 122ra21-122ra21. https://doi.org/10.1126/scitranslmed.3003276

Fisher, J. A., & Monahan, T. (2011). The “biosecuritization” of healthcare delivery: examples of post-9/11 technological imperatives. *Social Science & Medicine*, 72(4), 545–552. https://doi.org/10.1016/j.socscimed.2010.11.017

Fisher, J. a, & Monahan, T. (2008). Tracking the social dimensions of RFID systems in hospitals. *International Journal of Medical Informatics*, 77(3), 176–183. https://doi.org/10.1016/j.ijmedinf.2007.04.010

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1), 39–50. https://doi.org/10.2307/3151312

Fosso Wamba, S., Anand, A., & Carter, L. (2013). A literature review of RFID-enabled healthcare applications and issues. *International Journal of Information Management*, 33(5), 875–891. https://doi.org/10.1016/j.ijinfomgt.2013.07.005

Foster, K. R., & Jaeger, J. (2007). RFID inside: The murky ethics of implanted chips. *IEEE Spectrum*, 44(3), 24–29. https://doi.org/10.1109/MSPEC.2007.323430

Garbarino, E., & Johnson, M. S. (1999). The Different Roles of Satisfaction, Trust, and Commitment in Customer Relationships. *American Marketing Association*, 63(2), 70–87. https://doi.org/10.2307/1251946

Gasson, M. N., & Koops, B.-J. (2013). Attacking Human Implants: A New Generation of Cybercrime. *Law, Innovation & Technology*, 5(2), 248–277. https://doi.org/10.5235/17579961.5.2.248

Holden, R. J., & Karsh, B. T. (2010). The technology acceptance model: its past and its future in health care. *Journal of Biomedical Informatics*, 43(1), 159–172. https://doi.org/10.1016/j.jbi.2009.07.002

Honaker, J., King, G., & Blackwell, M. (2011). Amelia II: A Program for Missing Data. *Journal of Statistical Software*, 45(7), 1–47.

Horton, N. J., & Kleinman, K. P. (2007). Much ado about nothing: A comparison of missing data methods and software to fit incomplete data regression models. *American Statistical Association*, 61(1), 79–90. https://doi.org/10.1198/000313007X172556

Hu, L., Ong, D. M., Zhu, X., Liu, Q., & Song, E. (2014). Enabling RFID technology for healthcare: application, architecture, and challenges. *Telecommunication Systems*, 58(3), 259–271. https://doi.org/10.1007/s11235-014-9871-x

Ip, R., Michael, K., & Michael, M. G. (2008). *The Social Implications of Humancentric Chip Implants : A Scenario - “Thy Chipdom Come, Thy Will be Done”.* Collaborative Electronic Commerce Technology and Research (pp. 1–11). Madrid, Spain: IEEE Computer Society.

Jones, K. C. (2007, October 15). *California Bans Forced RFID Implants For Humans*. Informationweek. Retrieved from http://www.informationweek.com/california-bans-forced-rfid-implants-for-humans/d/d-id/1060296?

Katz, J. E., & Rice, R. E. (2009). Public views of mobile medical devices and services: A US national survey of consumer sentiments towards RFID healthcare technology. International *Journal of Medical Informatics*, 78, 104–114. https://doi.org/10.1016/j.ijmedinf.2008.06.001

Kline, R. B. (2011). *Principles and practice of structural equation modeling*. New York: Guilford publications.

Koufteros, X. A. (1999). Testing a model of pull production: a paradigm for manufacturing research using structural equation modeling. *Journal of Operations Management*, 17(4), 467–488. https://doi.org/10.1016/S0272-6963(99)00002-9

Lee, C.-P., & Shim, J. P. (2007). An exploratory study of radio frequency identification (RFID) adoption in the healthcare industry. *European Journal of Information Systems*, 16(6), 712–724. https://doi.org/10.1057/palgrave.ejis.3000716

Liao, W. P., Lin, T. M. Y., & Liao, S. H. (2011). Contributions to Radio Frequency Identification (RFID) research: An assessment of SCI-, SSCI-indexed papers from 2004 to 2008. *Decision Support Systems*, 50(2), 548–556. https://doi.org/10.1016/j.dss.2010.11.013

Lin, J. M., & Lin, C. H. (2013). RFID-based wireless health monitoring system design. *Procedia Engineering*, 67, 117–127. https://doi.org/10.1016/j.proeng.2013.12.011

Little, R. J. A. (1988). A Test of Missing Completely at Random for Multivariate Data with Missing Values. *Journal of the American Statistical Association*, 83(404), 1198–1202. https://doi.org/10.2307/2290157

Lu, M.-T., Lin, S.-W., & Tzeng, G.-H. (2013). Improving RFID adoption in Taiwan’s healthcare industry based on a DEMATEL technique with a hybrid MCDM model. *Decision Support Systems*, 56, 259–269. https://doi.org/10.1016/j.dss.2013.06.006

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, 1(2), 130–149. https://doi.org/10.1037/1082-989X.1.2.130

Mackinnon, A. (2010). The use and reporting of multiple imputation in medical research - a review. *Journal of Internal Medicine*, 268(6), 586–593. https://doi.org/10.1111/j.1365-2796.2010.02274.x

Masters, A., & Michael, K. (2007). Lend me your arms: The use and implications of humancentric RFID. *Electronic Commerce Research and Applications*, 6(1), 29–39. https://doi.org/10.1016/j.elerap.2006.04.008

Matta, V., Koonce, D., & Jeyaraj, A. (2012). Initiation, experimentation, implementation of innovations: The case for radio frequency identification systems. *International Journal of Information Management*, 32(2), 164–174. https://doi.org/10.1016/j.ijinfomgt.2011.10.002

Mehrjerdi, Y. Z. (2011). Radio frequency identification: The big role player in health care management. *Journal of Health, Organisation and Management*, 25(5), 490–505. https://doi.org/10.1108/14777261111161851

Meyer, H. J., Chansue, N., & Monticelli, F. (2006). Implantation of radio frequency identification device (RFID) microchip in disaster victim identification (DVI). *Forensic Science International*, 157(2–3), 168–171. https://doi.org/10.1016/j.forsciint.2005.10.001

Monahan, T., & Fisher, J. A. (2010). Implanting inequality: empirical evidence of social and ethical risks of implantable radio-frequency identification (RFID) devices. International *Journal of Technology Assessment in Health Care*, 26(4), 370–376. https://doi.org/10.1017/S0266462310001133

Morris, M. G., & Venkatesh, V. (2000). Age Differences in Technology Adoption Decisions: Implications for a Changing Work Force. *Personnel Psychology*, 53(2), 375–403. https://doi.org/10.1111/j.1744-6570.2000.tb00206.x

Mou, J., & Cohen, J. F. (2017). Trust and online consumer health service success: A longitudinal study. *Information Development*, 33(2), 169–189. https://doi.org/10.1177/0266666916642507

Nysveen, H., & Pedersen, P. E. (2016). Consumer adoption of RFID-enabled services. Applying an extended UTAUT model. *Information Systems Frontiers*, 18(2), 293–314. https://doi.org/10.1007/s10796-014-9531-4

Occhiuzzi, C., Vallese, C., Amendola, S., Manzari, S., & Marrocco, G. (2014). NIGHT-Care: A Passive RFID System for Remote Monitoring and Control of Overnight Living Environment. *Procedia Computer Science*, 32, 190–197. https://doi.org/10.1016/j.procs.2014.05.414

van Oranje-Nassau, C., Schindler, H.R., Valeri, L., Vilamovska, A., Hatziandreu, E., & Conklin, A. (2009). *Study on the requirements and options for Radio Frequency Identification (RFID) application in healthcare Final report*. RAND Europa. Retrieved from https://www.rand.org/content/dam/rand/pubs/technical_reports/2009/RAND_TR608.1.pdf

Pachucki, M. C., Ozer, E. J., Barrat, A., & Cattuto, C. (2015). Mental health and social networks in early adolescence: a dynamic study of objectively-measured social interaction behaviors. *Social Science & Medicine*, 125, 40–50. https://doi.org/10.1016/j.socscimed.2014.04.015

Parlak, S., Sarcevic, A., Marsic, I., & Burd, R. S. (2012). Introducing RFID technology in dynamic and time-critical medical settings: Requirements and challenges. *Journal of Biomedical Informatics*, 45(5), 958–974. https://doi.org/10.1016/j.jbi.2012.04.003

Perakslis, C., Michael, K., Michael, M. G., & Gable, R. (2014). *Perceived Barriers for Implanting Microchips in Humans: A Transnational Study*. In Norbert Wiener in the 21st Century (21CW). Boston, MA: IEEE. https://doi.org/10.1109/NORBERT.2014.6893929

Peris-Lopez, P., Orfila, A., Mitrokotsa, A., & van der Lubbe, J. C. a. (2011). A comprehensive RFID solution to enhance inpatient medication safety. *International Journal of Medical Informatics*, 80(1), 13–24. https://doi.org/10.1016/j.ijmedinf.2010.10.008

Pornprasertmanit, S., Miller, P., Schoemann, A., Rosseel, Y., Quick, C., Garnier-Villarreal, M., … Byrnes, J. (2015). *Package "semTools,"* Retrieved from https://github.com/simsem/semTools/wiki

Rosseel, Y. (2012). lavaan: An R Package for Structural Equation Modeling. *Journal of Statistical Software*, 48(2), 1–36. https://doi.org/10.18637/jss.v048.i02

Rosseel, Y. (2014). *The lavaan tutorial.* Retrieved from http://lavaan.ugent.be/tutorial/tutorial.pdf

Rotter, P., Daskala, B., & Compano, R. (2008). RFID implants: Opportunities and challenges for identifying people. *IEEE Technology and Society Magazine*, 27(2), 24–32. https://doi.org/10.1109/mts.2008.924862

Safkhani, M., Bagheri, N., & Naderi, M. (2014). A note on the security of IS-RFID, an inpatient medication safety. *International Journal of Medical Informatics*, 83(1), 82–85. https://doi.org/10.1016/j.ijmedinf.2013.04.003

Siddiqui, K. (2013). Heuristics for sample size determination in multivariate statistical techniques. *World Applied Sciences Journal*, 27(2), 285–287. https://doi.org/10.5829/idosi.wasj.2013.27.02.889

Smith, C. (2008). Human microchip implantation. J*ournal of Technology Management and Innovation*, 3(3), 151–156. https://doi.org/10.4067/S0718-27242008000100015

Srakar, A., Hren, R., & Prevolnik Rupel, V. (2016). Health Services Utilization in Older Europeans: an Empirical Study. *Organizacija*, 49(2), 127–137. https://doi.org/10.6103/SHARE.w5.100

Suh, B., & Han, I. (2002). Effect of trust on customer acceptance of Internet banking. *Electronic Commerce Research and Applications*, 1(3–4), 247–263. https://doi.org/10.1016/S1567-4223(02)00017-0

Talpur, M., & Shaikh, M. (2014). Internet of Things as Intimating for Pregnant Women's Healthcare: An Impending Privacy Issues. *Indonesian Journal of Electrical Engineering*, 12(6), 4337–4344. https://doi.org/10.11591/telkomnika.v12i6.4227

Teo, T., & Zhou, M. (2014). Explaining the intention to use technology among university students: a structural equation modeling approach. *Journal of Computing in Higher Education*, 26(2), 124–142. https://doi.

org/10.1007/s12528-014-9080-3

Tsirmpas, C., Rompas, A., Fokou, O., & Koutsouris, D. (2015). An indoor navigation system for visually impaired and elderly people based on Radio Frequency Identification (RFID). *Information Sciences*, 320, 288–305. https://doi.org/10.1016/j.ins.2014.08.011

Tung, F. C., Chang, S. C., & Chou, C. M. (2008). An extension of trust and TAM model with IDT in the adoption of the electronic logistics information system in HIS in the medical industry. *International Journal of Medical Informatics*, 77(18), 324–335. https://doi.org/10.1016/j.ijmedinf.2007.06.006

van der Togt, R., Bakker, P. J. M., & Jaspers, M. W. M. (2011). A framework for performance and data quality assessment of Radio Frequency IDentification (RFID) systems in health care settings. *Journal of Biomedical Informatics*, 44(2), 372–383. https://doi.org/10.1016/j.jbi.2010.12.004

Venkatesh, V., & Davis, F. D. (2000). A Theoretical Extension of the Technology Acceptance Model : Four Longitudinal Field Studies. *Management Science*, 46(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478. https://doi.org/10.2307/30036540

White, I. R., & Carlin, J. B. (2010). Bias and efficiency of multiple imputation compared with complete-case analysis for missing covariate values. *Statistics in Medicine*, 29(28), 2920–2931. https://doi.org/10.1002/sim.3944

Wu, I.-L., & Chen, J.-L. (2005). An extension of Trust and TAM model with TPB in the initial adoption of online tax: An empirical study. Inter*national Journal of Human-Computer Studies*, 62(6), 784–808. https://doi.org/10.1016/j.ijhcs.2005.03.003

Wu, Z.-Y., Chen, L., & Wu, J.-C. (2013). A Reliable RFID Mutual Authentication Scheme for Healthcare Environments. *Journal of Medical Systems*, 37(2), 9917. https://doi.org/10.1007/s10916-012-9917-0

Yao, W., Chu, C. H., & Li, Z. (2012). The adoption and implementation of RFID technologies in healthcare: A literature review. *Journal of Medical Systems*, 36(6), 3507–3525. https://doi.org/10.1007/s10916-011-9789-8

Yazici, H. J. (2014). An exploratory analysis of hospital perspectives on real time information requirements and perceived benefits of RFID technology for future adoption. *International Journal of Information Management*, 34(5), 603–621. https://doi.org/10.1016/j.ijinfomgt.2014.04.010

Zailani, S., Iranmanesh, M., Nikbin, D., & Beng, J. K. C. (2014). Determinants of RFID Adoption in Malaysia's Healthcare Industry: Occupational Level as a Moderator. Jou*rnal of Medical Systems*, 39(1). https://doi.org/10.1007/s10916-014-0172-4

Borut Werber is an Assistant Professor of Information System Development at the Faculty of Organizational Sciences, University of Maribor, Slovenia. His main research interests are micro-enterprises, information-communication technology, and novel technologies.

Alenka Baggia is an Assistant Professor of Quality and Information Systems at the Faculty of Organizational Sciences University of Maribor. Her main research interests are resource scheduling, simulation, information systems, and software quality.

Anja Žnidaršič is an Associate Professor of Quantitative Methods at the Faculty of Organizational Sciences, University of Maribor, Slovenia. Her main research interests are social network analysis, micro-enterprises, information-communication technology, students' performance in methodological courses, and technology adoption.