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A LoRa-based custom software to test the reception of accommodation hosts

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A B S T R A C T

In one of the external departments of the Faculty of Economics at the University of Debrecen, where they deal with information technology and software development, he has created software not yet available on the market. To sell the product successfully, it is necessary to assess the exact parameters of the product, the price at which it can be sold and the best way to obtain it. Mapping these parameters will contribute to the creation of profitable software that is not unique in the market but can also be cost-effective and attractive for accommodation providers. We can investigate this using the tried and tested method of questionnaires. This will allow us to investigate and measure, using direct questions, what the accommodation providers think about the software system developed by the company.

1. Introduction

The Guests can prove their identity by any personal document (identity card, passport or driving licence).
The recording of guest data by a document scanner, which essentially means scanning, is mandatory in all accommodation establishments in Hungary, regardless of the type and number of guests (I, 2023).
The introduction of the new guest identification system is mainly motivated by security reasons.
Through the digital document scanners, the guest data recorded in the accommodation management software will also be entered into the Guest Information Closed Database (Hungarian name is VIZA), which is a guest hosting service, in addition to the National Tourist Information Centre (Hungarian name is NTAK). The hosting provider of the database is the Hungarian Tourism Agency (Hungarian name is MTÜ).
In a statement issued earlier, the MTÜ stated that the VIZA system is a strictly closed and protected data repository serving the common interest and security of all, subject to the particularly strict security requirements imposed by law.
The system is new only in our country, the way of logging in and identifying guests is similar in several European countries (UK, Spain, Italy, Germany, France).
In the beginning, accommodation providers with up to 8 rooms and 16 beds could do this more easily using the ”VENDÉGEM” application (II., 2023), which is provided free of charge by the MTÜ.
Of course, as with any new system, there were problems. Besides a smooth launch of the system, a concerted effort had to be made to inform potential travellers.
Therefore, accommodation providers do not have many options because registration of accommodation providers is required by law. On this basis, from small guesthouses to large hotels, it is therefore necessary to register guests, of course respecting the GDPR rules on data processing.
This is why the company mentioned in the abstract has created software not yet available on the market. To potentially successfully market the product, it was necessary to assess exactly what parameters were needed. Since the definition of these parameters will contribute to the creation of

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profitable software that is not unique on the market, but also cost-effective, it could be attractive for accommodation providers.
However, what could not be found in any of the accommodation software systems examined, at least in the systems we studied, is the PMS feature, which makes the software developed by the company unique. This module is responsible for the management of the bracelets used for the software and the tracking of the guests, for example in the case of a forest excursion, and it does this via the LoRa network, the use of this technology is what makes the software innovative.

2. Methodology

To find out exactly what kind of software accommodation providers would like to receive and use, we conducted a questionnaire survey. This method was chosen because it is the most suitable for conducting research even with a small number of items.
Once the results of the questionnaire have been used to parameterise the desired product, we will try to estimate its energy demand.
Once we can see the cost of producing the product, its energy requirements and its deployment, we will be able to parameterise the selling price.

2.1. Technological adoption models

Today's world is characterised by constant innovation, renewal and technological development, complemented by continuous improvement and accelerated data exchange. Different models of technology adoption are an important part of innovation, as modelling studies provide answers to questions about the adoption, perception and potential failure of innovations. The effectiveness of these models has been demonstrated in several studies over the years (Blut et al., 2016).
In developing the TAM model, Davis first analysed the use of computers and software in the workplace (Davis, 1989). In developing the model, Davis used the Theory of Reasoned Action and added several relevant variables to the model.
Usage is determined by intention to use, which in turn is determined by user attitudes. User attitudes are influenced by perceived usefulness and perceived ease of use. The basic concept of this model is that a technology is adopted if it is easy to use and has high perceived usefulness. This basic model was later extended with several new variables into the TAM2 and TAM3 models (Venkatesh and Davis, 2000), where social influence and cognitive means were added, and perceived ease of use was developed.

2.2 Using the UTAUT model

In parallel with the TAM model, Venkatesh and colleagues integrated the earlier models into a unified theory of technology adoption and use, the UTAUT model (Venkatesh and Bala, 2008).
The model uses four variables to measure technology use intention directly and actual use indirectly. These variables are expected efficiency, expected effort, social impact and potential conditions. In addition, four adjustment variables, namely gender, age, experience and voluntariness are also included in the model.
To interpret the model, it is important to understand what each variable measures and what issues are associated with it. Expected effectiveness measures how well the technology helps the user with a particular task or behaviour. Expected effort measures how much effort the user thinks the technology requires. Social influence measures how important the user considers the technology to be according to the opinions of people important to the user. In 2012, the UTAUT model was revised and extended by Venkatesh and his colleague as UTAUT 2 (Venkatesh et al., 2012).

2.3. Structural Equations Model (SEM)

Latent variable modelling is used in many research areas and one of the most common methods is structural equation modelling. This model is essentially a multivariate analysis method that combines the basics of multivariate regression and factor analysis (Kovács, 2013). In structural equation modelling (hereafter SEM), two important parts can be distinguished: the measurement part can be considered as a confirmatory factor model, in which latent variables are measured by explicit indicator variables.

The aim is to use this method to confirm the hypothesized relationships and to check whether our model is consistent with previously established models (Münnich and Hidegkuti, 2012).

2.4 Bootstrapping procedure for PLS-SEM

The bootstrap method was developed by Efron and its first forms date back to the 1950s (Efron, 1979). Where PLS path analysis is used to test the significance level of each path coefficient, the bootstrap procedure can be performed by sampling. This method is used because there is no normal distribution from which regression coefficients can be easily tested. This problem (non-normally distributed samples) is at the forefront of most research in the social sciences, partly because sample sizes are relatively small; so-called quadratic sampling or resampling can partially or completely overcome this problem.

2.5 Logistic regression

Logistic regression essentially examines the probability of an event (dependent variable) occurring as a function of the independent variable. It is often mentioned as an alternative to discriminant analysis, but the assumptions of this method are less stringent. The most important of these is the exclusion of multicollinearity between variables and the linear dependence of the independent variable on the dependent variable. The method has the advantage of not requiring a normal distribution (Hosmer et al, 2013). This method is mostly used to predict events or to measure the indirect effects of dependent and independent variables; three types are distinguished: binomial (binomial), polynomial and ordinal (ordinal), selected according to the level of measurement (Gasso, 2019). The regression coefficient is used to calculate the odds ratio, which is the probability that something happens in the group under study multiplied by the probability that something happens in the control group. The parameters are estimated iteratively using the maximum likelihood method instead of the least squares method of linear regression (Bartus, 2003).

We conducted our research taking into account the above methodologies, with 100 accommodation providers participating and completing the questionnaire, from which we hope to infer the necessary parameters. The results of the questionnaire were evaluated. The questions of the questionnaire are shown below.

Table 1. Questionnaire questions and parameters

Questions	Parameters
The use of devices/systems increases safety during the excursion	Expected performance
The use of devices/systems can be useful during the trip Expected results	Expected performance
The use of devices/systems can be useful during the trip	Expected performance
Learning to use the device/system is (would be) easy	Expected effort
My interaction with the device/system is (would be) unambiguous	Expected effort
I think it (would be) easy for guests to use the tool/system.	Expected effort
I find the tool/system reliable.	Reliability
I find that the tool/system provides reliable data.	Reliability
I believe that customers can rely on the device/system.	Reliability
The business has sufficient financial resources to implement.	Financial availability
The associated budget would allow support for the implementation	Financial availability
We have the resources (knowledge, infrastructure) to use the systems/tools.	Supporting factors
New systems/tools could be expected to fit in with our existing solutions.	Supporting factors
I can request appropriate assistance in case of problems or questions.	Supporting factors
The company believes that similar tools could have an impact on competitiveness.	Competitive pressure
Competitors are already using similar tools.	Competitive pressure
Our company believes that using the tools could increase business opportunities.	Relative advantage

Our company believes that the use of tools can improve our services	Relative advantage
Our company believes that using tools can increase competitiveness	Relative advantage
The use of tools can be beneficial.	Adaptive Intention
Overall, I support the use of tools.	Adaptive Intention
Our company plans to use the tools in the coming years.	Adaptive Intention
We plan to use the tools.	Adaptive Intention

4. Results

For the questionnaire evaluation, simple descriptive statistics were produced and plotted on a pie chart. Only a few relevant parts of these are highlighted.

- The first category was chosen for under 16 people because it allows smaller accommodation providers to use the free My Guest accommodation software. So, by definition, they are not a target group for sales. Of the remaining part, the number of accommodation establishments that can be targeted for software sales is around 67%.
- From the point of view of both the accommodation providers and the sales of the software developed by our company, the mobile coverage of the accommodation is an important issue. Around 70% of accommodation providers stated that signal strength is strong everywhere in and around the accommodation. As mentioned in the other research, we are not using the mobile service, but the coverage of the LoRa network is important, I think that if the mobile coverage is good in and around the area, then presumably there will be no problem with the LoRa network.
- We looked at the internet in accommodation based on the quality of the connection. As again we got a value of around 70%, it is quite likely that the majority of the accommodation units that filled in the questionnaire use mobile internet to access the internet. In any case, the results are quite encouraging in terms of software sales.
- How many of the accommodation providers who completed the questionnaire had heard of LoRa devices or LoRa networks? To be honest, it is not surprising that 70% had not even heard of it before reading the brochure. Only 10% said they were familiar with these devices and even used them. This clearly shows that there is still a large gap in the market for the company to sell its fully-fledged software product.

Several methods were applied to the patterns that emerged from the data collected. These methods have been applied gradually, thus expressing new approaches. For the evaluation, the following methodological items were applied as far as the available sample allowed, based on the preliminary designs.

- PLS-SEM (structural equation modelling)
- Ordinal logistic regression
- Kruskal-Wallis test

For the present survey, the relationships shown in the figure below were assumed. Among the independent variables, the classification of the accommodation (V3), accommodation capacity (V4), typical guests (V11 and V12), tours organised by the accommodation (V13) and experience of guests getting lost or lost from the group (V14) were used. Among the dependent variables, the model variables attitude (AT) and willingness to use (WTP) were used in the analysis.

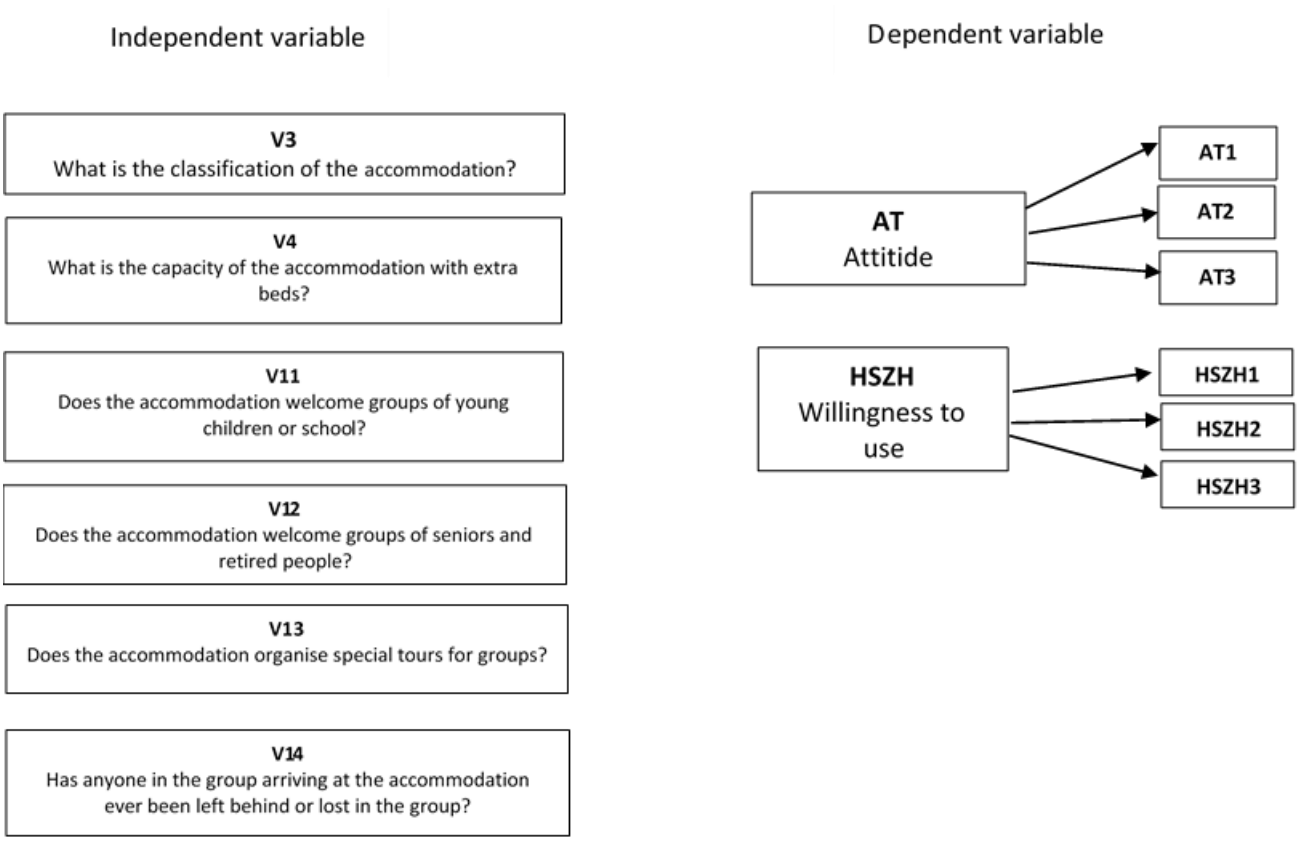

Figure 1. Thematic evolution of keywords

3.1. Differences between electoral groups

In the present case, a Kruskal-Wallis test was used, with the null hypothesis that the median of the scores is equal. The variables mentioned, except variable V4, were controlled to identify possible options.

Table 2. Kruskal-Wallis test result

	Dependent variable	***Independent variable***	***Chi2***	***df***	***p***
Willingness to use	HSZH1	V3	7,84	6	0,250
Willingness to use	HSZH1	V4	6,21	6	0,400
Willingness to use	HSZH1	V11	0,69	2	0,708
Willingness to use	HSZH1	V12	4,80	2	0,091
Willingness to use	HSZH1	V13	0,63	1	0,427
Willingness to use	HSZH1	V14	12,70	2	**0,002**
Willingness to use	HSZH2	V3	7,97	6	0,241
Willingness to use	HSZH2	V4	4,72	6	0,581
Willingness to use	HSZH2	V11	0,56	2	0,755
Willingness to use	HSZH2	V12	6,19	2	0,045
Willingness to use	HSZH2	V13	0,62	1	0,431
Willingness to use	HSZH2	V14	10,57	2	**0,005**
Attitude	AT1	V3	10,51	6	0,105
Attitude	AT1	V4	5,28	6	0,508

Attitude	AT1	V11	0,77	2	0,679
Attitude	AT1	V12	5,82	2	0,054
Attitude	AT1	V13	0,24	1	0,622
Attitude	AT1	V14	7,46	2	**0,024**
Attitude	AT2	V3	6,62	6	0,357
Attitude	AT2	V4	7,14	6	0,309
Attitude	AT2	V11	3,66	2	0,160
Attitude	AT2	V12	4,18	2	0,124
Attitude	AT2	V13	0,10	1	0,758
Attitude	AT2	V14	12,43	2	**0,002**

The results show that there was a difference between the respondents who answered differently to question V14, i.e. "Have you ever had a group of children/older people arriving at the accommodation and getting lost in the group, being left behind?", when taking into account the model variables of attitude and willingness to use. The difference was observed in all cases, but the direction and nature of the difference cannot be determined without further analysis.

3.2. Impact of choices on attitude and willingness to use

How the above independent variable influences the assessment of the dependent variables is reviewed below. For the sake of simplification, the variable considered relevant above has been used as the independent variable.

Table 3: Ordinal logistic regression results

Dependent variable	*Options*	*Koeff.*	*Std. Error*	*T*	*p*
HSZH1	V14: Yes, but it is very rare	-0,802	0,706	-1,135	0,256
HSZH1	V14: No, this has never happened before	0,811	0,662	1,225	0,221
HSZH2	V14: Yes, but it is very rare	-0,768	0,669	-1,148	0,251
HSZH2	V14: No, this has never happened before	0,664	0,626	1,061	0,289
AT1	V14: Yes, but it is very rare	-0,113	0,797	-0,142	0,887
AT1	V14: No, this has never happened before	1,007	0,760	1,325	0,185
AT2	V14: Yes, but it is very rare	-0,255	0,793	-0,322	0,748
AT2	V14: No, this has never happened before	1,289	0,739	1,744	0,081

In the present case, the results did not identify the impact of previous experience with lagging and straying on this assessment. Thus, it can be concluded that, although the previous calculation showed that there was a discrepancy, no concrete model can be established for this based on the present data set.

3.3. Route analysis

In the development of the PLS-SEM model, some elements of the model variables used in the survey were applied. Attitude (AT) and willingness to use (WTP) were used as dependent variables. Some independent variables of the UTAUT2 model for measuring technology acceptance were used in the model development, including expected performance (VTEL), expected effort (VE) and support factors (TAM). The internal reliability indicators and the validity of the latent variable were reviewed before the calculations.

Table 4.: Internal reliability, validity

	Cronbach alfa	*rho*	*CR*	*AVE*
AT	0,887	0,887	0,946	0,898
HSZH	0,974	0,975	0,987	0,975
REL	0,954	0,955	0,97	0,916
TAM	0,835	0,905	0,899	0,75
VE	0,842	0,89	0,901	0,753
VTEL	0,926	0,927	0,953	0,872

All indicators were calculated to be within the thresholds, so no problems were identified that would justify changes.

Table 5: HTMT indicators

	AT	*HSZH*	*REL*	*TAM*	*VE*	*VTEL*
AT						
HSZH	0,885					
REL	0,956	0,807				
TAM	0,625	0,653	0,515			
VE	0,499	0,492	0,415	0,389		
VTEL	0,835	0,638	0,801	0,448	0,544	

The convergent validity of the latent variables is assessed by comparing the correlations between the latent variables and the internal correlations of the latent variables based on the STCT indicators. Since the characteristic threshold is 0.85 based on the literature, we conclude that there is a strong relationship between the latent variable reliability (REL) and the latent variable attitude (AT). To eliminate this, the variable reliability (REL) is not used in further calculations.

Table 6.: The typical route coefficients

	Koeff.	*Average coef.*	*Spread*	*T*	*p*
AT → HSZH	0,824	0,822	0,035	23,298	**<0,001**
VTEL → AT	0,613	0,613	0,072	8,496	**0,023**
TAM → AT	0,295	0,299	0,070	9,97	**<0,001**
VE → AT	0,050	0,052	0,086	0,578	0,563

The results allow us to observe the typical paths in the model. The variables expected effort (VTEL) and support factors (TAM), also used in UTAUT2, have a positive effect on attitude (AT), which also has a positive effect on willingness to use (WTP). In contrast, expected effort (VE) had no significant effect on attitude (AT), so the assumed ease of use of the tool is not a clear determinant of willingness to use.

Conclusion

One important question was the mobile phone coverage in and around the accommodation, as many accommodation providers only provide internet access via mobile phones. This received a positive response of 70%. The quality of the internet connection was also rated as good by the accommodation providers, with almost the same percentage (70%).

From a financial point of view, the majority of accommodation providers are rather neutral on the question (around 50%) whether they have sufficient financial resources to implement the solution offered. We also asked whether the associated budget would allow them to support the software implementation. Here again, the proportion of neutrals is around 50% (but encouragingly, 32% tend to agree and only 17% tend to disagree).

Looking at relative advantage, we found that around 60% of accommodation businesses believe that using the tools could increase business opportunities, improve their services and increase their competitiveness.

The results of structural equation modelling, ordinal linear regression, and Kruskal-Wallis test tests show that there was a detectable difference between respondents who answered differently to question V14, i.e. "Have you ever had a group of children/older people arriving at your accommodation that got lost in the group, left behind the others?", when taking into account the model variables that express attitude and willingness to use. The difference was observed in all cases.
The results also show that there are characteristic pathways in the model. The variables of expected effort (VTEL) and support factors (TAM), also used in UTAUT2, have a positive effect on attitude (AT), which also has a positive effect on willingness to use (WTP). In contrast, expected effort (VE) had no significant effect on attitude (AT), so the assumed ease of use of the tool is not a clear determinant of willingness to use.
In short, the results show that the product has a high level of receptiveness and willingness to use among accommodation providers, although it is true that it is not yet widely used by accommodation providers and many of them have not even heard of LoRa networks and devices, but they are confident that this new innovative technology will increase their competitiveness and most of them are confident that the use of the devices can increase their business opportunities and improve their services and competitiveness.

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