

# The young and the restless of mobile phone security (How security awareness and feeling lessen with age in students)

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**Abstract:** - The present paper answers the question whether there is a statistically significant connection between the age of a student and his security awareness and practices in regards to mobile phone usage. It is based on the responses of a large pool of 7172 students in 17 Universities of 10 Eastern and Southern Europe countries. Results support that younger students are more aware. On the other hand, older students feel mobile phones communication is less secure than what younger ones believe. Namely, these age groups exhibit different values of two metrics that we named “mean security awareness value” and “mean security feeling value”. We also introduced a “mean actual awareness value”, comparing respondents’ subjective view of awareness to the objective awareness levels as extracted from their actual answers. There was a linear association proving that users that subjectively state they are more aware, indeed are so. As such, awareness campaigns should focus mainly on groups that feel they are not secure, as pinpointed in this paper, in order to enhance their confidence.

**Key-Words:** - mobile phone security, user profiling, survey, mean security awareness value, mean security feeling value, mean actual awareness value.

## 1 Introduction

Mobile devices are nowadays used by all age segments. The research question that this paper tries to answer is whether there is a change in mobile phone security awareness and practices according to the age of users. As this paper reveals, young users exhibit different levels of knowledge in regards to security of their phones, depending on their actual age group. The work is based on the responses of a large pool of 7172 students in 17 Universities of 10 Eastern and Southern Europe countries, according to Table I. Specific age groups exhibit different values of two metrics that we named “mean security awareness value” and “mean security feeling value”. Results show that there is indeed such a connection with younger students stating that they are more aware. On the other hand, older students feel communication with mobile phones is less secure than what younger ones believe. Lacking a theoretical foundation and previous large scale surveys for the mobile phone security awareness, we

used a prototype questionnaire. Furthermore, we introduced a “mean actual awareness value”, comparing respondents’ subjective view of awareness to the objective awareness levels as extracted from their actual answers. There was a linear association proving that users that feel they are more aware, indeed are so. Thanks to the statistical process employed these specific age categories can be pinpointed and awareness and security campaigns can focus on them in order to enhance their confidence. In the rest of the paper, related literature is examined in Section II and the methodology used for the survey is described in Section III. Results are presented in Section IV, closing with conclusion and future work in Section V.

## 2 Related work

Although there have been quite many theoretical studies concerning mobile services and mobile phones, not much academic work has been carried out in regards to mobile phone security awareness.

An earlier survey [1] published in November 2008 focused on mobile phones security issues and in which degree these issues concern the users. The conclusion was that a major part of the participants are extremely concerned about security and don't want any of their private data to be available to 3rd party unauthorized users. There also exist several survey studies from antivirus companies and other, non academics in this direction. Some of these surveys studies focus on mobile phone's security issues [2][3] while others on mobile phone services, touching also security issues [4]. The vast majority of the rest of surveys indicate the growing importance of mobile phones in everyday life and the increased popularity of new features [5]. In any case, the security of mobile phones has proven to be inadequate in many research papers [6][7]. Modern smart phones, specifically, are vulnerable to more security risks [8]. Furthermore, users are interested in mobile services adoption only if the prices are low and the security framework tight enough. Despite the importance of security in the given field, cyber security and safety education is left out from the educational system [9]. Users, in turn, do not know if their phones are secure or not [10]. Our contribution, therefore, aims at tracing the specific user categories that are mostly in need of security training and awareness campaigns.

### 3 Methodology

A very useful evaluation method for surveying user's practices is the use of multiple-choice questionnaires (i.e. in person delivery or e-mail questionnaires) [11][12]. Our survey was conducted using in-person delivery technique, with a total of 7172 respondents participating in this survey, in 17 Universities of 10 Eastern and Southern Europe countries, according to Table I. This method was selected from other alternatives because is more accurate and has a bigger degree of participation from the respondents (e-mail questionnaires usually are treated as spam mail from the respondents plus there is the risk of misunderstanding some questions). Indeed, the approximate ratio of participation was 80% since the researchers were able to answer the questions of participants regarding the scope and the purpose of the survey. There was also a pilot study, conducted in the University of Ioannina, Greece, before the questionnaire was administered to the sample, to ensure the reliability of the questionnaire. As stated, there are not available already validated questionnaires for the subject and as such we have tried to form an initial basis for further work by other researchers. Data entry, finally, took place

using custom software [13] while processing was done with SPSS. The target group of the survey was university students from ages mostly 18-26, incorporating both younger and older youth segments because these ages are more receptive to new technologies. Given the fact that nowadays a very high percentage of young people is studying, the sample is not deemed limited and can be considered as representative of a large percentage of general youth population. Furthermore, since they are still studying, it would be easier to participate in security education programs, possibly implemented in Universities.

The research hypothesis tested was that mobile phone security awareness and security practices change with the age of users. Along with age, naturally the level of education changes, but we have limited our sample to University students who have more or less the same education level. Lacking a theoretical foundation and previous large scale surveys for the mobile phone security awareness, we used a prototype questionnaire. We correlated the answers using the question: "Are you informed about how the options and technical characteristics of your mobile phone affect its security?" which had the following possible answers: "A Very Much, B Much, C Moderately, D Not too much, E Not at all". Apart from the statistical interpretations, a simple mathematical formula was developed in the analysis of the security knowledge to produce numerical values from the multiple choice questionnaires. We weighted the responses with the following weights: Very Much: 4, Much: 3, Moderately: 2, Not much: 1, Not at all: 0, added them and then divided by the number of occurrences, in order to get a mean value that we called "Mean Security Awareness Value-MSAV"

Accordingly, we examined the other main question: "How secure do you consider communication through mobile phones?" which had the same possible answers: "A Very Much, B Much, C Moderately, D Not too much, E Not at all". The same weighting was used to get a mean value that we called "Mean Security Feeling Value-MSFV"

In addition to MSAV which was based on subjective answers, another metric was introduced, the "Mean Actual Awareness Value-MAAV". MAAV was calculated as following: we added one point for each "I don't know" in the answers. The maximum score would hence be 7 (there were 7 questions with a possible "don't know" option in the answers) denoting a highly lacking awareness profile while 0 would be the mostly security aware score (negative scale).

## 4 Results

The questionnaire was divided in two parts. In the first part participants were asked demographic questions including gender, age and field of studies as well as some economic data including mobile phone usage, connection type and budget spent monthly on phone service. In the second part we introduced security knowledge and practice questions. In the following sections we present the results of categorizing users in regards to their age as described earlier. All of the findings presented are statistically significant at Pearson's Chi-Square  $p < 0.001$  level. In the total sample, 53% of the participants were females and 47% were males. Most of the respondents, in turn, were aged 18-26 (75%).

Our fundamental research questions were whether students are informed about how the options and the technical characteristics of their mobile phones affect the security of the latter (awareness) and whether they are feeling the communication is secure. The majority of students (30.8%) states that they are “moderately” informed while a large 15.8% believes that they are “not at all”. In pace with this, students have a feeling of moderate security no matter how much money they spend per month for their mobile phone bill. At the same time, users that spend more money (>30 Euros per month) are exhibiting higher percentages in the responses ‘not at all’ and ‘not too much’.

Czechs and Slovaks and Romanians felt the more informed. 62% of Bulgarians said they are not much or not at all informed followed by Latvians, Greeks and Estonian that each one have sums of 46%-48% in the same two categories. In absolute terms, 30% of Bulgarians and 25% of Greeks are not at all informed.

Respectively, for the question about how secure they feel communication is, the majority (36.9%) replied “moderately” followed by 28.6% “much”. On the other hand, some 21.36% felt not too much or not at all sure they are secure. Czechs and Slovaks consider mobile phone communication very much or much secure in percentages of 87% and 84% followed by 67% of Romanians. On the other hand, Slovenians, Bulgarians and Greeks appear more “suspicious” with percentages of 40%-43% believing that communication is not too much or not at all secure. The most “reserved” ones were Greeks with 21% feeling not at all secure.

Using the simple formula described in Section III (Methodology), the mean security awareness value (MSAV) was 1.86, in the 0-4 scale (0 not at all, 4 very much), while the mean security feeling value (MSFV) was 2.26 in the same 0-4 scale.

The mean security awareness values, as well as the mean security feeling value, were found to be increasing in younger ages (Figures 1 and 2). Younger youth segments feel mobile phones communication is more secure and at the same time they believe they are better informed about how the various options and characteristics of their phones affect its security.

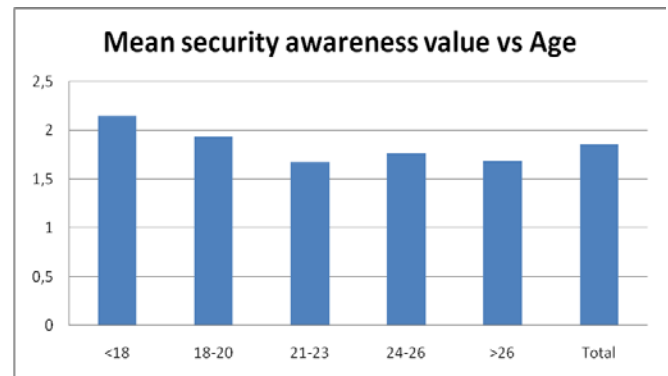


Figure 1. Mean security awareness value vs. Age.

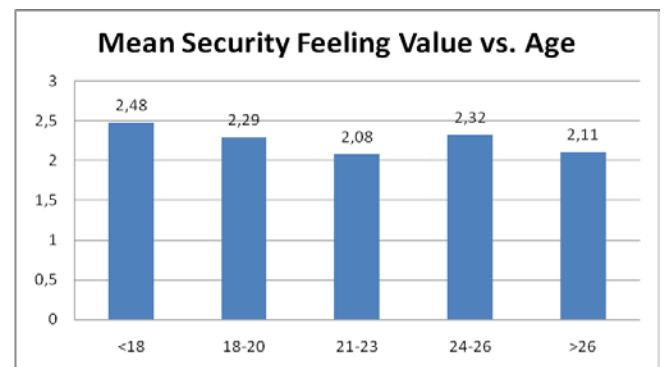


Figure 2. Mean security feeling value vs. Age.

Sorting the actual responses regarding security awareness we can see in Figure 3 that older students believe they are less informed while indeed younger ones have a sense of “over assurance” regarding their awareness.

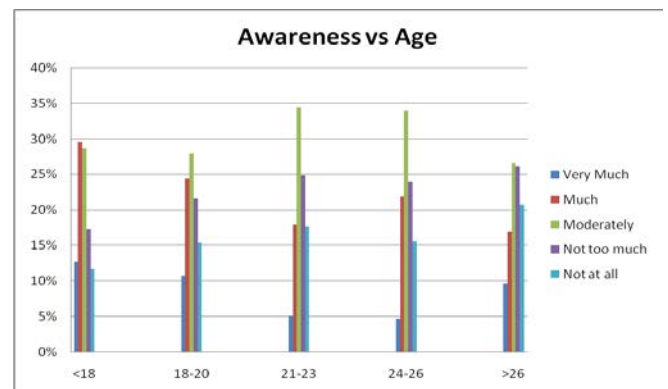


Figure 3. Security awareness vs. Age.

The trend in subjective sense of awareness as stated by the students is fortunately backed up by the objective values extracted from the Mean Actual Awareness Value (MAAV). There is a linear correlation, in figure 4, where students that believe that they are very much informed indeed have the better scoring (lower value) in MAAV. The values change all the way to those of students that believe that are not at all informed and as such have the lowest scoring (highest value of MAAV).

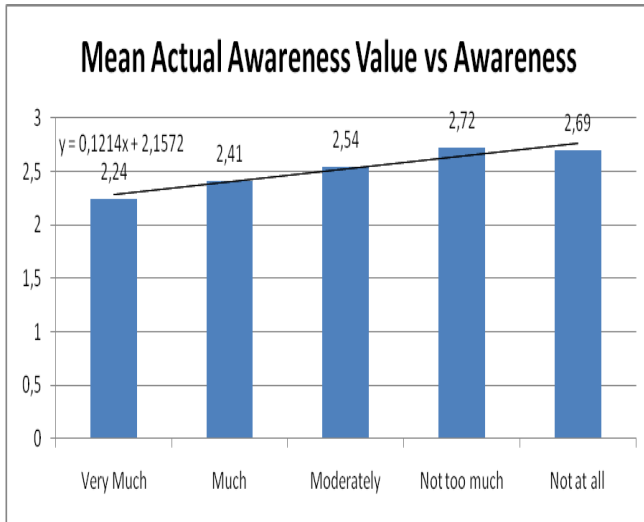


Figure 4. Subjective vs Objective awareness.

Proceeding, in the following paragraphs we are focusing on security practices, where again we came across differentiations among age groups.

As Figure 5 reveals, there is a global ~45% percentage of students that do not know what IMEI (International Mobile Equipment Identity) is. Younger students however tend to having it noted somewhere more than older ones. IMEI is very significant because if the phone is ever stolen, using this serial number the provider can block access to the stolen phone effectively mitigating stealing risks. In practice, however, not all operators use this feature, so its importance is limited.

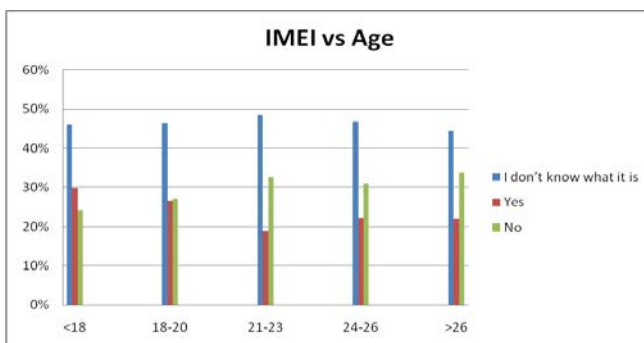


Figure 5. IMEI vs. Age.

Knowledge of IMEI feature and actual implementation of the white and black lists by the operators would help the 51% of users who unfortunately had their phone lost or stolen once or more. Similarly high percentages are noted by other studies too [14][15]. In respect to lost phones, we noticed a particular change in responses of students 24-26 years old, where, in contrast to other categories, they had more cases of lost/stolen phones (Figure 6). It is also interesting to note that the ratio of stolen/lost phones does not change with age (it would be logical to assume that older students, owning a phone for more time than younger students would have more chances of having their phone stolen/lost).

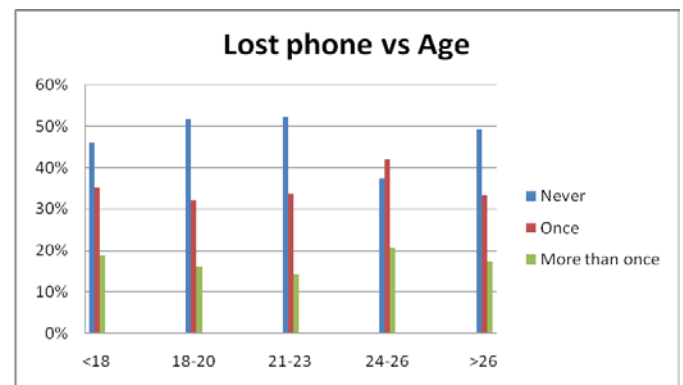


Figure 6. Lost phones vs. Age.

Concurrently, just 25% of users are aware of the existence of the special icon that informs the user that his/her phone encryption has been disabled. Younger ones are more aware of this indicator however as Figure 7 shows.

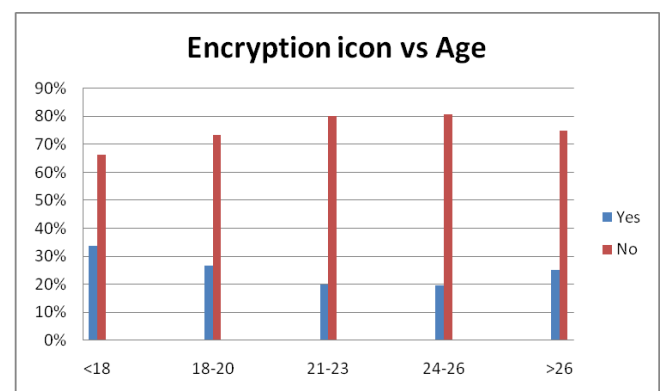


Figure 7. Encryption icon knowledge vs. Age.

In short, in GSM, when A5 encryption is switched off or not supported, there is provision for handsets to display a special icon informing the user about the situation. Such an occurrence can be attributed either to network's lack of encryption capability or to temporary failure/overloading.

Unfortunately, the same can happen when a malicious attacker is launching a man in the middle attack, impersonating network's base stations to deceit the handset into connecting with the false base station instead of the true one. The fraudster can then channel the communication through his own equipment, effectively intercepting it.

Proceeding with Bluetooth, there was an inversion in trends. Younger ones are far more actively using it, having it switched on (visible or not) in almost 50% rate (Figure 8).

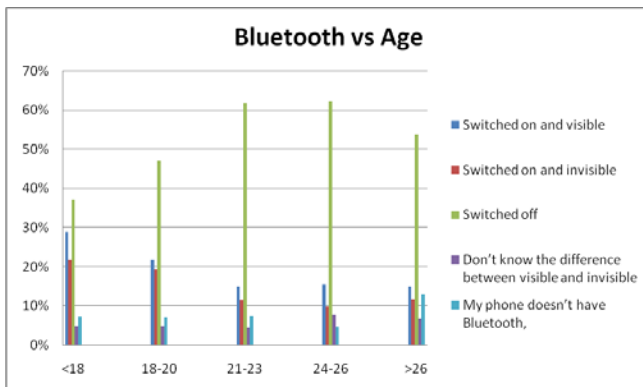


Figure 8. Bluetooth usage vs. Age.

While older students are more cautious with Bluetooth usage, they are not so careful when it comes to storing passwords in the mobile phone (Figure 9). There is a clear shift in trends. In ages of less than 21 years old students are at least using some form of encryption when they are saving passwords while in ages of more than 23 years old users are saving the passwords in plaintext.

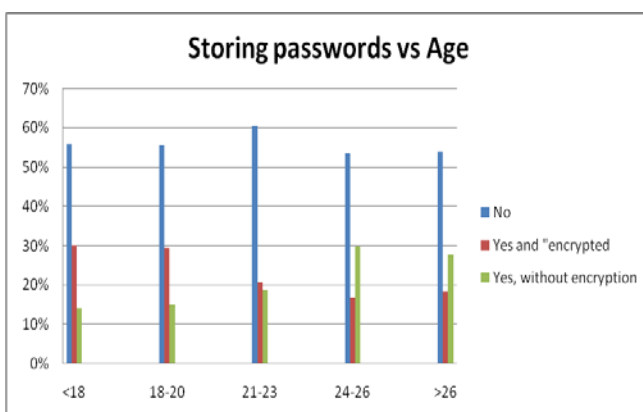


Figure 9. Saving important passwords vs. Age.

Ending the security section, the issue of backup was examined. The frequency of backup is higher in younger segments, although it still lies in low percentages (Figure 10).

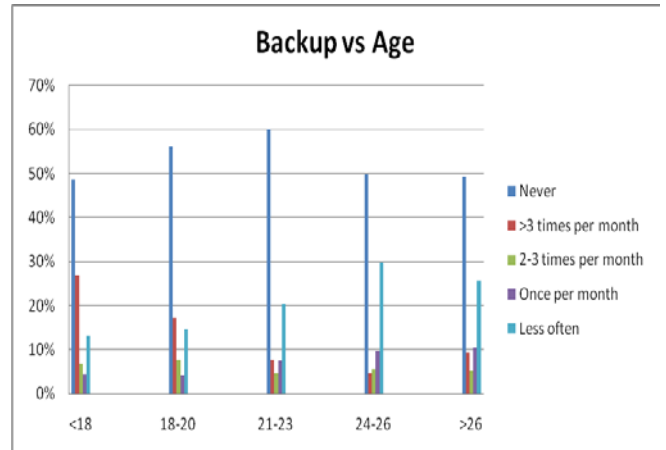


Figure 10. Backup frequency vs. Age.

Before closing, in this paragraph we are also presenting other interesting results from the survey according to [16] and [17]. Examining the field of study we discovered that soon to be medical doctors are feeling the most secure (MSFV 2.69). Mathematics and Natural Science students with MSFV 1.89 were in the other end of spectrum the most worried ones. Engineers were in the middle of the range, with MSFV 2.24. Humanities-Philology and Medicine students appear less informed about downloading. Law students specifically like ringtones-logos and Maths-Natural sciences students prefer downloading games

## 4 Conclusion

As this survey's results show (supported by using Pearson's Chi Square), users' security awareness and behavior (in regards to mobile phone usage) change with age (negatively). Younger users seem to be more promising for the future of security but older ones must be protected right now. The metric of "mean security awareness value – MSAV" helped further quantify the results among age groups.

Excessive confidence could lead to "relaxation" of security practices so we used the "mean actual awareness value – MAAV" to examine the issue in an objective perspective rather than the subjective answers of the users. Correlating MSAV (subjective awareness) to MAAV (objective awareness) we noticed an almost linear relationship. Users that feel very much informed have indeed the better score in following actual security practices. On the other end, users that do not feel informed are indeed exhibiting a handicap in following security best practices.

Finally, older youth segments feel mobile phone communication is less secure than younger ones believe. This is backed up by their lower feeling of

awareness they state they have. Fear certainly hinders technology adoption and as such operators should focus their awareness and security campaigns on these subsets of users. Enhancing users' security awareness would lower their fear of communication insecurity, leading to greater phone usage, especially for the new services offered.

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#### Appendix

##### The Questionnaire used

- 1) Male (A) or Female (B)?
- 2) Age? (A < 18, B 18-20, C 21-23, D 24-26, E >26)
- 3) Are you studying: (A: Humanities-Philology, B Medicine, C Law, D Engineering-Computer Science, E Maths-Natural Sciences, F Economics-Business Administration, G OTHER)
- 4) How many mobile phones do you use (daily)?  
A) 1 B) 2 C) >2 D) None
- 5) Are you a contract subscriber or a prepaid subscriber?  
A) Pre-paid (Card) B) Post-paid (Contract) C) Both
- 6) Your average monthly phone bill? (A up to 10 Euros, B 11-20 Euros, C 21-30 Euros, D 31-40 Euros, E >40 Euros)
- 7) Brand of the phone you are mostly using now? (A Nokia, B Sony-Ericsson, C Samsung, D Sharp, E Apple I-phone, F Motorola, G LG, H Other)

- 8) Does it have an advanced operational system (eg Symbian, Windows Mobile, Android)? (A I don't know, B yes, C no,)
- 9) Have you noted somewhere your mobile phone's IMEI? (A, I don't know what it is, B yes, C no,)
- 10) Was your mobile phone ever lost or stolen? (A Never, B once, C more than once)
- 11) Are you aware of the existence of a special icon in your telephone which informs you for the encryption's deactivation? (A Yes, B No)
- 12) Do you have SIM card's PIN activated? (A Yes, B No)
- 13) Do you use password in your phone's Screen-Saver? (A I don't know if it has such a feature, B, doesn't have such feature, C, Yes, D No)
- 14) Do you have Bluetooth: (A Switched on and visible, B Switched on and invisible, C Switched off, D don't know the difference between visible and invisible, E My phone doesn't have Bluetooth,
- 15) Do you lend it to others? (A Never, B Only for a while and if I am present, C Yes)
- 16) Do you "download" software to your phone? (A I don't know if my mobile phone can download, B No, C mostly Ringtones/Logos, D mostly Games, E mostly Applications)
- 17) Do you use Antivirus software in your phone? (A Doesn't have the ability, B Don't know if there is such product for my phone, C I know there is but I don't use D Yes)
- 18) Do you store important passwords in your phone (eg Credit cards passwords, ATM passwords)? (A No, B Yes and "encrypted", C yes, without encryption)
- 19) How often do you create backup copies of your phone's data? (A Never, B >3 times per month, B 2-3 times per month, C Once per month, D Less often)
- 20) Do you keep sensitive personal data into your phone (photos/videos/discussion recordings)? (A Yes, B No)
- 21) How secure do you consider communication through mobile phones? (A Very Much, B Much, C Moderately, D Not too much, E Not at all)
- 22) Are you informed about how the options and technical characteristics of your mobile phone affect its security? (A Very Much, B Much, C Moderately, D Not too much, E Not at all)

Country	City	No of Universities	Students	University name
Greece	Ioannina	1	780	University of Ioannina
Bulgaria	Sofia	1	991	University of Sofia
Romania	Iasi	3	994	Gheorghe Asachi University of Medicine and Pharmacy Alexandru Ioan Cuza University
Czech	Brno	2	663	Masaryk University Brno University of Technology
Slovakia	Bratislava	1	509	Comenius University
Hungary	Budapest	4	959	Semmelweis University Budapest Business School Eotvos Lorand University Corvinus University
Lithuania	Siauliai	1	759	Siauliai University
Latvia	Riga	2	620	University of Latvia Riga Technical University
Estonia	Tallinn	1	829	University of Tallinn
Slovenia	Ljubljana	1	98	University of Ljubljana
<b>10</b>		<b>17</b>	<b>7172</b>	

Table 1. List of participants in survey