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Empirical study on ICT system's users' risky behavior and security awareness

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Abstract - In this study authors gathered information on ICT users from different areas in Croatia with different knowledge, experience, working place, age and gender background in order to examine today's situation in the Republic of Croatia (n=701) regarding ICT users' potentially risky behavior and security awareness. To gather all desired data validated Users' Information Security Awareness Questionnaire (UISAQ) was used.

Analysis outcome represent results of ICT users in Croatia regarding 6 subareas (mean of items): Usual risky behavior (x_1=4.52), Personal computer maintenance (x_2=3.18), Borrowing access data (x_3=4.74), Criticism on security in communications (x_4=3.48), Fear of losing data (x_5=2.06), Rating importance of backup (x_6=4.18). In this work comparison between users regarding demographic variables (age, gender, professional qualification, occupation, managing job position and institution category) is given.

Maybe the most interesting information is percentage of questioned users that have revealed their password for professional e-mail system (28.8%). This information should alert security experts and security managers in enterprises, government institutions and also schools and faculties.

Results of this study should be used to develop solutions and induce actions aiming to increase awareness among Internet users on information security and privacy issues.

I. INTRODUCTION

The importance of ICT system's users' knowledge and awareness about information security issues should be acknowledged when dealing with user's privacy and information security in general [1-3]. Users with potentially risky behavior can significantly affect overall security level of different information and communication systems [4-6].

Generally, main goal of empirical studies is to produce some new knowledge based on gathered data analysis. In that manner aim of this work was to produce some new conclusions about ICT system's users' knowledge, behavior and awareness regarding information security issues. For purpose of collecting data authors used previously validated Users' Information Security Awareness Questionnaire (UISAQ) [7]. Total of 701 participants included in this study were ICT users from different areas in Croatia with different knowledge, experience, working place, age and gender.

Other empirical studies with similar aim in their research examined only certain segments of ICT users'

awareness or behavior, mostly focused on password usage and password quality [8-13]. However, by using UISAQ questionnaire when examining ICT users this empirical research covers wide range of awareness, knowledge and user's behavior. Additional quality of empirical research was succeeded by using UISAQ questionnaire as statistically validated measuring instrument.

The UISAQ questionnaire has two main scales and six subscales, each with five or six items. Associated abbreviations are used in further text and tables:

- Potentially Risky Behavior (PRB; k=17)
  - Usual Behavior (UB; k=6)
  - Personal Computer Maintenance (PCM; k=6)
  - Borrowing Accessing Data (BAD; k=5)
- Knowledge and Awareness (KA; k=16)
  - Security in Communications (SC; k=5)
  - Secured Data (SD; k=5)
  - Backup Quality (BQ; k=6)

These subscales describe user's behavior, knowledge and awareness. Participants should evaluate their agreement with the statement on a 5-point Likert-type scale where five means excellent from aspect of information security. At the end of UISAQ questionnaire there were two additional questions about behavioral security of users and one part with demographic data.

For statistical analysis in this work statistical software tool MedCalc 14.12.0 was used. Statistical significance, when comparing differences among groups was defined as $p<0.05$, using nonparametric tests Mann-Whitney U Test and Kruskal-Wallis Test with Bonferroni correction when needed.

II. PARTICIPANTS

In this research a paper version of UISAQ questionnaire for data collection was used. Sample was defined in a way to be as similar as possible to general ICT user in the Republic of Croatia restrictive to adult users, but covering different regions (Dalmatia, Slavonia,

Zagreb area), both rural and urban areas, both government institutions and business organizations and also including students, unemployed and retired users with different background knowledge and experience regarding information security issues.

Participants (n=701) in total were 32.0 ± 11.5 years old (arithmetic mean ± standard deviation), youngest participant was 18 and oldest was 66 years old. Among participants there was 61.6% of female participants and 31.4% of all participants were working at private sector meaning business organizations. Regarding professional qualifications most of the participants were with high education (masters) 36.8%, while there was similar percentage of those with high school (25.2%) and bachelor degree (24.5%). The 28.8% of all participants revealed their password for professional e-mail systems' access by writing it down on the questionnaire.

Analysis outcome of the whole sample represents average results of ICT users in Croatia regarding 6 subareas (mean of items): Usual risky behavior (x_1=4.52), Personal computer maintenance (x_2=3.18), Borrowing access data (x_3=4.74), Criticism on security in communications (x_4=3.48), Fear of losing data (x_5=2.06), Rating importance of backup (x_6=4.18).

III. COMPARISON RESULTS

In order to compare ICT users, authors made groups regarding gender, age, workplace in government or private sector, professional qualification, managing job position and regarding revealing password. Following results are more interesting part of total results, depending on existence of statistical significant difference.

Comparing results regarding gender are showing that female ICT users got generally better results, except in subscale "Usual Behavior" (Table 1). There is no statistically significant gender difference regarding password revealing (p=0.547, Chi-Square Test).

Comparing results regarding age, where four groups were defined, are showing that middle age and older ICT users got generally better results (Table 2). For analysis between each group was used Mann-Whitney U Test with Bonferroni correction (with p<0.0125) Analysis results have shown that youngest group of users is significantly different of all other groups in total and most other subscales (UISAQ, PCM, KA, SC) while significant

TABLE I. GENDER DIFFERENCES IN USERS' INFORMATION SECURITY AWARENESS

gender	Male (n=269) x±SD	Female (n=432) x±SD	p*
UISAQ	3.68±0.37	3.71±0.32	0.237
PRB	4.17±0.40	4.15±0.34	0.409
UB	3.30±0.96	3.14±0.87	0.018
PCM	4.45±0.48	4.58±0.38	<0.001
BAD	4.75±0.38	4.72±0.39	0.050
KA	3.18±0.54	3.27±0.46	0.013
SC	3.33±0.83	3.57±0.81	<0.001
SD	2.06±0.84	2.05±0.76	0.734
BQ	4.16±0.72	4.20±0.65	0.667

* Mann-Whitney U Test

difference among other three groups of users is found only regarding subscale "Personal Computer Maintenance".

Regarding workplace of ICT users, working in government institutions or in private sector, results have shown that both groups of ICT users got similar results, except in subscale "Secured Data" where users working at private sector got significantly lower result (p=0.015; Mann-Whitney U Test with Bonferroni correction). However, ICT users that work in private sector significantly more often reveal their password (p<0.001, Chi-Square Test), 48.2% of them.

Results of comparison between groups of ICT users with different professional qualification have shown that participants with masters got total result and two subscales regarding behavior (UISAQ, PRB, UB) significantly better than all other groups (with p<0.001; Mann-Whitney U Test with Bonferroni correction) (Table 3). Most significant differences (with p<0.0125; Mann-Whitney U Test) were found between users with masters and users with high school (UISAQ, PRB, UB and SD) while users who attended gymnasium are more skeptical in securing data than users with high school (SD).

Results of comparison between groups of ICT users regarding managing job position have shown significant difference between top management and the rest of employees and also significant difference between employed and unemployed users (Table 4). Statistical analysis between each group (p<0.0125; Mann-Whitney U Test with Bonferroni correction) has shown that

TABLE II. AGE DIFFERENCES IN USERS' INFORMATION SECURITY AWARENESS

age	18-30 (n=166) x±SD	31-40 (n=206) x±SD	41-50 (n=190) x±SD	51-66 (n=139) x±SD	p*
UISAQ	3.58±0.36	3.73±0.31	3.74±0.35	3.73±0.32	<0.001
PRB	4.07±0.39	4.21±0.37	4.18±0.34	4.14±0.33	0.028
UB	3.25±0.78	3.40±0.90	3.16±0.93	2.90±0.95	0.105
PCM	4.30±0.50	4.48±0.42	4.61±0.33	4.76±0.27	<0.001
BAD	4.66±0.49	4.74±0.37	4.78±0.29	4.77±0.38	<0.001
KA	3.09±0.51	3.26±0.43	3.30±0.55	3.31±0.46	<0.001
SC	3.15±0.89	3.49±0.83	3.66±0.74	3.62±0.74	<0.001
SD	2.04±0.78	2.00±0.69	2.11±0.92	2.07±0.75	0.832
BQ	4.07±0.67	4.29±0.56	4.13±0.80	4.24±0.65	0.009

* Kruskal Wallis Test

TABLE III. DIFFERENCES IN SUBSCALES OF UISAQ REGARDING PROFESSIONAL QUALIFICATION OF USERS

professional qualification	High school (n=177) x±SD	Gymnasium (n=77) x±SD	Bachelor (n=172) x±SD	Masters (n=258) x±SD	p*
UISAQ	3.64±0.36	3.65±0.40	3.66±0.30	3.77±0.32	<0.001
PRB	4.13±0.38	4.07±0.40	4.08±0.35	4.24±0.34	<0.001
UB	3.05±1.02	3.00±0.90	3.03±0.80	3.46±0.83	<0.001
PCM	4.56±0.48	4.49±0.55	4.51±0.42	4.53±0.35	0.103
BAD	4.77±0.38	4.70±0.43	4.70±0.42	4.75±0.36	0.211
KA	3.15±0.49	3.24±0.60	3.24±0.46	3.30±0.48	0.090
SC	3.49±0.83	3.39±0.97	3.49±0.83	3.49±0.78	0.976
SD	1.93±0.81	2.17±0.78	1.99±0.76	2.13±0.81	0.005
BQ	4.03±0.85	4.15±0.73	4.22±0.59	4.27±0.58	0.088

* Kruskal Wallis Test

unemployed users are significantly different from all other groups in total and in several other subscales (UISAQ, PCM, KA, SC, BQ). Significant difference was also found between top and middle management regarding "Borrowing Accessing Data", while there was no difference found between each management group and employed users.

Comparing results between ICT users that did or did not reveal password for accessing professional e-mail system are shown in last table (Table 5). ICT users that revealed their password got significantly lower overall result and results for three subscales that examine "Potentially Risky Behavior" (UB, PCM and BAD). Also there is significant difference regarding age, where younger ICT users significantly more often reveal their password.

However, ICT users with lower level of education significantly more often reveal their password (p<0.001, Fisher's Exact Test).

IV. CONCLUSION

Some general conclusions about ICT user's behavior and awareness emerging from analysis results are:

- Female users are generally more careful and more skeptical comparing to their male colleagues;

- Regarding age difference, middle age and older ICT users got better results in total and in most of the subscales;

- ICT users that work in private sector significantly more often reveal their password;

- Comparison of users with different professional qualification has shown that participants with masters got overall result significantly better than other users. Most significant differences were found between users with masters and users with high school;

- Unemployed users got significantly lower results than all other groups in total and in several subscales, both regarding behavior and awareness. Significant difference between three groups of employed users was only regarding borrowing access data;

- Participants who did not reveal their password generally got better results than participants that did reveal their password.

Regarding gender, age and different professional qualification results are expected. However, top management participants achieved surprisingly well results, which is very important as that kind of ICT users is most often target in direct phishing hacker attacks.

Maybe the most interesting information is percentage of users that have revealed their password for professional e-mail system (28.8%) and they are working in private

TABLE IV. DIFFERENCES IN SUBSCALES OF UISAQ REGARDING MANAGING JOB POSITION OF USERS

job position	Top management (n=24) x±SD	Middle management (n=126) x±SD	Employee (n=495) x±SD	Unemployed (n=55) x±SD	p*
UISAQ	3.85±0.35	3.72±0.32	3.70±0.34	3.54±0.35	0.001
PRB	4.26±0.31	4.15±0.36	4.15±0.37	4.12±0.31	0.259
UB	3.47±0.79	3.17±0.93	3.18±0.90	3.37±0.92	0.151
PCM	4.43±0.37	4.58±0.34	4.55±0.43	4.20±0.48	<0.001
BAD	4.89±0.16	4.71±0.36	4.73±0.41	4.77±0.26	0.020
KA	3.44±0.56	3.28±0.44	3.25±0.49	2.96±0.53	<0.001
SC	3.63±0.86	3.65±0.73	3.50±0.82	2.87±0.81	<0.001
SD	2.25±0.75	2.02±0.65	2.06±0.82	2.03±0.87	0.470
BQ	4.46±0.43	4.18±0.65	4.20±0.69	3.98±0.71	0.012

* Kruskal Wallis Test

TABLE V.   DIFFERENCES IN SUBSCALES OF UISAQ REGARDING USERS' PASSWORD REVEALING

password revealed	No (n=499) x±SD	Revealed (n=202) x±SD	p*
UISAQ	3.72±0.35	3.64±0.31	0.003
PRB	4.19±0.36	4.06±0.37	<0.001
UB	3.25±0.92	3.07±0.86	0.008
PCM	4.56±0.40	4.46±0.49	0.029
BAD	4.77±0.34	4.65±0.48	0.001
KA	3.25±0.51	3.21±0.46	0.530
SC	3.51±0.83	3.41±0.83	0.259
SD	2.04±0.79	2.08±0.80	0.461
BQ	4.20±0.68	4.14±0.68	0.134
Age	40.34±11.42	37.92±11.49	0.009

* Mann-Whitney U Test

sector significantly more often. This information should alert security experts and security managers in companies, government institutions and also schools and faculties.

There are few possible drawbacks of this study. It was not possible for authors to check out if the revealed password is true and active, and also there would be higher amount of revealed passwords if some employees in some departments were not warned in advance. Other recommendations for future studies would be additional questions in demographic section of UISAQ questionnaire and bigger sample size.

Results of this study should be used to develop solutions and induce actions aiming to increase awareness among Internet users on information security and privacy issues.

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