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Persuasive Technology for Improving Information Security Awareness and Behavior: Literature Review

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ABSTRACT—The use of Persuasive Technology in various fields is rapidly increasing. It can be applied in many fields such as computing, marketing, sales, environment, education, and health. Persuasive Technology has been found effective in bringing a required change in users' behaviors and attitudes. However, the use of persuasive technology is scarce in the field of Information Security awareness. This paper reviews extensive literature review which focuses on a perspective on how to create awareness among users for good information security practices by applying Persuasive Technology techniques and approaches. The conceptual findings suggest there is a tremendous potential of Persuasive Technology to be applied to persuade users to change their behavior and perception toward Information Security practices.

Keywords—*Persuasive technology; information security awareness; literature review; information security; behavior*

I. INTRODUCTION

The advancement in the field of information technology has seen tremendous growth in the past few years. The technology has penetrated into the lives of people so much that the people can now shop, pay bills and even order groceries with just one click away. This advancement is extremely useful, and it saves a lot of time of the people. However, it is said that everything comes at a price and the price for this advancement is the increasing threat of information security to individuals as well as organizations. Therefore, to secure the confidential, integrity and availability of information of the individuals and also those of the organizations, persuasive technology must be used. Persuasive technology is a technology to bring about a change in the behavior and attitudes of the people with respect to various issues in information security. This technology can be used to secure the personal and top secret

information, the threats of which can cause harm to the person or the organization. A literature review was carried out to comprehensively determining utilized methods and approaches in the research area of using persuasive technology to improve users' information security awareness and behavior within the past years. Hence, the use of persuasive technology in securing information and changing user behavior is discussed in this conceptual paper.

II. DEFINITIONS AND MEANINGS

A. Meaning Of The Term 'Persuasion'

The term persuasion is well explained by Ijsselsteijn, de Kort, Midden, Eggen, and van den Hoven [1] as Persuasion is generally part and parcel of people relationship. Persuasive effort in a steady attempt to provide an effect on our awareness and behaviors, persuading us to spend money on one product rather than another, to select for a particular politics party, to stop cigarette smoking, to doing exercises much more, to deal with for environmental preservation, animal well-being, much better education or to eat a fruit. As per the author, humans are the best persuaders because they have a strong social impact on the society. However, Fogg [2] says, computers have a lot of advantages over human persuaders. The best advantage of computers is that they can cover a vast area at one time as against the humans who will not be able to be present at more than one place at one time.

According to Qudaih, Bawazir, Usman, and Ibrahim [3], persuasion forms a critical part in the field of human interaction. There are many human ways of persuasion which help in influencing the people to behave in a certain manner. In order to amplify the impact created by the persuaders on the minds of the users, the persuaders often use the technology for helping users to shape their attitude

and behavior. The technology also comprises of using the digital media to influence the people to behave in a certain manner.

B. Persuasive Technology (Captology)

Fogg [2] states that computers can be used as persuasive technology and can be so designed to bring about a change in the behaviors and attitudes of the people with respect to health, environment, education, fitness, personal improvement and also in personal finance. The computers also help in involving the community and developing personal relationships so as to influence the behavior of the consumers. Fogg [2] has termed this study of computers being used as a tool for persuasive technologies as "Captology". He gave some examples of the users of this technology such as Amazon gold box offer, America's Army, RSI guard, Sportbrain and Quitnet.com. This entire technology is designed to influence the prospective consumers to buy a product or influencing the employees to behave in a certain manner as is required by the organization. Fogg [2] prescribed the way in which to carry out the influence analysis which involves outlining the landscape, identification of the targets, and proposing the appropriate solutions.

Fogg [2] presented a new model in order to understand the behavior of humans which suggests that people behavior is influenced by these three factors ability, triggers, and motivation. The model assumes that if a person wants to achieve a target behavior, it is essential that the person must be motivated sufficiently, possess enough ability to be able to perform a certain kind of behavior and he is triggered to perform the target behavior. Also, it is assumed in the model that all the three above mentioned factors must occur simultaneously. Otherwise, the target behavior will certainly not happen. This model helps the employees to work in teams and promotes teamwork culture because the employees are able to understand the change in behavior. It is essential to understand the change in behavior to make the employees more efficient. The tools which are used to create persuasive products are very easy to use. This is due to the fact there have been many innovations that have taken place in the online videos and the social networks. [4] Fogg also proposed three steps method for the designers. The steps in that method are "Get specific, make it easy and trigger the behavior". Fogg in his book also offers "Behavior Design Boot Camps", which serves as a guide for the designers which helps them to use the persuasive technology to the full. In the year 2007, his famous "Facebook Class" helped many of his students to launch various types of apps at a very fast pace and most of them earned a huge amount of money before they had completed the course. Fogg says that this period can be said to be "a period of time when you could walk in and collect gold." [5]

In a conference held in Austria [6], it was stated that Persuasive Technology is a really lively multidisciplinary study area, concentrating on the design, development and

evaluation of interactive technologies targeted at changing users' awareness or behaviors throughout persuasion and social impact, although not via deception or coercion.

Fogg [7], have explained that in the era of cloud computing and further advancement in the technology, "there are many new opportunities for a more effective relationship between people and solutions." This has further increased the scope of the researchers.

In the qualitative study, for example, smoke cessation which was conducted in New Zealand context using a game that developed in "think-aloud" protocol to persuade people to quit smoking by recording their respond and comments and evaluate them, shows that the effectiveness of the game to change their behavior in this matter[8] . On the other hand, quantitative studies also show the improvement among the users, for instance, a mobile application that promoted healthy lifestyles persuading the majority of participants' awareness to improve health-related behavior modification [9].

III. INFORMATION SECURITY

A. Threat to Confidential Information

As per the views of Crossler, Johnston, Lowry, Hu, Warkentin and Baskerville [10], Information Security study is far achieving and contains technical, behavioral, philosophical, managerial, and organizational approaches that identify the protection and mitigation of risks to information assets. The authors believe that most of the confidential information of the organization is threatened due to the internal people of the organization. The authors state that "researchers estimate that nearly half of intrusions and security violations occur from within an organization by organizational insiders." The major areas that are researched by the authors are categorized into three parts namely, separating insider misbehavior from insider deviant behavior; revealing the mystery of the hacker world; improving information Cross-cultural InfoSec research and security compliance. Also, the authors have classified the threats internal to the organization into two parts, i.e. intentional and unintentional. Therefore, the organization must employ persuasive technology to reduce such malicious acts of the people internal to the organization.

B. Information Security Awareness

In accordance with Siponen [11], the approaches to information security awareness at present are quite detailed and theoretical and are not accomplishment oriented. Siponen further explained that information security awareness is of essential importance, as information security procedures or techniques might be misinterpreted, misused, or not utilized by end-users, therefore losing their actual usefulness. Also, the author believes that with an organization level, it's critical, for instance, to recognize, understand and quantify the background and hidden reasons for the 'human errors' under consideration.

As per the views of Lean-Ping and Chien-Fatt [12], the organizations must strive to promote the awareness regarding the information security, which has been highly jeopardized in the present times due to the increase in technology usage. All the flexibility, convenience, and ease-of-use features of technology include threats. The potential risks might be regarding financial losses, data losses, reputation risks, legislation risks or intellectual property. These risks can lead to the closure of the business carried on by the organization.

C. *Creation of Information Security Policy*

The views of Yeo, Rahim, and Ren [13] are quite similar to the other authors discussed above. Persuasive technology has proved to be very useful in the sales and marketing and now it is also being used in information security within the organization. In the research conducted by them, they have studied the use of persuasive technology in the field of information security. They have extended the application of persuasive technology in creating awareness among the employees of the company with respect to information security. They have used a theory-based approach, for evaluating the use of the web-based paradigm, i.e. persuasive technology. This will help in the improvement of awareness regarding the information security in the end users of the information. This will especially be useful for the IT researchers in the development of various effective information security strategies for improving the behaviors and attitudes of the end users regarding the information security. As mentioned in this research, there are three types of behavior of the end users which are, malicious, neutral and beneficial. On the basis of the behavior types, the policy must be created.

One of the methods generally employed by the organizations to deal with the misuse or loss of information is the framing of the Information Security Policy within the organization. The Information Security Policy details the guidelines that are required to be followed by the employees of the organization while using the information assets. The policy can be enforced using technology also [14]. Technology which uses persuasive strategies has been utilized to enhance various of target behaviors in varied domains, for example , health, education, sustainability, etc [14]. Therefore, it is often advised to use technology to implement the Information Security Policy in the organization.

IV. USING PERSUASIVE TECHNOLOGY

A. *Persuasive Technology for Information Security*

It has mentioned in the research[15] ,"Employees in organizations frequently violate information security policies. According to a survey by PWC, 87% of small and 93% of large organizations had a breach in information security in 2013; 36% of the security breaches are caused by the organizations' employees." Moreover, based on IBM Security Services 2014 Cyber Security Intelligence Index

magazine [16], it is disheartening, that over 95 percent of digital incident caused by human error. Such as poor patch, system misconfiguration, management, lost mobile devices or laptops, using default user names and passwords or easy-to-guess passwords and disclosure of regulated information via the use of an incorrect email address. Essentially the most common making contributions human fault? "Double clicking" on an infected attachment or unsafe URL. The authors [15] in their research report also stated that Persuasive strategies are used only hardly ever within the area of information security and not in a concentrated method to improve information security policy compliance. Therefore, it is believed to explore this area of persuasive technology extensively.

D'Arcy, Hovav and Galletta [17], also state that the misuse of the information resources which is intentional and happens within the company is the most serious threat that can cause serious disruption to the normal working of the company. Depending on the reports, industry statistics claim that between 50%-75% of security breach begin from inside an organization. Since there has been a tremendous increase in misusing the information by the employees or others closely related to the company, there is a need for the organization to understand how to reduce such a misuse. Hence in order to reduce the misuse of information critical to the organizations or an individual, persuasive technology must be used. This is a new area where this technology can be used. The outcome of the research conducted by the authors resulted in finding out the three practices to discourage the misuse of information and they are: creating awareness about the security policies among users, security training, and education and developing various awareness programs monitoring the computers regularly. The research further suggests that perceived severity of sanctions works more effectively in cutting IS misuse than a certainty of sanctions. Hence, the companies must use this latest technology in order to reduce such misuse of the information.

Hochleitner and Tscheligi [18] have discussed that the information security policy in the organization often gets violated by the employees of the company and such violations are very frequent and these add to the ever increasing expenses of the organization. There are many methods that are employed by the organizations in order to stop these violations. These methods include training and proper education regarding the importance of information security in the organization and various other awareness campaigns. These methods employed by the company have a short term effect on the attitudes of the employee with respect to the information security policy of the organization. For the promotion of the long-term awareness of the information security policy and its compliance, the authors have suggested a very innovative framework called PAINLESS "(Personalized Multimodal Persuasive Ambient Intelligence for Information Security at the Workplace)." The organization can employ this framework for detecting

any sort of violations caused by the information security policy. The concept of the PAINLESS framework is that this framework will make the use of various sensors which involve both the hardware and software sensors which will help in providing adequate information to the monitoring of the security policy and the alerting system as well. The persuasive technology is one method that is proposed under the framework as suggested above. The persuasive technology aims to change the behavior and attitude of the people in a certain sphere. This is done by implementing various strategies of persuasion. The persuasive technology has been used very rarely in the field of information security.

Information is considered to be an integral part of the organization and this information is required to be kept confidential in order to become successful in the long run. Any breach caused in the information security policy framed by the organization can lead to disastrous consequences. Therefore, the authors have suggested using the computer technology in order to persuade employees of the organization so that they understand the importance of keeping the information safe and secure and also to change their attitude towards the organization [3].

Kegel and Wieringa [19] have also expressed the views of the above-mentioned authors that the use of digitalization in the organization can cause a serious threat to the information in an organization. The security of information is hampered to a great extent due to the advancement in the technology. Nowadays all the organizations provide their employees the facility to do work from home. This poses a serious threat to the information security in the company. The organization has an option to use its self-designed persuasive tool in order to motivate the people to act in a certain manner. There are various factors that influence the ability of the system which leads to persuasion. Therefore, it is very important for the organizations to adapt to the persuasive technology in order to influence the behavior of the employees regarding the security of the information in the organization.

B. Persuasive Technology to Change Behavior regarding Information Security

Another popular approach is the Behavior Change Support System. A Behavior Change Support System is an efficient and common approach for changing people awareness and behavior. Depending upon the concepts of persuasion, system designed to be able to promote positive users awareness in the direction of organizational information security, enable users to create advised security actions, and enhance secure work practices as subjective norm in the organization [14].

It is always suggested that the organization must motivate their employees to adopt all the measures they can for the security of the information. According to the authors numerous security professionals experience the issue of weak passwords to an insufficient user motivation and

effort. On the other hand, the authors reveal that users generate insecure passwords because not enough motivation, but to misunderstanding the security threats, and how you can successfully protect themselves with the offered mechanisms [20]. The authors suggest that by using the persuasive technology the users can be motivated to create strong passwords.

Some of the authors also suggest that the end users must be diligent enough to update their antivirus regularly so as to prevent the system from unwanted intervention and unauthorized access. The people are required to be motivated for the same and they must stop procrastination. The antivirus is software that helps in detection of the malicious software programs which intent to destroy the confidential and important information [21].

Some of the researchers suggest that it will be better to persuade the developers of software to install and adopt various security tools while developing software. For this, the developers need to understand the vulnerabilities of the system and the software. There is available methods which can be properly discovered or reduce these vulnerabilities. Nevertheless, these kinds of methods are simply helpful if they are used. Software developers, system administrators and intelligence analysts require various kinds of security tools within their respective domains [22].

The major problem that the organizations have to face is they are not able to influence their employees to behave securely. The authors state that there have been a large amount of research in providing new security measures and instructions. Still the users do not create strong passwords. The Persuasive Authentication Framework can be used by the organizations to teach their users and employees the importance of Information Security and this mechanism applies persuasive technology in order to authentication mechanisms [23].

Some of the researchers also believe that the current security systems do not take into consideration the importance of humans in building safe and secure systems. The researchers believe that the password system must be very strong in order to secure the system and the information. "In an attempt to generate more memorable passwords, graphical password system has been developed" [24]. Therefore, many stronger authentication passwords must be created to keep the information safe and secure.

The persuasive technology must be implemented by the organizations for ensuring the creation of strong passwords. This will help to save the confidential information from the unauthorized access. The users within the organization depend on the security messages and communication to create essential decisions. A failure for making certain that these security messages are communicated in an easy to understand structure and format will lead to misconception, unclear and worst situation confusing users [25].

The users are required to be persuaded in order to make the information secure. Especially while doing online

shopping, the users are required to give their details very securely and keep their passwords secure. The continuing development and viability of e-commerce are mainly influenced by its capability to assure customer security and stop deceptive activities. A specific problem during these efforts is to confirm the identification of the particular person to be able to prevent incorrect access to his or her personal information [26]. Hence, the users are required to keep their passwords safe and secure as the leakage in the passwords can cause a financial loss to them. As outlined by Weirich and Sasse [27], "The mechanisms of the password are the first line of protection of most computer systems, and therefore affect almost every user on everyday basis". It should also be investigated that how much the user's willingness is impacted by the brand familiarity and also their willingness to engage themselves in the ever increasing security procedures. This will help the developers of the software to incorporate the appropriate security tools and measures.

Another critical element of information security aware behavior is email management. A vital factor of email management is worried about spam emails. Spam email is undesirable email that could contain commercial advertising and marketing, porn material or get-rich-quick strategies. The issues presented by spam have increased from simple disturbed to security problems, for instance, virus attacks. The flood of spam costs about approximately \$20 billion annually. However, by implementing persuasive technology to manage users' email, that will help user to reduce the likelihood of becoming attacked. Therefore, when you are security cautious and using methods against spammers, also by carrying out a good email management practice, such as, using anti-virus to scan email attachment, delete email from people you don't know and using spam and phishing filter[13].

Further, the researchers believe that the attitude of the users towards the information security must necessarily be changed. Therefore, a growing number of information technology systems and services are being developed for persuasive purposes, i.e. to change users' attitudes or behavior or both [28].

V. CONCLUSION

There are many types of information which may be confidential to the organization and the leakage or corruption of such information may cause serious harm to the organization, financially as well as socially. Vulnerabilities to any type of digital information are extremely hard to deal with. It requires adequate training and motivation to perform functions in a manner which will lead to the good conduct of the security practices. However, these are short-term ways to create awareness. The companies, thus, in order to create a long-term impact must make use of persuasive technology to secure the information that is critical to the company. Furthermore, creating long-term impact will enhance the sustainability of users'

security awareness and behavior as well as raise the awareness of current or future security issues. Based on the finding in some researches that have been conducted on persuasive technology with few security measures, it has been confirmed that has highly potential to change users' awareness and behavior toward information security. However, the limitation in this field is testing very few security measures which need to include other security topics in future research. Moreover, this field of research does not have any clear model or framework that helps designers to create more efficient system.

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