DIGITAL PIRACY DECISION MAKING MODEL BASED ON AHP.

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ABSTRACT: *This study aims to identify the most important factors of digital piracy acts with respect to its (AHP) priorities. Social Learning Theory, low-self control theory, rational choice theory and digital media cost) are considered as a potential keys that that may influence an individual's intention to pirate digital material. From past and recent research studies of digital piracy motives; many sociologists and economist pointed that the attitude toward the behavior, subjective norms, digital media cost, perceived behavioral control and punishment certainty are the potential key factors of digital piracy. Thus, there should be a mechanism that helps them to make decisions accordingly. Analytic Hierarchy Process (AHP) is a sub-discipline of operations research that explicitly evaluates multiple potential criteria in decision-making. The model has been designed to featuring the ability to analyze and select the best alternative from a number of individual's intention to pirate digital material. In this respect, the benefit of using AHP is to analyze the priority of the intention to pirate digital material factors and to obtain weights of the selected criteria. This model could be applied in a computer simulation of situation tests of the series digital piracy cases. The results are summarized that social learning theory has been proven to be the most important factor in the study of digital piracy that occurs over the Internet.*

Keywords: Digital piracy, social learning theory, low self-control, rational choice.

I. INTRODUCTION

The huge revolution in information and communications technologies has changed the world and individuals dramatically to new form of piracy called digital piracy. The increasingly higher internet connections and information technologies all of us became closer, breaking most of the geographic barriers. Despite of all the obvious benefits there is many major problems that still threaten the copyright industry: digital piracy. The new types of technologies that provide the service that easily copy digital material increased the intentions to this phenomenon. As there are risks and problems caused by this phenomenon, it was necessary to go about studying this phenomenon causes and identify the priority of the factors influence the intention to pirate digital materials.

Digital materials industry badly affected by digital piracy, therefore stakeholders lose their money and face financial problems, thus the stakeholder and legalists are fighting the propagation of digital piracy by different strategies. Moreover, digital piracy causes many problems such as unemployment, tax evasion, infringes intellectual property, unfair competition in economy, inflation and encourages organized crimes [3].

A comparative approach of digital piracy to the physical form of piracy argues that digital or online piracy lack negative social stigma. In most cases individuals are not feeling that they are involved in breaking the law by purchasing pirated software, books, movies or music [1].

The factors behind committing digital piracy crime have been examined by scientists from different fields such sociology, psychology, political science, computer science and economics. They argued that digital piracy is more acceptable to people than physical piracy. And pointed that the social learning , low-self control, rational choice and cost of digital product are most likely factors behind digital piracy activities[3,5,6].

2. METHDOLOGY

AHP method was used to measure the experts' views on the topics by a questioner designed with (1..9) weight scale to estimate the factors that are under investigation. However, questionnaires were provided to a small decision group of experts in digital piracy and sociology, and minor modifications were made to improve the clarity of some factors.

The AHP is developed by Thomas L. Saaty , and is probably the best-known and most widely-used model in decision-making. It is a powerful decision-making tool in determining the priorities among different criteria. The AHP encompasses six basic steps according to [16]:

Step 1: AHP decomposes a complex decision problem into several sub-problems forming a hierarchy. The goal of the problem is placed at the top level, representing the root, and the characteristics are decomposed into several nested sub-levels representing the process of breaking down the criteria into sub-criteria.*Step 2: A decision-matrix, based on Saaty's nine-point scale, is constructed. The decision maker uses the fundamental 1-9 scale to assess the priority score. In this context, the assessment of 1 indicates equal importance, 3 moderate importance, 5 strong importance, 7 very strong importance, and 9 indicate the extreme importance (Table 1). The values of 2, 4, 6, and 8 are intermediate values of importance. The decision-matrix involves the assessments of each alternative in respect to the decision criteria. If the decision-making problem consists of n criteria and m alternatives; the decision-matrix takes the following form :*

$$\begin{matrix} d11 & d12 & d1 \\ d21 & d22 & d2 \\ d31 & d32 & d3 \end{matrix}$$

Step 3: The third step involves the comparison in pairs of the elements that make up the hierarchy. The aim is to set their

relative priorities with respect to each of the elements at the next level up. The Pairwise-comparison-matrix, based on the Saaty's one-to-nine scale, has the following format, where w_i represents the weight value of the criteria:

$$\begin{matrix} d11 & d12 & d1n \\ d21 & d22 & d2n \\ d31 & d32 & d3n \end{matrix} \qquad \begin{matrix} w11 & w12 & w1n \\ w21 & w22 & w2n \\ w31 & w32 & w3n \end{matrix}$$

Assuming *n* is the number of criteria, then the number of pairwise comparisons between them is equal to *n(n-1)/2*. Each value (a_{ij}) in the left-hand-side matrix is matched with the corresponding (w_i/w_j) value in the right-hand-side matrix. Each pairwise, $a_{ij} \leftrightarrow w_i/w_j$, is computed as follows: $w_i/w_j = 1 / a_{ji}$ in all cases except when $i = j$ then $w_i/w_j = 1$. In the comparison-matrix, a_{ij} can be interpreted as the degree of preference of i^{th} criteria over j^{th} criteria. It appears that the weight determination of criteria is more reliable when using pairwise comparisons compared to the method of obtaining them directly, because it is easier to make a comparison between two attributes than to make an overall weight assignment.

Step 4: Verify the consistency of judgments across the Consistency Index (CI) and the Consistency Ratio (CR):

$$CI = \frac{\lambda max - N}{N - 1}$$

where λmax is the Eigen value corresponding to the matrix of pairwise comparisons and N is the number of elements being compared, Consistency ratio (CR) is defined by:

$$CR = \frac{CI}{RCI}$$

where, (RCI) is a random consistency index defined in Table 2. A value of CR less than 0.1 is generally acceptable; otherwise the pairwise comparisons should be revised to reduce incoherence.

Step 5: The comparison matrix has to be normalized. Therefore, each element has to be divided by the sum of the entries of the corresponding column. In that way, a normalized matrix is obtained in which the sum of all element vectors is 1.

Step 6: The eigenvalues of this matrix need to be calculated which would give the relative weights of criteria. The relative weights obtained in the third step should satisfy the formula: $A * W = \lambda_{max}$, where *A* represents the Pairwise-comparison-matrix, *W* represents the weight and λ_{max} represents the highest eigenvalues. If there are elements upward on the hierarchy, the weight vector is calculated by multiplying each element (weight coefficient) by its parent at the higher level, this process continues until the top of the hierarchy is reached. The alternative with the highest weight coefficient value should be taken as the best alternative as shown in table 1.

TABLE I

SCALE OF RELATIVE IMPORTANCE ACCORDING TO

Intensity of Importance	Definition	Explanation
1	Equal Importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong importance	An activity is favored very strongly over another; it dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	For compromise between the above values	Intermediate values of importance
Reciprocal	If variable *i* has one of the above numbers assigned to it when compared with variable *j*, then *j* has the value 1/number assigned to it when compared with *i*. More formally if $n_{ij} = x$ then $n_{ji} = 1/x$	

(SAATY,1980

TABLE 2 AVERAGE RCI VALUES

Number of Criteria	Consistency Ratio Index
1	0
2	0
3	0.58
4	0.90
5	1.12
6	1.24
7	1.32
8	1.41
9	1.45
10	1.49

3. The strengths and weaknesses of the AHP

AHP strengths and weaknesses have been subject of manifest debate among researchers in multiple correspondence analysis (MCA).

AHP has many advantages over other multi criteria methods including, flexibility, conversion of verbal to weight, evaluation appeal to the decision makers and its capabilities to test inconsistencies [15]. Also, analysts find the pairwise comparison form of data input straightforward and convenient.

Additionally, AHP method has a major advantage that decomposes a decision problem case into sub-problems and constructs hierarchies of criteria. This makes the importance of each criterion clear [13].

AHP provides the consensus of both subjective and objective evaluation measures. It maintains a helpful method

for testing the consistency of the evaluation measures and alternatives, AHP avoids bias in decision making.

AHP helps to build new models by deriving scales where measures ordinarily do not exist for any situations [14].

AHP is one of the most popular criteria analysis methods .However; many researchers have shown weakness for some issues in the AHP methodology. Their concerns related to the irregular rankings that may occur when the AHP or some of its variants are used. These irregularities are likely to occur e.g. when an alternative or a near alternative of an existing criterion is added to the set of alternatives that are being measured [13].

Additionally, AHP−method is an additive type with complete aggregation probability. This leads to the problem of overlapping between proper scores on some criteria and improper scores on other criteria can occur. Detailed, and often important, information can be lost by such overlapping [15].

4. LITERATURE REVIE

Al-Rafee and Cronan defined digital piracy as "the illegal copying/downloading of copyrighted software and media files", such files may be movies, TV series, music albums, eBooks and video games. Commonly, unless looking for a very specific software program or a very old movie/music album, it's very easy to download (or watch online) this digital content. For that purpose, users usually depend on warez sites or peer-to-peer (P2P) networks[17].

One of the most common implications of digital piracy is the use of unlicensed software by individuals or organizations as it is free software. The unlicensed software is often considered as malware software that disrupts computer or mobile operations, gathers sensitive information and gains access to private content. Figure 1 shows statics by (BSA,2016) of the use of unlicensed software all around the world. Statics reveal that the average ratio of unlicensed software use in Middle East and Africa is (75%).

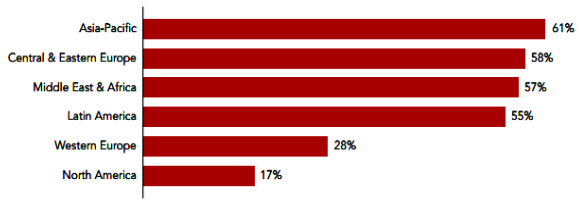

Figure 1: The average rate of unlicensed use of software (2016).

The Business Software Alliance estimates that (39%) around the world of the software installed in personal computers is unlicensed, representing a commercial value of USD 52.2 billion (BSA, 2016). Their report suggests that the recent migration for cloud solutions may help lower this rate, however, this kind of services are still young, adding up to 9.3 percent of the USD.

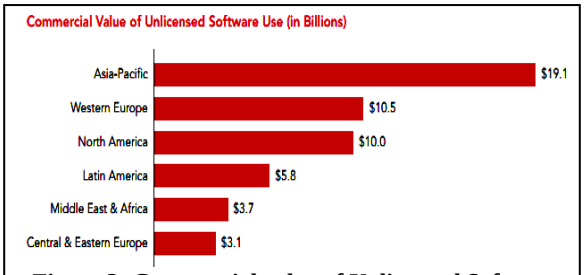

Figure 2: Commercial value of Unlicensed Software Use in(Billions $)

Social and cultural factors leading to the act of digital piracy have been examined in many researches to reduce such act in the cyberspace. With regard to music piracy involving 26 countries by Walls, 2008, it has been argued that piracy in creases with the issue of collectivism and social coordination within society; whereas the rate of income has an insignificant impact on the level of piracy in any nation.

The social learning theory Akers, 2011 suggested that criminal behavior is learned through association with people. He also proposed the sequence of such learning and its manifestation. Once a social environment is created consisting of associations of people inclined to criminality, patterns of imitation are likely to be followed. With further reinforcing stimuli, the deviant behavior may be perpetuated. Akers, 1992; Akers and Lee, 1996 further stated that the relationship between individual and social processes is influenced by person's models of behavior, conducive or aversive environment to crime commission, and differential reinforcement [12].

Sheehan , Tsao and Yang argued that economic, social and collective utilities motivate the acts of digital music piracy among college students; with social utility being the most important factor [10]. These studies reinforce the need to find out the most important factor behind the digital piracy acts among a set of potential factors.

Figure2: Commercial value of Unlicensed Software Use in(Billions $).

Self-control theory can be used as a predictor in interpreting criminal acts. It has been established by Gottfredson and Hirschi, 1990; Gottfredson, 1987. Krueger *et al.*,1996 suggested that individuals with low self-control are more likely to immediate need and, as a result are less likely towait for the original version of digital media.

Higgins suggested that low self control has direct and indirect effects with intentions to digital piracy Further, the self-control has indirect links with a modified version of situational factors (i.e., value). In addition to these results, the present study shows that situational factors have both direct and indirect effects with digital piracy These results indicate that low self-control and rational choice theory may be compatible theories that can explain digital piracy[6].

Matrix-1: Pairwise Comparisons Judgment for the Characteristics According to 'Digital Piracy'

Digital Piracy	Social Learning Theory	Low-self control	Rational choice	Cost of digital material	Priority
Social Learning Theory	1	6.00	4.00	8.00	63.1%
Low-self control	0.17	1	2.00	5.00	18.8%
Rational choice	0.25	0.50	1	4.00	13.5%
Cost of digital material	0.12	0.20	0.25	0.12	4.6%
CR = 0.086					∑ Priority =100%

RESULTS

Decision group of experts in digital piracy and sociology with long empirical research experience provided the (1-9) scale to assess the priority score for every criterion that has been used in the study; using Saaty scaling-table , expert's assessment, and the AHP six steps, a weight value is assigned for each of the characteristics, namely: Social Learning Theory , low-self control theory, rational choice theory and digital media cost. The outcome regarding to digital piracy is shown in Matrix-1, below.

Through model comparison in matrix1, the results are summarized that Key Feature adjusted Social Learning modelis more conducive in confirming the digital piracy acts with respect to the highest priority gained (63.1%)

CONCLUSION

The present study helps criminologists to understand more about the decision-making mechanisms for digital piracy. The results indicate that Social learning theory has been proven to be the most important factor in the study of digital piracy that occurs over the Internet. It gained (63.1%) with respect of AHP priorities. While low self control theory, rational choice and cost of digital material have much lesser priority with (18.8%),(13.5%),(4.6%) respectively. Therefore, the easy accessibility, autonomous and anonymous identity over digital space helps individual to associate with groups or individuals inclined to pirate digital material, and then new patterns of imitation are likely to be committed.

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