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VERIFICATION ON THE TRUSTWORTHINESS OF INFORMATION: A STUDY

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ABSTRACT

The pervasive use of social media has generated massive information sharing among its users. Given the fluidity and excessive information available online, issues relating to the trustworthiness of information have become a concern among the users and authorities. Sensational and unreliable information shared in the social media may cause and harm the reputation of an individual, product, organisation or government. Therefore, there is a need to develop a mechanism that helps users to verify the trustworthiness of information that feed in the social media so that they can decide whether to trust or to ignore the information. This paper reports a review on the analysis of the existing work related to trustworthiness of information. The analysis were based on three questions that address the definition of trustworthiness of information, factors influencing trustworthiness of information and existing tools to verify trustworthiness of information. Based on thirty nine selected articles reviewed, it was found that the verification on the trustworthiness of information approach is required. It is anticipated that the adoption of this approach will help to educate and make the public users aware of the level of trustworthiness of information, hence developing an informed, safe and ethical users of media content.

Keywords: *Information Trustworthiness, Factors, Social Media, Tools, Approaches*

1. INTRODUCTION

Information trustworthiness is very important as the amount of information freely available in modern day society is phenomenal. Due to the openness of the Web and proliferation of modern communication systems, the difficulty in determining who and what to trust online is more significant than ever before. Information can also be obtained freely via the internet where everyone can publish anything in blogs, Facebook, Twitter or WhatsApp. Not only is there a concern regarding assessing and building trust in Web sites, content sources and other users of cyberspace, but also about the intelligence, information and data itself that is stored and obtained online through social media. Information poisoning can be avoided. Information poisoning means the information that could bring negative impact. A small quantity and chosen information will provide the ability of better decision making, while too much of it will fare a better chance.

The necessity in trusting the information is vital in order to have reliable information. As professionals and casual users attempt to pick from this glut of informational content to make decisions, a crucial question that they face is what information to trust, and which sources of information should they trust or rely on. There are very limited studies on verifying information trustworthiness in social media. As readers are confronted with an ever-growing and ever more overwhelming set of content offerings, accessible through an ever-multiplying set of channels and services, one hears a great deal of concern about the ability to identify trustworthy information. Therefore, it is subject to factors which information could be taken seriously or the information is just merely chained information shared by individual.

In this study, we would like to investigate the automation approach with the factors influencing the information trustworthiness and the existing tools applied in verifying the trustworthiness of information. Nonetheless, the definition of trustworthiness of information is

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also important as different articles will present different meaning. From there, this review deliberates the concept of automation approach in verifying trustworthy information from online sources.

2. RESEARCH METHOD

The study was conducted by using search engine like Scopus, IEEEXplore, ACM Digital Library, Science Direct, Google Scholar, Springer, Wiley InterScience and Citeseer Library database. The search string used were (information OR trust OR trustworthiness OR "information trustworthiness") AND ("trust metric" OR "trustworthiness metric" OR "information trustworthiness technique" OR "information trustworthiness metric") AND ("factors influencing trust" OR "characteristic of information trustworthiness") to ensure all related the papers are included. As the initial search based on the keyword "automated approach in verifying trustworthiness of information" has resulted 569,000 results from Google and 19,800 results from Google Scholar. By examining the title and abstract of the primary identified studies, we had excluded most of the papers due to irrelevant topic found in the studies. 39 articles were selected as they are relevant studies. Furthermore, we accessed and evaluated the articles by checking the content of the articles. Irrelevant studies will be rejected at this stage and the relevant studies will be examined further. Out of 39 articles, there are only 12 articles considered for further review.

3. RESULTS AND DISCUSSIONS

In this review, we outlined the research questions (RQs) as follow and explain further in the sub section I, II and III:

RQ1	What is the definition of information trustworthiness?
RQ2	What are the factors influencing information trustworthiness?
RQ3	What are the existing works in verifying information trustworthiness?

This section presents the results of the analysis to address the three research questions mentioned above. It is organized in three sections consistent with the sequence of the research questions.

3.1 Information Trustworthiness

As from the review, professionals and causal users attempt to pick from this glut of informational content to make decisions, a crucial question that they face is what information to trust, and which sources of information should they trust or rely on [2]. Relying on available information in crisis is crucial in order to be able to make immediate decision. Such information need to be reliable and trusted. According to Jason et al., this trust problem is exacerbated when accessing Web 2.0 content (e.g., tweets, blogs, posts and wikis), considering that anyone online can be an author, since the customary gatekeepers to publishing, who historically have had some governance over quality, no longer exist in that sphere [1]. Clearly, consumers of content develop their own strategies for avoiding information overload and high risk information, usually using some heuristic (consciously or not) for scoping down the sources that they trust [2].

Table 1 shows the definition of trustworthiness from selected articles. Most of the articles are from the aspect of computer science.

Table 1: Definitions of Trustworthiness

Article(s)	Definition
22	The perceived likelihood that a piece of information will preserve a user's trust in it, and encompasses characteristics such as the competence and predictability of the information source.
14	Unreliable data could dominate the result of queries, taint inferred data, affect local knowledge bases, or may have negative or misleading impact on software agents.
33	Trust intuition, common sense, or gut reaction to a source as an indicator of quality.
6	Trustworthiness was described for the main qualitative content analysis phases from data collection to reporting of the result.
29	Verification as checking of the trust, determination of trustworthiness.
16	Trustworthiness encompasses functional correctness and also includes properties of security (confidentiality, integrity,

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	availability) and safety (it also relates to reliability and maintainability)
17	Trust should indeed be regarded as a significant factor in contemporary and should not be taken lightly in view of the fact that trust is by and large coupled with multitude of advantages not only to organizations but also individuals.
26	Worthy of being trusted to fulfil the critical requirements needed for a particular software component, system or system of system.

Based on the definition found as shown in Table 1, there are plenty of research dedicated to the definition and conceptualization of information trustworthiness. Jason et al. mentioned that, one way to consider information quality is as an enabler of information trustworthiness. Therefore, if information quality is low, a user is often likely to have less confidence that a piece of information will preserve their trust. In addition to examine characteristics of the information source, the attributes of the information itself are useful for provenance, quality and trustworthiness deliberations [21]. Klaus-Peter et al. indicated that there are several viewpoints of trust from the context of sociologists, psychologists, economists and computer scientists. He added that computer scientists mainly refer on the context of trustworthiness of information or specific services.

As a result, we concluded that information trustworthiness requires the reliability of the information, the integrity, importance to verify the information trust based to factors such as the period of time the information, the reliability of the source, the proximity of the information has occurred and even the popularity of the information.

3.2 Factors Influencing Information Trustworthiness

Next, we investigated the factors that influence the trustworthiness of information. This is to answer our second RQ: "What are the factors influencing information trustworthiness?" To do this, we have analysed the factors of trustworthiness considered by the authors in Table 2.

Table 2: Factors Influencing Information Trustworthiness

Article(s)	Factors
1	data integrity, data quality, data security
2	data integrity, data quality, data security, policies
3	large scale,, virtualization, versatility, on demand service, scalability
4	privacy, security, information leakage, online social network
6	rigor, validity
8	interpretation, substantiation, clarification, modification, agreement, disagreement
9	information reliability, consistency degree
10	rating of items (user, group), reliability score
11	transparency of trust, timeliness, comprehensibility, perceived trustworthiness, competence, benevolence, honesty
12	behavior measurement
13	validity, reliability
14	trust infrastructure,
15	knowledge level, level of expertise
16	trust systems, trusted connectors, security properties, confidentiality, trusted patterns
17	culture, sociability, solidarity, benevolence, competence, networked, communal, fragmented, mercenary
19	recency, proximity, popularity, corroboration, competence
20	competence, popularity, recency, corroboration,
21	information provenance, quality, infrastructure integrity, preference and opinion, topical problem, competence, proximity, corroboration, popularity, recency
22	risk management
23	trust sealed, web site certification
24	provenance, quality
25	provenance, integrity, timeliness
26	predictable execution, conformance
28	information quality, web credibility, authority, currency, accuracy and

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	relevance
29	competent
30	high quality, authority, related resources, popularity, provenance, age, quality dimension (accuracy, timeliness, relevancy, objectivity, believability)
34	accuracy of impression, impression formation, truth bias
35	platforms, virtualization, multi-tenant, on demand pay, integrity, confidentiality

Table 3: Factors Influencing Information Trustworthiness Metrics

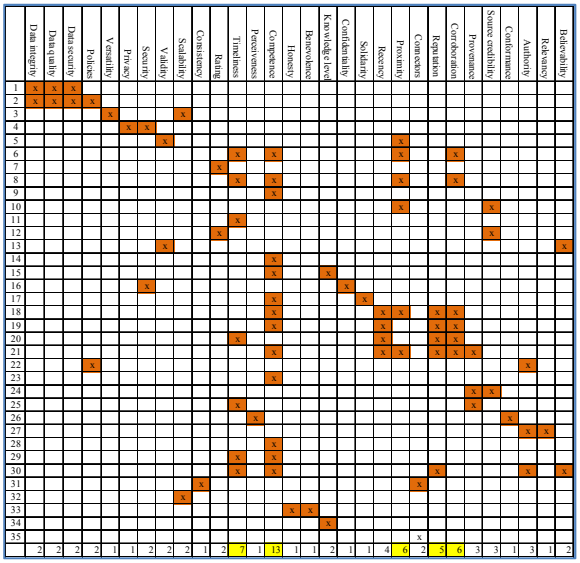

Table 2, 3 and Figure 1 above, show the factors of trustworthiness considered in related research conducted. It is found that many factors that there are many factors influence the information trustworthiness. These factors are summarised in Figure 1. It shows that the factors with the highest frequencies are competence, timeliness, corroboration, proximity and reputation. Recency can be grouped together with timeliness as the indication is related to time. Furthermore, authority and source credibility as well as knowledge level can be grouped together with competence as it shows the credibility and reliability of the source of information. Based on the analysis, we found that there are some factors with the similar meaning, and being applied in different context. Based on the analysis of matrix in Table 3, it is found that the most influential factors are the proximity, timeliness, competence, reputation, popularity and corroboration.

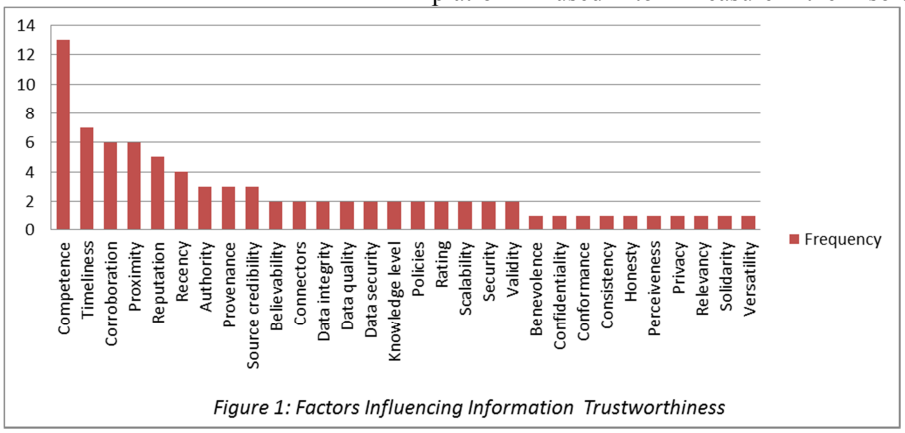

Figure 1: Factors Influencing Information Trustworthiness

3.3 Existing Works on Verifying Information Trustworthiness

In order to answer our third RQ: "What are the existing works in verifying information trustworthiness?" we have investigated further the existing available works that are related to verification of information trustworthiness. It is found that there are various types of works done to verify the trustworthiness of information. The work done also rely to the sense of its content of the information, reliability, software development and the security of the information. Table 4 shows the selected articles on the related approaches, framework, model or technique used. For example, Zhenjiang develops a measurement model that provide a new method for measuring the software trustworthiness and a platform used to measure the software trustworthiness of the information system [7]. Zhenjiang establishes a new set of software trustworthiness indices and divides the definition of software trustworthiness into five levels indices. A new algorithm is introduced for measuring the software trustworthiness: fuzzy

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comprehensive evaluation based on stepwise regression and the analytic process. However, this work is only focused on measuring trustworthiness on intelligent subway information system. On the other hand, Yen-Hung Hu et. al discuss the challenges in building a trustworthy network and develop a trustworthy network model that is both scalable and interoperable with existing and future network architecture [8]. They introduce countermeasures, trustworthy characteristics and major network component into the trustworthy network model and describe their function in their work. Yet, this experiment is considered immature as no assessment is done on the trustworthy network model. Likewise, Xiaoli Liu investigate on trustworthiness on cloud computing by presenting an approach to address the difficulties in the trust software development of cloud computing [7]. This work is believed to be beneficial since it provides a lightweight framework to explore on the other aspect, Cloud Service Engineering. However, the limitation of this work at the time is lack of concrete methods.

Table 4: Approaches/Techniques/Methods on Information Trustworthiness

Article (s)		Type		
		Approach/ Case study	Tool/ Algorithm	Method/ Model/ Technique
21	Policy-based approach, visual communicating through radar graph	x	x	
3	Threat Model		x	x
11	Experimental Method			x
4	Data-reachability Model/Matrix		x	x
30	Web Information Quality Assessment Framework,		x	x
9	Multi-Source Joint Matrix		x	
15	Normative trustworthiness criteria	x		
13	Trustworthy Construction Approach, BPR Software	x	x	
	System Based, Semantic Model Verification, Petri Net			

Therefore, there is the need to verify the trustworthiness of the information. It has become the digital lifestyle relying to such information from the internet. Existing studies [2][3] indicate that perceived trust in the reliability of technical elements and structures, as well as the fairness of other internet user, are the major determinants of sustainable internet usage among individuals. Working with intelligent systems means dealing with information. Furthermore, information presentation and information quality are two elementary functions that make it easier for the consumer to deal with the system where it might otherwise even be impossible.

Nevertheless, an appropriate technology stack is necessary to guarantee a high information quality level. This technology must fulfil two requirements to prevent information overload and hence reactance: distinguishing important and unimportant information from each other and making system performance transparent to its users [5][6]. In such circumstances, decision support which seeks to convey the potential trustworthiness of information will be a crucial factor in avoiding potential negative consequences should be wrong (i.e. high-risk) information be relied upon. Existing approaches to deal with this problem rely on trusted third parties who investigate the trustworthiness of Internet sources and create a trusted network of content publishers for customers to access. This has a significant limitation in that you are restricted to preselected sources and so it would not scale appropriately to the scenarios we are considering [2].

Due to this, information trustworthiness needs to be verified to provide possible solutions to solve the crisis. Nevertheless, the factors that claimed to deliver information trustworthiness only display whether the information is useful and not providing possible decision to overcome the crisis. The decision portrays the reliability of the trust in the information obtained in the web. To the best of our knowledge, there is no systematic review on both perspectives together, i.e. information trustworthiness and information crisis.

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Table 5: Approaches and Tools From Various Authors

Article(s)	Approaches/ Case Study	Tools/ Algorithm	Method/ Model/ Technique
1			x
2	x		
3		x	
4			x
5	x		
6	x		
7			
8			x
9		x	
10		x	
11	x		
12			x
13		x	
14		x	x
15	x		
16		x	x
17			x
18			x
19			x
20			x
21	x		x
22	x		
23	x		
24	x		x
25	x	x	
26			x
27	x		
28			x
29	x		
30		x	
31	x		
32	x		x
33	x		
34			x
35		x	
36			x
37			x
38			x
39	x		
	16	9	19

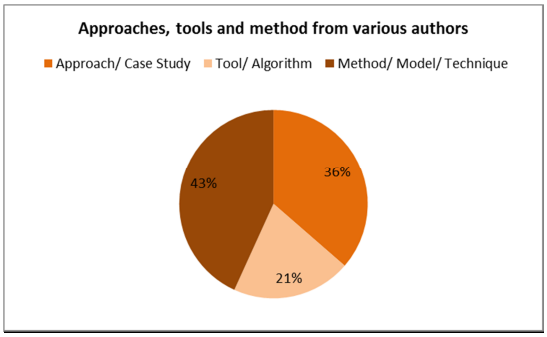

Figure 2: Approaches, Tools, and Methods from Various Authors

Table 5 shows the various approaches and tools developed for verifying the information trustworthiness. Most tools developed can be summarised for the purpose of verifying network security and software development in form of information trustworthiness. Figure 2 shows the percentage of the approaches from the existing works. Most works focuses on methods, modelling and techniques and case study where not focusing on social media of information trustworthiness. Very few authors focus on the information trustworthiness on online information. Therefore, there is the need to look into more detail on verifying information trustworthiness on online information.

4. CONCLUSIONS & FUTURE WORK

This paper discussed the verification on trustworthiness of information from the social media. Based on our findings, it is important to understand the definition of the information trustworthiness, to explore the factors which contribute influencing the trustworthiness and then the approaches of the existing works that being done. From the findings, we conclude that in order to verify the trustworthy of information especially from the social media, we need to obtain the main factors that need to be considered and we outlined the five main factors that give an impact on the information trustworthiness. These factors are proximity, reputation, competence, corroboration and timeliness. Furthermore, based on the analysis of the existing works, we found that most research focus on the integrity of the information, the

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trustfulness of software as well as on the networking security of the information. Less work were found on verifying information trustworthiness especially information from the social media. Therefore, our research aims to develop an automated approach to verify the degree of perceived trustworthiness of information in media social. Figure 3 shows our proposed approach drawn from the findings of this analysis. To do this, the factors influencing the degree of perceived trustworthiness will be analysed and a rule to verify the trustworthiness will be constructed. Then, an automated tool embedded with a crawler capability will be developed to realise the approach. The tool will then be evaluated using both qualitative and quantitative approaches for its usability with the users of social media. It is anticipated that the adoption of this approach will help to educate and make the public users aware of the level of trustworthiness of the information, hence developing an informed, safe and ethical users of media content.

For future work, a survey will be conducted with the users of social media to investigate the pattern of usage and the level of trustworthiness as well as the contributing factors on the perceived trustworthiness. Here, the quantitative research approach will be used to analyse the data and to find the most significant factors that contribute to the degree of perceived trustworthiness. In the design phase, the researchers will review the findings in the earlier phase and design a new approach to verify the degree of perceived trustworthiness of information in social media. Then, rules on the trustworthiness will be constructed based on the identified significant factors in the earlier phase.

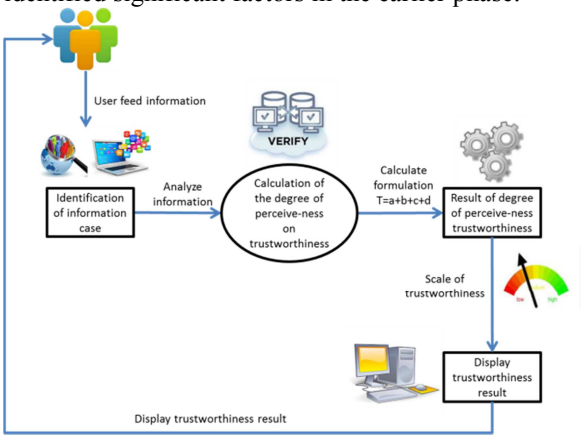

Figure 3: The Overview of the Proposed Trustworthiness Verification Framework

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