Journal of Engineering and Applied Sciences 12 (Special Issue 8): 8261-8265, 2017
ISSN: 1816-949X

Formulating Crowdsourcing Task Multi-Dimensional Ecosystem Model

Nurhayati Zakaria, Siti Salwa Salleh, Norjansalika Janom,
Syaripah Ruzaini Syed Aris and Noor Habibah Arshad
Faculty of Computer and Mathematical Sciences,
Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, Malaysia

Abstract: With the availability of the internet connection, it allows the organizations to employ an online workforce. Crowdsourcing utilizes this workforce to complete the task which are usually published to the public. It is potential to reach a large number of crowd worker with various background such as knowledge and skill. The crowd worker may be suitable for certain task but not for all type of tasks. Therefore, this study will come out with three components that comprises of type of tasks (simple and complex), outcome variations (low and high) and competency level of crowd worker (knowledge, comprehension, application, analysis, synthesis and evaluation) that are relate to each other. Association rules has been used to present the relationship among the components.

Key words: Crowdsourcing, association rules, Apriori algorithm, multi-dimensional model, competency, internet

INTRODUCTION

The vast growth of technology makes almost everything is possible to be done now a days. People around the world had been exposed with the cyber world where they are currently connected with the internet through internet connection. Aligned with the internet evolution, crowdsourcing has been introduced by Howe (2006) the researcher of Wired magazine. Howe (2006) defined crowdsourcing as an act of a company or organization to outsource a task to a large group of people (unknown or anonymous crowd) via. a flexible open call. Crowdsourcing is a method where individual, group of people or organizations offers works or tasks to the other group of individuals or unknown person who have different skills, knowledge and experiences to solve problems or complete tasks.

Many organizations in the world start to apply the crowdsourcing as a new business model which allows organizations to depend on the power of crowd to obtain completed jobs. The examples of crowdsourcing are TopCoder (platform of software development), 99 designs (platform to design logos) and Amazon Mechanical Turk (platform to produce product descripting). In crowdsourcing, there are three main actors which are job providers, platforms and crowd workers. The job providers are the companies or individual that outsource their tasks to the crowdsourcing platform. Platforms is the system that will advertise the outsourced tasks to the crowd worker. The advertisement details including the descriptions, duration of the tasks and descriptions of the payment details for performing the tasks. The platforms act like a moderator between the job provider and the crowd worker. The crowd worker can be anyone with any kind of skills who want to perform the task that has been outsourced by job providers.

Currently, the job provider face critical and challenge about what tasks can actually being crowd sourced (types of task) who will be performing, accomplishing or undertaking the task (crowd) why people do this (reward), and how the task had been done (skill, knowledge or education). Thus, the job provider should understand each process in all stages of crowdsourcing activities (Malone *et al*., 2010). In our initial theoretical study, we found that each process has multiple relationships among each other. The relationship can be represented in multidimensional form.

Multidimensional describes different components consist of different parts or different process. According to Zogaj *et al*. multidimensional must have at least three dimensions and each dimension have many categories that are related to each other. Crowdsourcing comprises of a few components which are task, platform, job provider and crowd worker. Each component is related to each other (Hosseini *et al*., 2014). Recent researchers (Schenk and Guittard, 2011; Ye and Kankanhalli, 2013) looked at limited dimension of components in crowdsourcing process. Task complexity and the nature

Corresponding Author: Nurhayati Zakaria, Faculty of Computer and Mathematical Sciences,
Universiti Teknologi MARA (UiTM), Shah Alam, Selangor, Malaysia

of task are two dimensions that are proposed by Schenk and Guittard (2011). Ye and Kankanhalli (2013) represented two dimensional components which are the classifications of task complexity and variation of outcome. The researcher describe multi-level intersection using two dimensional representation form. Based on the literature, we conclude that the real relationship among the components must at least has three dimensions. However, the relationships in multi-level intersection are not easy to read, not easy to understand and can cause confusion among readers.

Therefore, further analysis need to be done to provide description of relationships that are readable and dynamic. Nevertheless to define the dimension is complex as each dimension has at least three components which are related to each other and it is difficult to model (Heylighen, 1999). According to Zogaj *et al*., the relationship in crowdsourcing multidimensional process eventually lead to the solution to the platform, job provider and crowd worker. The relationship of each dimension is important to the organization because the suggestion from relationship of each dimension can help the organization save their resource such as budge (Rouse, 2010). To tackle this limitation, this study will come out with three components that comprises of type of tasks (simple, complex), outcome variation (high, low) and competency level of crowd worker (knowledge, comprehension, application, analysis, synthesis, evaluation). Association rules been used to present the relationship among the components.

MATERIALS AND METHODS

Crowdsourcing: Crowdsourcing is a new trend which enable organization to depend on the large number of crowd worker with various backgrounds to complete the tasks. Crowdsourcing represents the act of company taking a task performed by employees and outsourcing it to an undefined network of people in the form of an open call (Howe, 2006).

From Fig. 1, this study only focused on three elements: who forms the crowd what the crowd need to do and what the job provider get in return. The first element is who forms the crowd means that the crowd must have skill, knowledge and ability to perform the task. The skill, knowledge and ability are used to define the competency level of crowd worker. The second element is what the crowd need to do means that the crowd has to solve the problem based on type of tasks. The type of tasks refers to simple and complex tasks. The third element is what the job provider gets in return means that the job provider will obtain outcome variation from the crowd based on type of tasks. Based on the explanation above, it can be concluded that the competency level, the type of tasks

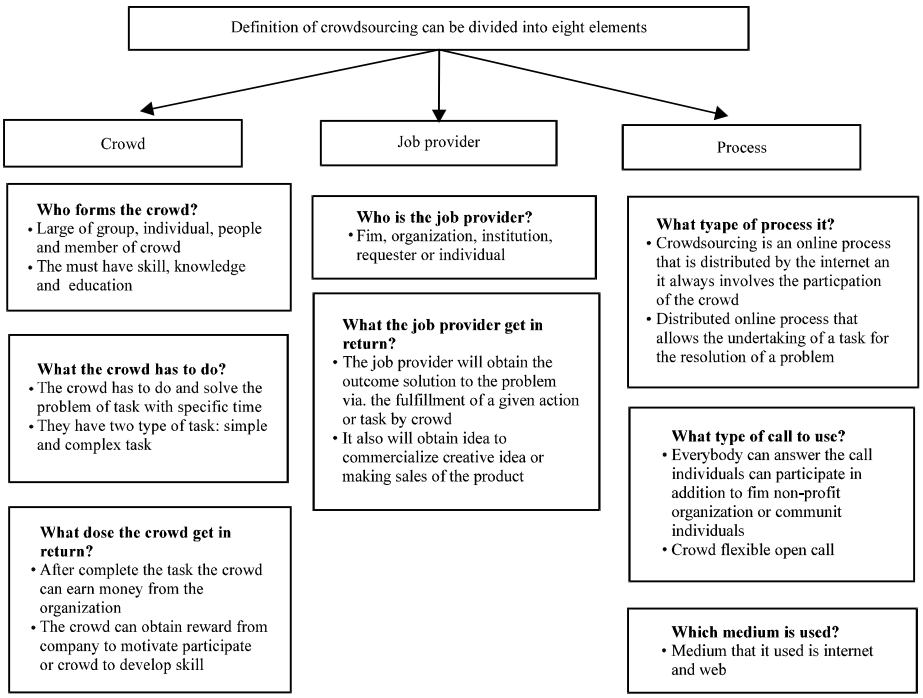

Fig. 1: Definition of crowdsourcing

outcome variation are the most important part that will be used in this study as the crowdsourcing task ecosystem model.

By combining all of these elements, a complete definition of crowdsourcing is obtained. As a result, crowdsourcing can be defined as a category of participative online job in which individual or a group of people offers the voluntary task to be done by other groups of individuals with different skills which gives mutual benefit to both crowdsourcers and crowd workers via a flexible open call. Thus, the open call will provide the benefit for everyone in the crowd to engage in a crowdsourcing activity.

RESULTS AND DISCUSSION

Components of crowdsourcing: To conduct this study, identification of the components is the first step before the relationship of the task. There are three components identified of type of tasks, outcome variety and competency level of crowd worker.

Type of tasks: In crowdsourcing, the type of tasks can be categorize as simple and complex tasks. Schenk and Guittard (2011)'s and Thuan *et al*. (2013) emphasized that the type of tasks is the first important dimension to identify the characteristics of crowdsourcing. According to Zhao and Zhu, the type of tasks should be clarified before decides on allocation of the tasks.

In the simple task, the organization can split down the large jobs into tiny individual tasks and the tasks have to be done by workers around the world via many platforms. These tasks can be completed within minutes and need little skill to be solved. Anyone can perform the simple tasks and earn little amount of money with paid by fixed amount of approved tasks. Complex task is a big jobs that require more time, effort and costs. Thus, a fewer number of people will be engaged or qualified to perform it. Solving the complex tasks need certain skills set, expertise and advanced academic levels.

Outcome variety: Second dimension is outcome variety. Outcome variety means that the extent to which the outcomes of the task can produce various answers. There are two categories of outcome variety comprise of low and high outcome variety. Low outcome variety indicates that the task does not require various outcome from crowd worker while high outcome variety refer to the task need various outcomes from crowd worker.

Simple task with low outcome variety usually require generic skill to accomplish the task and need to outsource the task to get various outcomes from crowd worker. The tasks are data input, labelling image and posting product advertisement to all public over the internet. Simple task with high outcome variety commonly require creative skill. The task does not difficult to be completed by crowd worker but the crowd worker must be creative. The example of the tasks are creating logo, designing T-shirts, poster and cover books.

Complex task with low outcome variety usually need specific skill to accomplish the task. The example of complex tasks with low outcome variety are website design, translation, programming, video clips design and photograph. Complex task with high outcome variety commonly require professional skill and knowledge. The key requirements for this task are the ability to compose various solutions using creativity, reasoning and past experiences. The examples are new product development, R&D innovation problems and software design.

Competencies level: The crowd may be a true open group in which anyone who interested in the tasks may engage in the crowdsourcing activity. However, the tasks may also be available only in a certain group which is prescreened to provide the certain skills or competency. According to Thuan *et al*. (2013), the crowd may be good or suitable for certain tasks but not for all types of tasks. This is an issue in human resource management to select the right crowd worker to accomplish the tasks (Ye and Kankanhalli, 2013).

According to Lu *et al*. (2013), the competency is a new model to solve this issues. Sharma (2010) supports this issue by introducing the knowledge, skills and abilities of crowd worker in the crowdsourcing. Therefore, the third component is competency level. Competency is a concept to measure related Knowledge, Skills and Abilities (KSA). In addition, the competency is the key to individual success in a job and show a good performance on a task.

Based on skill and knowledge of crowd worker, this study will refer to taxonomy of competencies that was introduced by Bloom (1984). Taxonomy means categories or classification of elements into group.

Bloom taxonomy competencies are divided into three domains which are cognitive, affective psychomotor domain. The focus only given to the cognitivedomain. It include knowledge and improvement of intellectual skills. There have six levels which are knowledge, comprehension, application, analysis, synthesis and evaluation. It will be referred in this study to facilitate the set up the ecosystem dimension relationships. To measure the skill of crowd worker, it is possible to identify the pattern of Blooms verbs based on level of competencies.

Association rules: To prove the relationship among components, this study will apply association rules. This method was introduced by Agrawal *et al.* to determine the association relationship among a set of items. Association rules mining is one among the most famous and important method that has been explored by research studies. Association rules mining is use to find the relationship of items in database (Hosseini *et al*., 2014; Han and Kamber, 2006; Intan, 2007; Han and Kamber, 2000; Lu *et al*., 2013). Association rule mining is suitably technique in data mining for finding interesting relationship between item sets in large database and gives the advantage to detect unknown relationship rules (Khare *et al*., 2009).

The discovery of the relationship between a set of items can help to define the decision making process. Usually, association rules have been a condition statement like if-then rules (Hosseini *et al*., 2014). An association rule can be expressed in the form A⇒B that interpreted as "database of tuples that meet the conditions in A is also likely to meet the conditions in B". The example of association rules is represented as below (Hosseini *et al*., 2014):

$$\text{buys}(X, \text{"laptop"}) \Rightarrow \text{buys}(X, \text{"printer"})$$

Association rule mining have two methods to find frequent pattern among set of items. The methods are apriori algorithm and FP-growth. Apriori algorithm has been applied to this study to find out the relationships patterns among set of item of competency level in crowd worker based on type of tasks and outcome variations.

Model: The three dimensions discussed above have been combined to create the three vertical sequences diagram, illustrated in Fig. 1. In Fig. 2, the diagram start from the left (Type of tasks), middle (Outcome variety) and right (Competencies level). Type of task is a first dimensions and it can be categorized as simple and complex tasks. The symbol terminator point or oval means the start of process. Outcome variety is a second dimension and it can be categorized as low and high. The symbol diamond represents a point where a decision is made. The type equal to S and type equal to H represent the variable in low and high outcome varieties while competency level is a third dimension. Competency level have six levels starting from knowledge, comprehension, application, analysis and evaluation. The symbol terminator denote the end of the process.

In order to determine the relationships between components, feedbacks from three subject matter experts who have experiences in crowdsourcing implementation

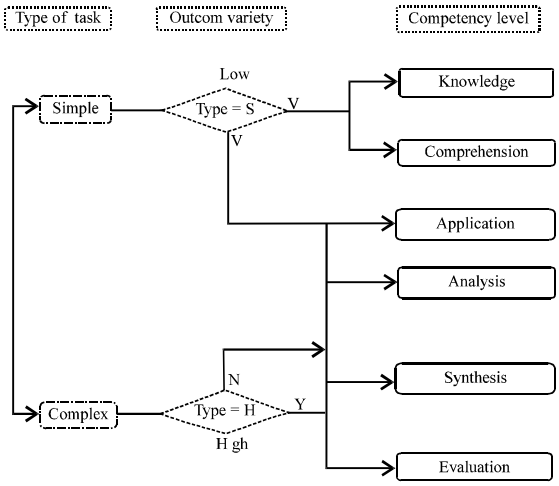

Fig. 2: Vertical requences tark, voriety and competany lend

at local and international platforms were gathered. As shown in Fig. 1 if type of tasks is simple and outcome variety is low then the competency level is knowledge and comprehension. It means that the crowd worker need knowledge and comprehension to accomplish the simple task with low outcome variety. Knowledge in the competency level means that the crowd worker must have knowledge in using computer. Components related to comprehension suggests that the crowd worker must at least understand the assignment instruction. The crowd worker must literate enough in computer and must understand the assignment task although the task is extremely simple. If the crowd worker does not understand the task and literate in computer they won't be able to perform the task.

If type of tasks is simple with high outcome variety then the competency level will be classified under knowledge, comprehension and application components. The crowd worker requires knowledge, comprehension and application to complete the simple task with high outcome variety. The example of this task is design logo. Application in the competency level is describe that the crowd worker must know to operate the specific tool such as adobe photoshop. The crowd worker must literate in computer, understand the assignment task and know to operate the specific tool, although, the task is extremely simple. If the crowd worker does not know to operate the tools then it cannot perform the task.

On the other hand, if type of tasks is complex and the outcome variety are low and high then the competency levels are classified under knowledge, comprehension, application, analysis, synthesis and evaluation. The

crowd worker will require to achieve the highest competency level to accomplish the complex task because the task need more time, effort and professional skill of crowd worker.

CONCLUSION

The purpose of this study is to propose the crowdsourcing task multidimensional ecosystem model. Based on current literature, three dimensions that are related to each other's were identified. The dimensions consist of type of tasks (simple and complex), outcome variation (high and low) and competency level (knowledge, comprehension, application, analysis, synthesis and evaluation).

Based on skill and knowledge of crowd worker, this study is based on the bloom taxonomy of competencies. Bloom taxonomy of competencies is used to clarify the goals regarding of knowledge and skill that are provided by any crowd worker to accomplish the requirement of task.

The crowdsourcing task multidimensional ecosystem model can give more systematic method to understand the relationships of each process in crowdsourcing activities. The relationship in crowdsourcing eventually lead the solution to the platform, job provider and crowd worker. Further study is needed to represent the relationship of dimensions by using association rules.

ACKNOWLEDGEMENTS

Researchers would like to thank to Ministry of Higher Education Malaysia for their funding support under Fundamental Research Grant Scheme, Research Management Centre, UiTM (Project Code 600-RMI/FRGS 5/3 (33/2014).

REFERENCES

Bloom, B.S., D.R. Krathwohl and B.B. Masia, 1984. Taxonomy of Educational Objectives: The Classification of Educational Goals. Longman Publishing, New York, USA.

Han, J. and M. Kamber, 2000. Data Mining: Concepts and Techniques. Morgan-Kaufman Publishers, New York.

Han, J. and M. Kamber, 2006. Data Mining Concepts and Techniques. 2nd Edn., Morgan Kaufmann, Burlington, Massachusetts.

Heylighen, F., 1999. The growth of structural and functional complexity during evolution. Evol. Complexity, 1: 17-44.

Hosseini, M., K. Phalp, J. Taylor and R. Ali, 2014. The four pillars of crowdsourcing: A reference model. Proceedings of the 2014 IEEE Eighth International Conference on Research Challenges in Information Science (RCIS), May 28-30, 2014, IEEE, Bournemouth, UK, ISBN: 978-1-4799-2393-9, pp: 1-12.

Howe, J., 2006. The rise of crowdsourcing. Wired Mag., 6: 176-183.

Intan, R., 2007. A proposal of fuzzy multidimensional association rules. J. Inf., 7: 85-90.

Khare, N., N. Adlakha and K.R. Pardasani, 2009. An algorithm for mining multidimensional fuzzy association rules. Intl. J. Comput. Sci. Inf. Secur., 5: 72-76.

Lu, Y., P. Zhang, J. Liu and J. Li, 2013. Competency-based personnel selection in crowdsourcing using fuzzy MCDM approach. J. Convergence Inf. Technol., 8: 1065-1074.

Malone, T.W., R. Laubacher and C. Dellarocas, 2010. The collective intelligence genome. MIT. Sloan Manage. Rev., 51: 21-31.

Rouse, A.C., 2010. A preliminary taxonomy of crowdsourcing. Proceedings of the 21st Australasian Conference on Information Systems Vol. 76, December 1-3, 2010, University in Victoria, Victoria, Australia, pp: 1-10.

Schenk, E. and C. Guittard, 2011. Towards a characterization of crowdsourcing practices. J. Innovation Econ. Manage., 1: 93-107.

Sharma, A., 2010. Crowdsourcing critical success factor model: Strategies to harness the collective intelligence of the crowd. London School of Economics, London, England. https://pdfs. semanticscholar. org/7e47/d791397f1b 78ca4ced 2dcfddd1 82e 5abddc0.pdf

Thuan, N., P. Antunes and D. Johnstone, 2013. Factors Influencing the Decision to Crowdsource. In: Collaboration and Technology, Antunes, P., M. Gerosa, A. Sylvester, J. Vassileva and G. J. Vreede (Eds.). Springer, Berlin, Germany, pp: 110-125.

Ye, H. and A. Kankanhalli, 2013. Leveraging crowdsourcing for organizational value co-creation. Commun. Assoc. Inf. Syst., 33: 225-244.