Mapping Organization Knowledge Network and Measuring Employee Reputation

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Abstract

Knowledge management is important aspects of business organization, especially in the ICT industry. Having more control of their knowledge capital is essentials for the organization to stay competitive in the business. One way to assess the organization knowledge capital is by measuring employee knowledge network and their personal reputation in social media. Using this measurement, we can see how employee build relationship around their peer networks or clients virtually. Knowledge flow information is benefited from mapping the organization knowledge network. Two contributions of this research are first to mapping knowledge network through case study and second to develop personal reputation formulas based on employee social media activities. To implement those two contributions, as the case study, we choose an Indonesian ICT company which actively build their business around their employee peer knowledge outside the company. Data collections are performed by conducting interviews for the case of mapping knowledge network, while for the case of reputation management, we crawl data from several popular social media. We base our work on Social Network Analysis (SNA) methodology. The result shows that employees knowledge is directly proportional to their reputation, but there are different reputations level on different social media observed in this research.

**Keywords:** Social Network Analysis, Knowledge Management, Personal Reputation, Social Media

I. INTRODUCTION

Knowledge management (KM) is a substantial aspect of an organization. It proposed to improve decision-making, responsiveness to customer, work efficiency, productivity, and ability to innovate [1]. Furthermore, human resources become an essential factor to make a good reputation for organization, since they are the actors who create, execute and develop organization’s plans and strategies. Therefore, they can influence the organizations’ reputation, whether they will create better or worse reputation for the organization. It depends on the level of their knowledge and how they utilize their knowledge in the organization. In another word, if an organization have more human resources who have a high level of knowledge, that organization will have a better reputation. Moreover, the organization can also increase its level of competitiveness [2]. Personal knowledge network (PKN) within the organization is an alternative to model overall organization KM [3].
Organizations’ reputation is influenced by personal reputation within the organization. Nonetheless, it is difficult to measure the reputation based on the relationship of each actor. At first, developing a network which includes all the actors takes too much effort in terms of time and money. For example, if the organization wants to get some information about their employee, they need to stay close to the employee, to monitor, or they can collect the data from their employee directly. This way, the organization needs to observe or analyze the data one by one. Several studies regarding organizational network analysis have focused on conceptual framework [4][5], and some use real network data such as using email data [6]. In this research, we propose a reputation metric as a complement to organizational network.

Nowadays, the technology development permit increases usage of social media. People start to change their behavior from conventional such as offline activities to digitally recorded activities. The collaboration of technology, internet, and social media allows people to communicate, exchange information and express themselves, which leads to a network creation and alters the relationship between people. Organizations can collect this digital trace in the form of massive data then analyze it to measure personal reputation.

According to [7], the most popular social media are Facebook, Twitter, Instagram, and LinkedIn. The problem arises since the formula to get the information about reputation from those social media is not available yet. Therefore, this study aims to construct formulas of KM and reputation for network modeling. The formulas are developed to measure KM and personal reputation based on their social media activities.

In this research, as the case study, we pick an Indonesian ICT company which actively build their business around their employee peer knowledge outside the company. There are 48 employees in the company who become our respondent. These employees represent the higher management position in the company. This paper presentation is organized as follows: Introduction section is to explain the research background, motivation, and several researches related to organization network analysis. Literature review section is to explain about the key characteristics of knowledge management and personal/social reputation based on the literature. Research methodology is explained on methodology section, while discussion about result and analysis is shown in the following section.

II. LITERATURE REVIEW

A. Knowledge Management

Knowledge Management (KM) is an activity which has a systematic approach to capture, structure, manage, and disseminate knowledge through an organization [8]. Human, technology, organization, and management process are the critical success factors of KM in practice. Previous studies highlight that KM which is the part of human capital plays important role in the competitiveness of large firms and small and medium enterprises [9][10]. In today information era, company valued by their human capital especially in ICT industry. Therefore, KM becomes one of the most important aspects related to the sustainability of the organization. There is also an effort to map KM using Big Data and Social Network Analysis (SNA), which clearly a new approach to the KM field [11][12].

In general, KM process is divided into three phases. First, the creation phase which explains acquiring and validating knowledge [10]. Second, the storage phase which explains about retaining and organizing knowledge. The last phase is the transfer phase. In this phase, knowledge is exchanged and shared by several actors.

B. Personal Reputation

Personal reputation explains social network of some individuals by reporting the information about people within individual life and their relationship [11]. That personal reputation was given by considering other people’s judgment toward individuals’ activities. It seems like accumulating other people’s perception in long-term about what individual has been done in their life.

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Generally, reputation has three-dimensional scales [12]:
1) Task Reputation

Task reputation explains the personal reputation based on their ability to finish tasks [12]. In another word, in the context of the organization, task reputation has a close relationship with the individuals’ performance. Individuals have high possibility to be famous and have a good reputation in their organization if they have a high ability to accomplish their tasks. For an instance, an individual is judged as an expert in some area if they have consistent performance in that area. Furthermore, they will be expected to finish a similar job in the future. It indicates that those individual’s successes to build a good reputation in their social life.

A wide range of literature developed several indicators to measure task reputation. Individuals who have a high level of task reputation has characteristics such as:

a) An expert in their area
b) Often asked for advice regarding work-related issues
c) Often asked to solve problem regarding technical issues at work
d) Have a good understanding of technical systems of the workplace

2) Social Reputation

As a social human being, an individual is created to be social units which cooperate to achieve their goal. Therefore, they often create a relationship with other people within or outside their group. A successes or failures to create relationship depends on their reputation in social life.

The fundamental of social reputation is a norm. The social reputation of individuals depends on their ability and willingness to live under control from the social norm [11]. It does not need to support their activities related to their job performance. Meanwhile, it will guide and help individuals to interact in their social life.

There are several characteristics of individuals who have a good social reputation, such as:

a) Has attractiveness to make other people feel comfortable
b) Often involved in social events
c) Well-liked by others
d) Popular in their social life

3) Integrity Reputation

Reputation is a tool to predict personal behavior and the integrity is one of the most important components to predict it. Integrity reputation can be seen in the decision-making process of any situation. Individuals who have a better reputation in any area does not mean they also have a better integrity reputation [12]. It’s because each reputation scale has their own parameters or own needs. Different from task reputation and social reputation, characteristics of individuals who have good integrity reputation are:

a) Seen as a person who has high integrity
b) Known for being an upstanding person
c) Can be trusted
d) Has a high moral character
III. Research Method

The research methodology is divided into several tasks shown in Fig. 1. The workflow starts from case selection, and finish at the main work in network model construction and formula reputation construction. We explain each step as follows:

A. Case Selection

Our case study is an Indonesian startup ICT company which has just focusing their services on social media monitoring and analyzing for business organization. It is a business to business (B2B) model. As an emerging business in this domain, they rely their growth on their relationship with customers through social media. The virtual network becomes an essential business aspect. Therefore, an individual’s reputation in the virtual world within the organization must be measured. However, knowledge transfer from past employee does not work well for this organization. Moreover, the shift business focus and the absence of comprehensive employee data record, makes matters become difficult for company to assess their employee knowledge capital. They had only recorded employee’ data as recent as 2016, although it was established in 2010. This case study is a perfect example of disruption in business environment that needs organization to recalculate their employee knowledge capital.

B. Data Collection

Data collection is performed by conducting the interview and handing the questionnaire. The interviewees are the organizations’ employees. The interview uses task reputation approach. The questionnaire contains several information to fill such as employee name, position, and rank their top-10 most knowledgeable or reputable colleagues according to their own preference. They rank from the best to the worst. The higher rank employee is given the bigger weight relations to the interviewee.

Additional data collection task is to perform data crawling from employees’ social media account. We analyze data from Instagram, Twitter, and LinkedIn. The reason to choose those social media is from the preliminary survey result and also from the reference of professional use of social media [7]. We also found that most of case study employee only use those three-social media, thus make it easier for us to measure comparable quantification. The employee use their social media account to establish connection with their potential customer in the form of informal relationship. The attributes used in the data crawling processes are the number of the post, the number of the followers and the number of following. The data that have been collected were organized into a dataset to create a network of individuals’ KM and reputation.

C. Network Construction

We construct a knowledge network based on Social Network Analysis (SNA) [13] methodology from the interview and questionnaire data. The model is an undirected network which captures the reality of how an employee votes for their colleagues. The edge weight has also applied to give some important measurement of voting. For example, employee A vote employee B in a higher rank than employee C, so we have undirected weight edge A to B higher than A to C.

We apply the centrality metric to identify the most influential employee in the organization. Because of directed network nature, we have an in-degree and out-degree measurement. In-degree measure how many people votes the actual employee, while out-degree measure how many votes has been given by an employee.
D. Formula Reputation Construction

After carefully studying some previous researches related to the reputation and SNA based knowledge network, we found that the specific formula to measure personal reputation in social media using SNA has not developed yet. Therefore, this study proposes to develop personal reputation formula to calculate personal reputation on Twitter, Instagram, and LinkedIn based on SNA methodology. The formula was developed by considering social reputation approach and 11 elements of popularity from the previous researches [2][11][12]. Then, expert’s judgments and comments were also considered to validate the formula.

1) Formula of Personal Reputation on Twitter and Instagram

The formula to measure personal reputation ($R$) on Twitter and Instagram were developed based on Zinko principle on reputation [12]. This formula is built by comparing the number of followers with the number of post and number of following. The formula (1) shows that someone with a good personal reputation is someone who has more followers but less number of post and less number of following. In another word, this individual has good attractiveness to make other people follow them. However, the attractiveness does not fully depend on their high frequency to post something on their social media.

$$R_l = \frac{\Sigma \text{follower}}{\Sigma \text{post}} + \frac{\Sigma \text{follower}}{\Sigma \text{following}}$$ 

(1)

where $\Sigma \text{follower}$ is the number of the followers of an actor in investigation. $\Sigma \text{post}$ is the number of the post of the actor. $\Sigma \text{following}$ in the number of the account that actor in investigation follows.

2) Formula of Personal Reputation on Linkedin

LinkedIn is one of social network services that connects peoples in their professionals life. Therefore, LinkedIn components can be used to assess personal reputation in their professional area. Personal reputation in LinkedIn ($R_l$) is calculated by comparing the ratio number of endorsements and the number of connection as the first element, we also add ratio of the number of endorsements and the number of skill as the second additive element. The formula (2) indicates that the ratio of endorsements comparing to connections and skills give representatives personal reputations.

$$R_l = \frac{\Sigma \text{endorsement}}{\Sigma \text{connections}} + \frac{\Sigma \text{endorsement}}{\Sigma \text{skills}}$$ 

(2)

where $\Sigma \text{endorsement}$ is the number of endorse that an actor received. $\Sigma \text{connection}$ is the number of connections that an actor has. $\Sigma \text{skill}$ is the number of skill that an actor has.

IV. Results And Discussion

A. Modelling The Knowledge Network

First, we analyze employee questionnaire data by constructing knowledge network based on SNA. The map result shown in Fig. 2 describes the general model of mapping employees’ knowledge network in the organization. The result consists of nodes which symbolized the knowledge level of each employee compared to the other employee. Those nodes are calculated based on an accumulated score given by their peer colleagues, thus it shows knowledge level ranking. The bigger size of a node indicates higher position of knowledge level. The result also consists of directed edges. The edges are mapping the relationship, in this case knowledge voting among employees. Weighted degree shows their accumulated score. Overall, the degree of centrality gives an information about employees who have the best knowledge level in the organization according to their
colleagues. There are three employees who have highest degree of centrality, they are employee number 1, 2, and 16 (shown in Fig. 3). Fig. 3 shows nodes rank based on their degree centrality value. The actual degree or number of connections is shown under Degree column, while degree rank with its weight information shown under Weighted Degree column. For example, although node 1 and 16 has the same number of connections, node 1 is more knowledgeable or reputable according to their peer network.

![General Knowledge Network](image)

Fig 2. General Knowledge Network

![Summary of Degree Centrality for Highest Knowledge Level](image)

Fig 3. Summary of Degree Centrality for Highest Knowledge Level
A. Knowledge Management and Reputation on Social Media

The second step is crawling data from each personal social media employee accounts from the duration of June 1st – July 1st, 2017. We then apply personal reputation formulas (1) and (2) for each social media. We combine KM based on knowledge network model in Fig. 2. and personal reputation measurement from all social media data (i.e. Instagram, Twitter, and LinkedIn). Fig. 4. shows the visualization result of aggregation social media network. We call this process as building KM and reputation on social media network.

From Fig. 4., we compare the three biggest nodes with the previous result in Fig. 3, where we have slightly different result. Now, we have nodes number 1, 2 and 8 as the three biggest nodes. Node 8 which previously unknown, now become one of the prominent employee based on this rank. Although node 8 have smaller number connection inside the company comparing to node 16 which is the rank number 3 in Fig. 3. Internal connection symbolized by degree centrality no longer affects the size of the nodes, but the actor reputation in social media is. Table 1. shows the result of overall best 5 actors based on the highest reputation network.

<table>
<thead>
<tr>
<th>Nodes</th>
<th>Total Reputation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.567</td>
</tr>
<tr>
<td>1</td>
<td>1.358</td>
</tr>
<tr>
<td>8</td>
<td>1.172</td>
</tr>
<tr>
<td>26</td>
<td>0.790</td>
</tr>
<tr>
<td>22</td>
<td>0.619</td>
</tr>
</tbody>
</table>

In order to have comparable result of network reputation between all social media in this research, we normalize reputation value in a range between 0 and 1. The value indicate that someone has a better reputation if the result of calculation is closer to 1. Table 1 gives an information about total employees’ reputation based on 3 social media in this research. We found that there are three employees who have the highest reputation in social media. To give a deeper analysis, this study also develops a model for each social media separately. Modeling result of each social media is shown in Fig. 5, 6, and 7. Then the summary of each result is shown in Table 2.

The result shows that each employee has different KM and personal reputation level on different social media. It depends on their activities on social media and how active they are to maintain their reputation on their
social media. Other than centrality metric, we also use other network metric that beneficial to the analysis of the KM and reputation network. One of them is density metric.

### TABLE I
**SUMMARY OF MODELLING RESULT OF KNOWLEDGE MANAGEMENT AND REPUTATION ON SOCIAL MEDIA**

<table>
<thead>
<tr>
<th></th>
<th>Reputation on Twitter</th>
<th>Reputation on Instagram</th>
<th>Reputation on Linkedin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nodes</td>
<td>Nodes</td>
<td>Nodes</td>
<td>Nodes</td>
</tr>
<tr>
<td>2</td>
<td>1,000</td>
<td>8</td>
<td>1,000</td>
</tr>
<tr>
<td>10</td>
<td>0.452</td>
<td>3</td>
<td>0.409</td>
</tr>
<tr>
<td>24</td>
<td>0.352</td>
<td>20</td>
<td>0.241</td>
</tr>
<tr>
<td>1</td>
<td>0.280</td>
<td>44</td>
<td>0.154</td>
</tr>
<tr>
<td>21</td>
<td>0.251</td>
<td>9</td>
<td>0.130</td>
</tr>
</tbody>
</table>

Table 2 shows the breakdown value of overall node (employee) reputation score from Table 1. We see that each employee performs differently on different social media. For example, node (employee) 2 perform best in Twitter, while he/she perform third in LinkedIn.

The density of knowledge network that occur in the entire KM and reputation is 0.658. The network density is measured by dividing the number of actual edges compared to the maximum possible edges in the network. This measurement implies that the network has high enough density comparing to other social network which commonly have around under the value of 0.2 [14][15][16] based on scale free or power law distributions. The high density of the network is influenced by a high interaction between actors, the interaction mentioned in this research is ranking activity among employees. This indicates that employees within the organization acknowledge their each colleagues benefit and limitation. It is a positive sign in a company since it can support knowledge distribution process and information easily.
Mapping Organization Knowledge Network and Measuring Employee Reputation

Fig 6. Personal Reputation Model on Instagram Network

Fig 7. Personal Reputation Model on LinkedIn Network
V. CONCLUSION

This study presents formulas to measure the level of knowledge management through personal knowledge network and reputation on social media using Social Network Analysis methodology. The results show knowledge network model that support both knowledge management and reputation of the employee. The main components of formula consider the number of posts, the number of followers, and the number of following which describes their activities on their social media. The modeling result shows that individuals who have better knowledge, also have better personal reputation. Meanwhile, their level of personal reputation in a different social media might be different. It depends on their activities and their relationship with other people on social media.

By having this tool as the measurement base, organization can get better understanding on how their employee perform in their peer network. Organization can also map whether their employee is over-performed or under-performed by comparing for example with their salary or other variables. This study also shows that knowledge management and reputation network mapping can outline employee knowledge, predict the optimal knowledge dissemination scenario, which then useful for overall decision support system in the organization and organization competitiveness.

There are several contribution from this research. First, knowledge network modelling based on SNA methodology. Second, the formulation of personal reputation on social media. Third, real world implementation of first and second contribution through a case study. The advantage of first contribution on practical application is to inform higher management about global overview of their employee knowledge network. The advantage of second contribution is quantification employee reputation, while the limitation is this formula can only work specifically on certain social media.

For the future development, we suggest more respondent, which means more actors and more relationships to be included. The objective is to understand whether the network complexity can reveal the real organization knowledge network flow problems. We also suggest comparison knowledge network between different organizations, to see which organization have better knowledge network and whether the advantage can be reflected to their performance.

REFERENCES