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Using Social Network Analysis to Analyze Collaboration in Batik Smes

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As a creative industry, batik industry should always create a breakthrough in the form of innovative batik motifs to attract buyers. Manufacturers of batik in Indonesia are batik SMEs with very simple organization and management. However, they are in a competitive business environment that threatens their survival.

In order to continue to create innovative products, collaboration of employees in batik SMEs is absolute important. Collaboration between individuals is more likely to occur in the patterns of informal relationships rather than in formal ways.

This article examines and analyses the patterns of informal relations in Winda Sari batik. Winda Sari batik SME is one of big SMEs in Sragen. Using Social Network Analysis (SNA) for analysis, the results of this study indicate that the relationships between individuals are highly dependent and focused on the specific individuals as intermediaries.

In addition, there are patterns of relationships in the subgroups, or cliques, which have only a few numbers of members. In addition, the relationships appear to be one-way relationships than reciprocal relationships. This kind of relationships is less support to collaboration.

Keywords: *social network analysis; batik; collaboration; informal relations.*

Introduction

Batik industry in Indonesia has a strategic position, since the industry absorbs a large number of labors. There are many regions in Indonesia that produce batik; however, the largest is in Java. According to the Ministry of Industry and Trade, in the year 2011 there were 39,600 batik business units absorbing 165,000 workers. While total export reached Rp 4 trillion and supplies of batik raw materials valued at Rp 1.8 trillion [1]. Moreover, people can wear batik clothes in formal and informal occasion.

Batik strategic position not only represents the business, but also reflects the struggle of local cultural richness in the middle of global cultural expansion. Batik expresses local cultural identities, which are not motif expressions solely, but also ethos, spirit, service, and sincerity to serve. When family members are involved in completing the work of other family members, they actually put aside their personal interests to serve the interests of the company [2].

The strategic position of batik is incompatible with the industrial structure of SMEs and the ability of their management and production. The main problem with the structure of the batik industry is that it is a home industry done by the traditional SMEs. As a creative industry, batik SMEs should always create a breakthrough in the form of innovative batik motifs to attract buyers and to compete with other garment industries. However, such structures do not exist in the structure of batik SMEs. In addition to inadequate human resources, there are also some other issues such as capital, raw materials, marketing, partnerships, and technology [3] [4].

Some studies also show that the performance of the batik industry is still unstable. Batik industry requires long production time, and economically less attractive to investors who need quick return [5]. The same has been raised by [6] who refers to the slow development of batik in Lasem, the Sub-District of Pancur in Rembang Regency. However, in fact, beyond estimation of many people, batik industry is able to make breakthroughs in the design and survive. The breakthrough is not only in terms of design, but also in color and coloring materials. In terms of colors, there is a shift in the pattern early batik toward a more varied pattern. Such changes indicate the presence of innovations in batik design.

The key to success in the face of any changes is innovation and entrepreneurship. Entrepreneurial companies always have strong

commitment to innovation [7]. Innovation is not only a deliberate action to generate new ideas, but also the introduction and implementation of new ideas, all aimed at improving organizational performance. In batik industry, innovation includes what they do to make a new technique, motive and coloring on batik cloth [8].

Innovation and collaboration are the two mutually support one another. The extent to which members of the organization is integrated in a network of personal relationships affect organizational innovation. Formal and informal collaborations in the organization reveal the structure of innovation in organizations and provide opportunities for leaders of organizations to conduct formal intervention in order to affect the network structure of employees in the innovation network [9]. The leader of an organization who is able to exploit the structure of formal and informal organizations can reduce costs, improve efficiency and create innovation. In addition, the disclosure of network characteristics of high performing employees can provide an opportunity to identify other employees who have the similar role in the network and at the same time encouraging their contribution to the company [10]. Though the development of innovative behavior of employees contribute to improving the efficiency and effectiveness of the organization, little is known about the innovative behavior in the context of small and medium enterprises (SMEs). Human resource managers who are able to develop innovative behavior of employees will create opportunities to align employee behavior with organizational goals [11].

The purpose of this article is to explain the behavior of informal relationships in Winda Sari batik SMEs in Sragen. Using Social Network Analysis (SNA) this research analyzed and plotted patterns of informal relationships.

Literature review

Batik

Although there are many manufacturers of batik almost all over Indonesia, but the biggest production number is in Java, especially in Central Java and West Java. One of the biggest batik centers in Central Java is in Sragen, especially in Sub-districts of Masaran, Plupuh and Kalijambe. According to

data in 2011, there were 4,702 batik business units in Sragen, which employed 8,524 workers. While the number of batik production in 2011 was 950,000 meters [12].

Beside the issue of capital, other biggest challenge in batik industry is human resources regeneration. Interests of young workers who want to work in this sector continually decreased [13]. In addition, there is competition from the apparel industry, and batik imports from ASEAN countries and China. Apparel industry (garment) has an advantage in the form of production speed and dynamically adaptability to the global trend. On the other, batik is a handcrafted industry with traditional local motifs. The greater challenge will come from the implementation of AFTA-China 2015. Invasion of batik imports from ASEAN countries and China will increase the intensity of competition [14].

Social network analysis (SNA)

Currently a social network analysis tool is increasingly important for organizations to understand the relationship between the patterns of employee interactions with business outputs, such as job performance, job satisfaction, adoption of new ideas or technologies [15] [16] [17][18].

A social network is a social structure consisting of individuals. In a social context, a network composed of nodes in the form of individual, organization, or equipment such as computers. A node can have one or more connections. The connections can represents, such as friendship, kinship, common interest, or belief. The social network analysis examines the structure of social relations within a group to uncover the informal relationships between people. In mathematical terms, the network refers to a graph structure to represent people or objects as nodes and relationships as edges that can be directed or undirected relationships.

The main goal of social network analysis is to identify the patterns of social ties among actors in social networks. Such patterns are often more informal than formal. For example, if one wants to understand how an organization works, one can find it in the formal structure of the organization chart. However, in line with the development of the organization, this chart may no longer be a sufficient guide to understanding how the organization really works [19].

To analyze a social network, SNA provides some measurement tools include:

- Degree centrality. This centrality measures the number of direct relationships possessed by an actor in a network. If the network is a directed network (relationships have a direction), then the degree centrality has two separate measures, namely in degree and out degree. In degree is the number of incoming connections to the node, and out degree is the number of relationships that come out of the node.
- Closeness centrality. This centrality indicates the speed of information or knowledge transferred. Closeness centrality is the most important measurements in the network [20]. This measure calculates the average number of steps required by an actor to reach others in the network. An actor who has a high closeness centrality is the most efficient actor to make contact with others in the network [21] [22]. In other words, the higher the closeness centrality of an actor, the better the position of the actors in the dissemination of information to other actors [23].
- Betweenness centrality. This centrality measures the number of shortest paths from all nodes to all other nodes that pass through the node. In other words, this measure shows the ability of an actor to control the information, due to his/her position in the network [23] [21].

Methodology

This study uses the saturation sampling technique to collect data. This method is very useful because the data were collected from all individuals along with their relationship. The advantage of this method is to allow a detailed analysis of all individuals and their location in the network as well as the accompanying attributes. This method has limitations in terms of just used to examine the small-sized organizations [24].

The data in this study consists of 59 employees of Winda Sari batik SMEs in Sub-district Masaran, Sragen. The selection of Winda Sari batik SMEs is because it is one of the big batik SMEs in Sragen.

Results of the questionnaire were tabulated into two matrices, relationships and attributes. The data then were analyzed using UCINET 6 program and NetDraw. Both of these applications are developed by Borgatti, SP, Everett, MG and Freeman, LC 2002 at Harvard University as an Analytic Technology.

Results and Discussion

Degree Centrality

Most Influential actors (out-degree)

Figure 1 shows the results using UCINET. The result indicates that Actor # 13 has the highest out-degree. Regardless of what information was given and to whom the information was given, this actor can be considered as the most influential actors in the entire network.

Recognition of Actor Position (in-degree)

In Figure 1, actor # 38 is the most known and recognized in the network seen from the number of in-degree. This indicates the willingness of sharing information from other actors in the network with this actor. Their willingness indicates an act of recognition or respect for the position of the actor.

NrmDegOut and NrmInDeg indicate the normalization of degree centralities, that is degree centrality divided by the number of actors in the network minus one (59-1 = 58). OutDegree normalization (NrmOutDeg) of Actor # 13 is 24%, while InDegree normalization (NrmInDeg) of actor # 38 is 31%.

FREEMAN'S DEGREE CENTRALITY MEASURES

		1 OutDegree	2 InDegree	3 NrmOutDeg	4 NrmInDeg
13	13	14.000	0.000	24.138	0.000
18	18	13.000	2.000	22.414	3.448
36	36	12.000	0.000	20.690	0.000
42	42	11.000	1.000	18.966	1.724
32	32	9.000	6.000	15.517	10.345
26	26	8.000	1.000	13.793	1.724
7	7	7.000	7.000	12.069	12.069
31	31	7.000	2.000	12.069	3.448
38	38	7.000	18.000	12.069	31.034

Figure 1: Degree centrality scores for several actors

DESCRIPTIVE STATISTICS

		1 OutDegree	2 InDegree	3 NrmOutDeg	4 NrmInDeg
1	Mean	3.051	3.051	5.260	5.260
2	Std Dev	3.643	3.116	6.280	5.372
3	Sum	180.000	180.000	310.345	310.345
4	Variance	13.269	9.709	39.443	28.862
5	SSQ	1332.000	1122.000	3959.572	3335.315
6	MCSSQ	782.847	572.847	2327.133	1702.876
7	Euc Norm	36.497	33.496	62.925	57.752
8	Minimum	0.000	0.000	0.000	0.000
9	Maximum	14.000	18.000	24.138	31.034
10	N of Obs	59.000	59.000	59.000	59.000

Network Centralization (Outdegree) = 19.540%
Network Centralization (Indegree) = 26.679%

Figure 2: Distribution of actor's degree centrality scores

Degree distribution of Actors

The following analyzes distribution of degree centrality in the network (Figure 2):

- Mean: The average degree of actors in the network is 3.051, which is quite low. This figure means that on average each actor only had three relationships with others.
- Max-Min: Max and Min values show the largest and smallest number of relationships. The maximum number of connection to the outside (OutDegree) in this network is 14, which is possessed by

actor # 13, while the minimum number of connection to the outside is zero. This means that there are actors who have absolutely no connection to the outside, only receiving without giving information to another party. For incoming relationship (InDegree), the maximum value is 18, while the minimum value is zero. This means that there are actors who only give information but do not receive information from the other party. From OutDegree and InDegree, the range of minimum and maximum values for InDegree is somewhat higher than the range of the minimum and maximum values for OutDegree. This suggests that in this network, actors prefer to receive rather than give information. In other words, the number of actors who receive information is more than the number of actors who give information.

- Standard Deviation and Mean: Standard deviation and mean indicate whether the population is homogeneous or heterogeneous in terms of their variability. To determine the variability (or the coefficient of variation), the standard deviation is divided by the mean value and multiplied by 100. The coefficient of variation for out-degree is 119, while for in-degree is 102. From these two figures, it is clear that the population is very heterogeneous both for out-degree (influence) as well as for in-degree (recognition).
- Graph centralization measures. Graph centralization describes the population as a whole. It describes whether there is a centralization of actors in the network. In a network with a star topology, actors are centralized to a particular actor. In other words, all the actors, but one, have degree centrality 1, while the actor at the center of the network has a degree centrality in accordance with the number of actors minus one. From the Figure 2, Out-degree graph centralization is 20% and in-degree graph centralization is 27% of the theoretical maximum.
- Thus, we can conclude from the analysis above that there is some amount of concentration or centralization across the network, that is, the power of actors varies rather substantially. Figure 3 shows the sociogram based on the degree centrality. Sizes of the nodes are proportional to their degree centrality values.

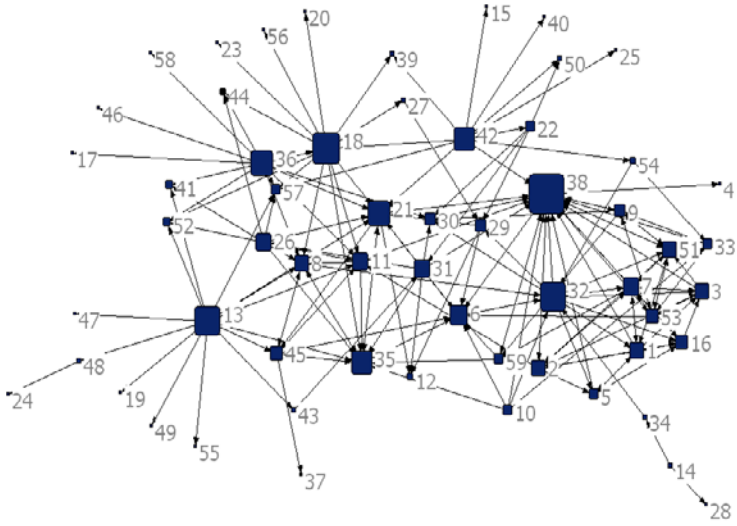

Figure 3: Relationships between actors based on their degree centrality

Closeness Centrality Measures

Closeness centrality measures the speed of information transfer in the network. Measurement of closeness is different from the measurement of degree centrality. Degree centrality takes into account only the direct relationships an actor has, and ignores the indirect ties to all other actors. Closeness centrality calculates the distance from an actor to all other actors in the network.

In Figure 4, Incloseness indicates distance from other actors in the network to an actor. While Outcloseness shows the proximity of an actor to other actors in the network. Incloseness and Outcloseness differ because there are asymmetrical relationships in sending and receiving information. From Figure 4, actor # 38 has the greatest Inclosesness and Outcloseness, 25.167 and 13.333 respectively. These figures indicate that the actor # 38 has a close proximity to other actors in the network, as well as the proximity of other actors to his (her) position. In other words, actor # 38 has a favored position in the network, because he (she) can reach other actors, or other actors can reach him (her), more quickly.

From the statistical results (Figure 5), the distribution of out-closeness has nearly the same as the distribution of in-closeness as indicated

by the network in-centralization (62.35%) and network out-centralization (62.94%). This means that the distance of an actor to other actors is almost the same as the distance of the other actors to the relevant actors in the network. Figure 6 shows the sociogram based on the closeness centrality. Sizes of the nodes are proportional to their closeness centrality values.

CLOSENESS CENTRALITY

Method: Reciprocal Geodesic Distances

		1 inCloseness	2 outCloseness	3 NinCloseness	4 NoutClosenes
38	38	25.167	13.333	43.391	22.989
6	6	20.417	8.983	35.201	15.489
35	35	18.783	10.833	32.385	18.678
32	32	18.167	14.500	31.322	25.000
51	51	17.583	12.283	30.316	21.178
21	21	17.167	12.333	29.598	21.264
7	7	16.917	13.167	29.167	22.701
2	2	16.833	13.083	29.023	22.557
53	53	16.500	11.533	28.448	19.885
11	11	16.367	11.667	28.218	20.115
30	30	16.250	8.567	28.017	14.770

Figure 4: Closeness centrality scores for several actors

Statistics

		1 inCloseness	2 outCloseness	3 NinCloseness	4 NoutClosenes
1	Mean	7.546	7.546	13.011	13.011
2	Std Dev	7.355	7.167	12.681	12.357
3	Sum	445.233	445.233	767.644	767.644
4	Variance	54.092	51.366	160.795	152.694
5	SSQ	6551.279	6390.494	19474.670	18996.713
6	MCSSQ	3191.403	3030.618	9486.929	9008.971
7	Euc Norm	80.940	79.941	139.552	137.829
8	Minimum	0.000	0.000	0.000	0.000
9	Maximum	25.167	25.333	43.391	43.678
10	N of Obs	59.000	59.000	59.000	59.000

Network in-Centralization = 62.35%
Network out-Centralization = 62.94%

Figure 5: Distribution of actor's closeness centrality scores

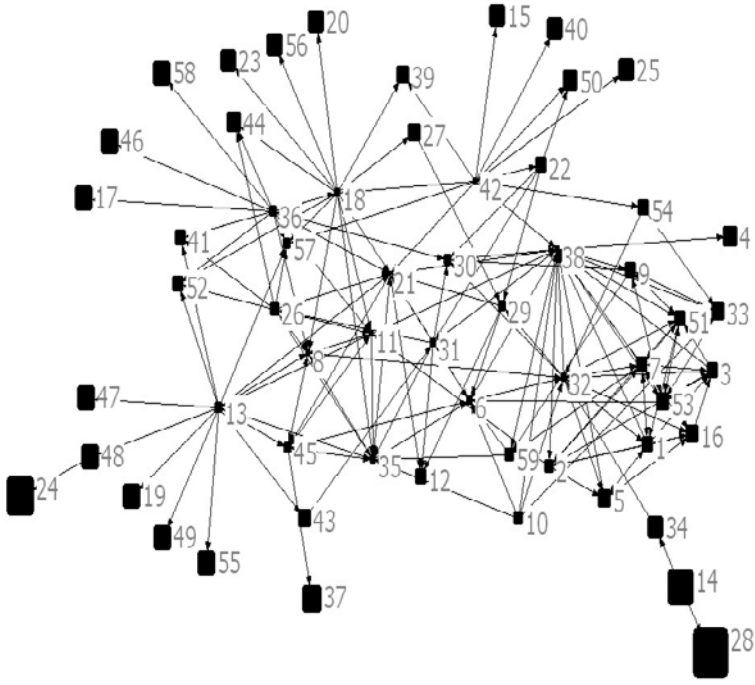

Figure 6: Relationships between actors based on their closeness centrality

Betweenness

Betweenness centrality considers the position of an actor as being in a favored position to the extent that the actor falls on the paths between other pairs of actors in the network. In other words, the more people depend on an actor to make connections with other people, the more power the actor has.

In Figure 7, actor # 38 has the highest betweenness centrality, followed by actor # 32 and # 21. From descriptive statistics (Figure 8), it can be seen that the values of betweenness centrality in the network vary from 0 to 233.128 with a coefficient of variation (standard deviation divided by the mean) equals to 2.054. Despite the large variations in the values of betweenness centrality, the value of the overall network centralization is very low (6.25%). This makes sense, since more than half of ties occur without the help of mediation. Figure 9 shows the sociogram based on

betweenness centrality. Sizes of the nodes are proportional to their centrality values.

FREEMAN BETWEENNESS CENTRALITY

		1 Betweenness	2 nBetweenness
38	38	233.128	6.813
32	32	216.365	6.323
21	21	149.598	4.372
35	35	83.196	2.431
2	2	76.639	2.240
29	29	75.876	2.217
6	6	61.165	1.787
59	59	56.658	1.656
11	11	52.466	1.533
31	31	45.333	1.325
45	45	44.060	1.288
8	8	42.333	1.237

Figure 7: Betweenness centrality scores for several actors

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1 Betweenness	2 nBetweenness
1	Mean	22.733	0.664
2	Std Dev	46.698	1.365
3	Sum	1364.000	39.860
4	Variance	2180.681	1.862
5	SSQ	161849.141	138.213
6	MCSSQ	130840.883	111.734
7	Euc Norm	402.305	11.756
8	Minimum	0.000	0.000
9	Maximum	233.128	6.813
10	N of Obs	60.000	60.000

Network Centralization Index = 6.25%

Figure 8: Distribution of actor's betweenness centrality scores

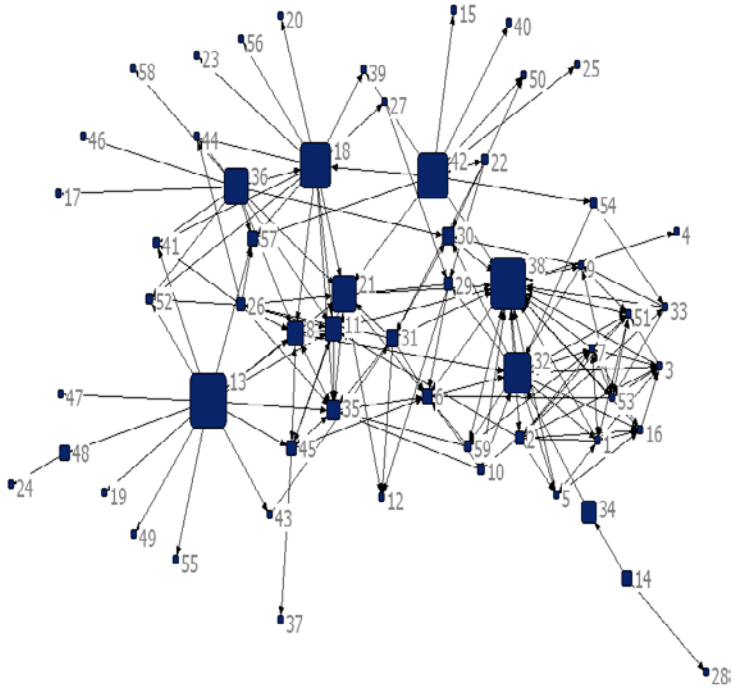

Figure 9: Sociogram indicates the relationships between actors based on their betweenness centrality

Reciprocity

Reciprocity shows the interrelationships between pairs of actors. In the network, the double-headed arrow indicates the existence of a reciprocal relationship where people give and receive information at the same time. This type of relationship is closer to the information (knowledge) sharing between actors. On the other hand, one-way relationship, showed by single-headed arrows in the network, indicates a transfer of information or knowledge from an actor to another actor. To improve collaboration among employees, the reciprocal relationship is more preferable than the one-way relationship.

Figure 10 shows a reciprocal relationship in Winda Sari employees. Actors who do not have a reciprocal relationship are intentionally removed

to simplify the diagram. As shown in this picture, the reciprocal relationships are focused on a few actors, namely actors # 7, # 35, and # 38.

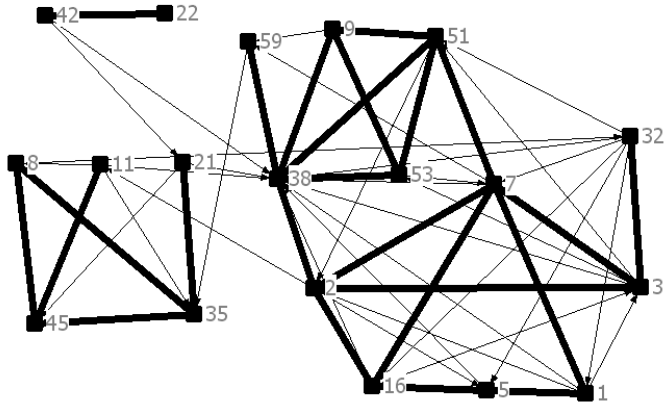

Figure 10: Diagram shows reciprocal relationships (thick lines) between actors

Cohesive Subgroups

A network often has one or more subgroups or cliques. A clique on a network has members who have a closer relationship to each other than their relationships with other actors who are not members of the group. A clique can have different norms of the overall network.

Figure 11 shows four cliques in Winda Sari employees. The clique participation score (Figure 11) indicates the proximity of an actor to a clique. An actor who has clique participation score equal to one means that the actor is the member of the clique, while a score less than one indicates that the actor is not the member.

In Figure 11, actor # 2 has clique participation score of one in cliques 1 and 2, which means that the actor belongs to clique 1 and 2. The same thing happened to actor #7 who has a score of one in cliques 1 and 2. Actor #3 has a score of one in clique 1, but only has a score of 0.667 in clique 2. Thus, actor # 3 belongs to clique 1, but not in clique 2.

Interesting to note that of the four cliques, only clique 4 contains actor #38 who is the actor with the highest centrality. Clique 4 has other members, namely actors #9, #51 and #53. This means that though actor #38 has a good position in the network, however the actor prefers to have closer relationships with actors #9, #51 and #53. In addition, the four cliques do not include the owners, namely actor #12, #6, and #4, except actor #35. Similarly, actor #21 (the quality control manager) also is not a member of the cliques.

```
CLIQUES
----------

4 cliques found.

   1:  2 3 7
   2:  2 7 16
   3:  8 35 45
   4:  9 38 51 53

Clique Participation Scores: Prop. of
clique members that each node is
adjacent to

          1     2     3     4
       ----- ----- ----- -----
   1  0.333 0.333 0.000 0.000
   2  1.000 1.000 0.000 0.250
   3  1.000 0.667 0.000 0.000
   4  0.000 0.000 0.000 0.000
   5  0.000 0.333 0.000 0.000
   6  0.000 0.000 0.000 0.000
   7  1.000 1.000 0.000 0.250
   8  0.000 0.000 1.000 0.000
   9  0.000 0.000 0.000 1.000
  10  0.000 0.000 0.000 0.000
```

Figure 11: Calculation indicates four cliques in the network

Conclusions

The above analysis has showed the use of SNA in analyzing and mapping the patterns hidden in informal interactions. The management of organization very often does not know the presence of the patterns.

Analysis using SNA concluded that the relationship between actors in Winda Sari is weak. Several factors support to this conclusion.

First, relationships in the network are heavily relying on to particular actors. Second, one-way relationships are more dominant than

the reciprocal relationships. Finally, there is the presence of some clique or subgroup with a limited number of members. The patterns of relationships like that, of course, less support to better collaboration.

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