Communication Networking in Chain Supply Information Management Among Indonesian MSMEs

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Abstract: *Indonesian tempeh micro, small, and medium enterprises (MSMEs) establish communication networks to address soybean raw materials and distribution challenges during the COVID-19 outbreak. This study aims to analyze the communication network structure among 204 tempeh entrepreneurs through centrality and actor-level analysis. The findings reveal that within the network structure, nodes serve as bridges, hubs, and cut points among entrepreneurs in raw materials and product distribution issues. The established communication network reflects a complex cybernetic pattern involving centrality and actor participation. The Sahabat Pengrajin Tempeh Pekalongan (SPTP) Indonesia network is centralized without isolation.*

Keywords: *centrality, communication network, MSMEs, network structure*

Abstrak: *Usaha Mikro, Kecil dan Menengah (UMKM) tempe di Indonesia membangun jaringan komunikasi untuk mengatasi tantangan bahan baku dan distribusi kedelai selama wabah COVID-19. Penelitian ini bertujuan untuk menganalisis struktur jaringan komunikasi di antara 204 pengusaha tempe melalui analisis sentralitas dan tingkat aktor. Temuan penelitian mengungkapkan bahwa dalam struktur jaringan, simpul berfungsi sebagai jembatan, titik sentral, dan titik potong di antara para pengusaha dalam masalah distribusi bahan baku dan produk. Jaringan komunikasi yang terbentuk mencerminkan pola sibernetik yang kompleks yang melibatkan sentralitas dan partisipasi aktor. Jaringan Sahabat Pengrajin Tempeh Pekalongan (SPTP) Indonesia terpusat tanpa isolasi.*

Kata Kunci: *jaringan komunikasi, sentralitas, struktur jaringan, UMKM*

The COVID-19 pandemic, which emerged globally in 2019, significantly impacted various sectors, particularly the economy. This economic disruption affected not only domestic markets but also global economies, pushing many countries into recession. In response, nations are implementing national economic recovery plans to mitigate the pandemic's effects. The effectiveness of these recovery efforts is crucial for accelerating recovery and fostering future economic development (Prohorovs, 2020, p. 14).

Indonesia's economic growth was -5.32 percent in the second quarter of 2020 and -3.49 percent in the third quarter, attributed to the COVID-19 pandemic (Badan Pusat Statistik, 2021). Due to unstable conditions, this global economic crisis poses significant challenges for micro, small, and medium enterprises (MSMEs). A rapid survey by LIPI in May 2020

revealed that 94.69 percent of businesses experienced a drop in sales, with declines exceeding 75 percent, placing many at risk of closure. Furthermore, 47.13 percent of businesses reported surviving for only one week to several months (Kurniati, 2021).

Since March 2020, the Indonesian government has implemented the bantuan langsung tunai (direct cash assistance) program to support the national economy amid the COVID-19 pandemic. Over 10 million MSME entrepreneurs have received IDR 2.4 million in assistance, with additional funds to be distributed in phases to the remaining entrepreneurs (Kementerian Keuangan Republik Indonesia, 2020, p. 32). In addition to MSME support, the government offers direct cash assistance through BPJS Ketenagakerjaan (Social Security Administrator for Employment), cash and food social assistance through the program keluarga harapan (family hope program), and kartu prakerja (pre-employment cards).

In developing countries, MSMEs significantly influence economic growth (Prasetyo, 2020, p. 475). MSMEs are vital drivers of economic development, as they create employment opportunities, enhance living standards, and reduce poverty (Zeb & Ihsan, 2020, p. 2). In Indonesia, MSMEs represent a rapidly growing sector, with approximately 62.9 million units spanning agriculture, livestock, processing, trade, services, and communications. MSMEs play a strategic role in the national economy, with 64,194,057 enterprises reported in 2018, employing around 116,978,631 individuals (Hardilawati, 2020, p. 92).

This sector has demonstrated resilience during economic crises, indicating its potential for further development through appropriate policies and institutional support (Syarief, 2020, p. 21). Local Indonesian products are competitive with foreign goods, as evidenced by their acceptance in the global market. Indonesia boasts abundant natural resources, from Sabang to Merauke, that communities can utilize as raw materials. One significant resource is soybeans. They are versatile crops that thrive in various soil types, provided water and air systems are properly managed.

Tempeh craftsmen utilize 30 to 200 kilograms of soybeans daily as their primary ingredient. The use of machinery significantly impacts both the efficiency and quality of the tempeh produced. Access to information regarding raw material sourcing and marketing is crucial for their operations. To address these needs, members of the tempeh craftsman organizations often interact and communicate through social media platforms like WhatsApp or in person. Tempeh craftsmen establish groups that create a communication network. This network features a structural aspect in which members exchange information. The intensity of communication and social interaction can be assessed by the frequency of exchanges between craftsmen, which helps to elucidate the flow of information within the tempeh craftsman network (Brown & Miller, 2020, p. 131).

Communication networks among groups are complex systems that

facilitate interaction, coordination, and information exchange among members. These networks are characterized by their structure, interaction patterns, and functional characteristics, which can significantly influence group dynamics and outcomes (Aditia & Hektanti, 2023, p. 92). Understanding these networks is crucial for improving communication efficiency, resolving conflicts, and enhancing group performance.

The structure of a communication network refers to the connections and interactions among its members. It can be analyzed in terms of network density, closure, and centrality. For instance, the Gembrong Street in Johar Baru, Jakarta, was identified as a central node in both rivalry and alliance networks, indicating its significant role in intergroup dynamics (Isnaini, Sarwoprasodjo, Kinseng, & Kholil, 2020, p. 265). Interaction networks can be event-based, capturing the temporal aspect of communication, which is crucial for understanding the dynamics of group interactions over time (Schecter, 2021, p. 35).

Communication networks serve various functions, such as information dissemination, decision-making, and conflict resolution. The effectiveness of these functions depends on the network's ability to facilitate clear and efficient communication among members (Rychwalska Talaga, Ziembowicz, & Jemielniak, 2021, p. 20). A communication network emphasizes the importance of establishing trust between service providers and service users to facilitate effective communication. The proposed model enhances trust accuracy, minimizes memory usage for storing trust values, and improves the packet delivery ratio compared to existing approaches (Ramu, Pandi, Lazarus, 2020, p. 6).

Communication networks can play a pivotal role in managing and resolving conflicts within and between groups. By mapping communication patterns, interventions can be designed to reduce misunderstandings and foster cooperation (Isnaini, Sarwoprasodjo, Kinseng, & Kholil, 2020, p. 263). Effective communication networks facilitate coordination among group members, enabling them to work towards common goals. The structure and dynamics of these networks can influence the group's ability to process information and make collective decisions (McCubbins & Weller, 2020, p. 6). Innovations in communication technology, such as wireless networks and peer-to-peer systems, have expanded the capabilities of group communication networks. These technologies allow for seamless information transfer and connectivity among diverse and distributed group members (Danton & Bushnell, 2023, p. 2). New methodologies, such as network coding and information synthesis, offer advanced ways to analyze and optimize communication networks. These approaches help in understanding the designed network structures to maximize information flow and group welfare (Filip, 2020, p. 3).

While communication networks are essential for group interaction, they can

also present challenges. For instance, unstructured communication may lead to inefficiencies or inaccuracies in belief formation, as seen in studies comparing different communication formats (Sun, Wu, Chiclana, Fujita, & Herrera-Viedma, 2021, p. 1290). Additionally, the complexity of network structures can sometimes hinder rather than help group dynamics, especially if not well-managed or understood. Therefore, ongoing research and technological advancements are crucial for optimizing communication networks to better serve group needs and objectives.

A proactive system refers to a mindset in which one actively seeks opportunities or takes action rather than waiting for things to come to them. In a business or economic context, it's akin to going out and capturing opportunities, being proactive in making deals, or responding swiftly to demand rather than waiting for things to happen (Matsuno & Kohlbacher, 2020, p. 94). Proactive market orientation (ProMO) is a critical component in the development and success of new smart connected products (SCP) (Shashishekar, Anand, & Paul, 2021, p. 499). It involves anticipating market needs and integrating these insights into product development and business model innovation (Wenninger, Rus, & Röglinger, 2022, p. 1399). Proactive market orientation, also known as personal or direct selling, involves direct oral presentations to one or more prospective buyers to facilitate a purchase (Brege & Kindström, 2020, p. 79). This process entails direct interpersonal contact, with sales presentations made to individuals or groups of potential buyers. The pick-up ball strategy involves service providers or product sellers contacting or visiting prospective customers directly (Ramadan & Al Baqi, 2023, p. 100), proving effective in achieving marketing targets (Perčić & Perić, 2022, p. 38). Contact can be established via telephone or direct visits to customers' homes or businesses. In addition, the method for reaching direct selling can also be done using the following methods: (1) delivery services to facilitate customer access to products without the need for in-person visits, (2) using communication technology to leverage technological advancements to ease product offerings and sales, and (3) involving regular field visits to prospective buyers and customers (Chen & Chen, 2021, p. 825).

The outreach system has both advantages and disadvantages. Its benefits include precise targeting, the ability to attract prospective buyers, time efficiency for consumers, and detailed product classification. However, providers may face challenges, such as time consumption, energy expenditure, and transportation costs associated with outreach efforts (Vukasović, 2020, p. 31).

Previous research on communication networks demonstrates that the structural and dynamic relationships among actors critically influence group coordination (Josephs, Peng, & Crawford, 2022), conflict management (Haerter, Jamtveit, & Mathiesen, 2012), and the distribution of collective information (Goñi et al.,

2013). An actor's structural position, whether occupying hub, bridge, or broker roles, constrains information-flow capacity and affects the resilience and stability of communication architectures. Technological advances have increased the diversity and complexity of these networks, for example, through peer-to-peer architectures and the integration of digital information systems, while methodological innovations such as network coding have expanded the analytical toolkit for characterizing network structure and behavior. At the same time, empirical evidence indicates that unmanaged complexity in communication networks can lead to operational inefficiencies and distort inter-actor trust.

Within business communication research, ProMO foregrounds the importance of organizational initiative in anticipating customer needs and in establishing direct customer interactions; practices such as direct outreach or pick-up systems exemplify this orientation. Existing work on ProMO has largely focused on outcomes related to marketing performance and business innovation, and has paid comparatively little attention to the role of communication network structures, particularly within production-oriented MSMEs (Lamore, Berkowitz, & Farrington, 2013, p. 695). Consequently, the literature still presents a gap in integrating communication network analysis with proactive market orientation practices in community-based, production-focused MSMEs (Schulze, Townsend, & Talay, 2022, h. 198).

This research aims to identify the communication network structure among tempeh MSMEs in Sahabat Pengrajin Tempeh Pekalongan (SPTP) Indonesia, Tangerang. This branch was chosen because it has the most members in Indonesia. Therefore, it could describe the network and relationships of each actor that are formed more completely. Additionally, it investigates the actor dominance and network structure types, including components and nodes that serve as bridges, hubs, and cutpoints, in relation to the fulfillment of raw materials and sales information for distribution. The hub position reflects a high degree of centrality, indicating the capacity for broad information distribution (Everett & Borgatti, 2026, p. 83). Meanwhile, cutpoints illustrate the structural vulnerability of the network, as the loss of these actors can lead to communication fragmentation (Islami, 2021, p. 310). From a network marketing perspective, hub and bridge actors function as market connectors and information gatekeepers, determining the smooth distribution of raw materials and sales information (Monticone, 2024, p. 1510).

METHOD

This research employs communication network analysis to identify stable communication patterns among individuals within an organization. To understand the communication network and its roles, network analysis can be used to reveal the types of relationships or connections among individuals and groups through indicators, such as components, cliques, hubs, bridges,

cutpoints, and isolates (Eriyanto, 2014, p. 53). Furthermore, network analysis can identify actors' positions within the network. Centrality is used to investigate which actors are prominent and most influential within the network (Bonacich, 1987, p. 1172).

In this study, the researcher used a nominal population, in which respondents were limited to naming actors associated with the informants within a specific region. A total of 204 tempeh craftsmen were recorded in Tangerang Regency. To identify the actors, the researchers implemented a positional strategy, focusing on tempeh craftsmen who are members of the SPTP Indonesia organization. This included 118 craftsmen from Kenanga Village, Cipondoh Sub-district, and 86 craftsmen from Buaran Indah Village, Tangerang Sub-district, both located in Tangerang Regency. The researchers have established operational definitions to achieve the research objectives, as seen in Table 1.

Data collection was conducted through structured interviews using questionnaires with samples. The questionnaire includes several semi-open and closed questions that allow respondents to express their perspectives, and researchers also provide answer choices aligned with the research concept. In addition, data collection was carried out through a literature study, using files relevant to the problem to be analyzed.

Data analysis was conducted using descriptive analysis and sociometric analysis. This analysis technique was used to identify the group structure and individual positions within the communication network among tempeh artisan actors in the SPTP Indonesia organization. This descriptive analysis was chosen to describe the relationship between actors (tempeh craftsmen) in fulfilling soybean raw materials and information on the sale of tempeh production results. Furthermore, sociometric analysis was used to show the flow of information about the fulfillment of

Table 1 Operational Definition

Concepts	Fulfillment of Soybean Raw Materials	Sales Information of Tempeh
Indicator(s)	Actor/s (node), link (edge), component, clique, bridges, hubs, cutpoints, isolate. Degree centrality (closeness centrality, betweenness centrality, eigenvector centrality)	Actor/s (node), link (edge), component, clique, bridges, hubs, cutpoints, isolate. Degree centrality (closeness centrality, betweenness centrality, eigenvector centrality)
Operational definition	Communication network structure: the presence of structural relationships between individuals within an organization or group, as established among tempeh craftsmen.	Communication network structure: the presence of structural relationships between individuals within an organization or group, as established among tempeh craftsmen.
Actor level	Identification of important actors in the network that do not refer to just one actor, but are spread across several actors that are intertwined among tempeh craftsmen through: degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality.	Identification of important actors in the network that do not refer to just one actor, but are spread across several actors that are intertwined among tempeh craftsmen through: degree centrality, closeness centrality, betweenness centrality, and eigenvector centrality.
Scale	Organization	Organization

Source: Primary Data (2024)

information on the issue of raw materials and the marketing of tempeh craftsmen's production results.

Coding was done by creating a matrix with rows and columns representing the relationship and the intensity established. The first column and row are filled with the names of the actors who are respondents, the next rows and columns are filled with binary numbers, namely the number 0, which symbolizes that there is no relationship established between actors, and the number 1, which symbolizes the existence of a relationship established between actors. Meanwhile, in the second matrix, it identifies the intensity of the relationship that is formed, in this case the researcher provides a scale of 1 to 3 which symbolizes the number 1 as a form of intensity of a relationship that rarely interacts, the number 2 which is interpreted as a form of intensity of a relationship that often interacts, and the number 3 which describes a form of interaction that is very frequent.

The data were processed into a sociogram using UCINET 6. The results of data processing using UCINET software form lines, called links, which indicate relationships among tempeh craftsmen in the SPTP Indonesia, Tangerang Regency branch. Using the links, an analysis is then carried out to identify the actors that serve as components, cliques, bridges, hubs, cutpoints, and isolates.

FINDINGS

Formation of Communication Network in SPTP Indonesia

An issue is one of the points that can refer to a problem or discussion in a communication network that occurs from a particular proximity. This proximity (tempeh craftsmen) enables them to communicate with each other, who share the same concerns about particular issues. In this research, the issue is related to the soybean raw materials and tempeh sales distribution. Table 2 shows the distribution of soybean raw materials among craftsmen.

Bridges are links (edges) that connect two separate groups in a network. In the communication network of tempeh craftsmen in the SPTP Indonesia organization, the raw-material links described as bridges are shown in Figure 1. Tempeh craftsmen who join the SPTP Indonesia and serve as the raw material providers communicate actively within the organization.

Sales distribution is an issue that can cause concern to tempeh craftsmen. Tempeh craftsmen want to sell their products at prices that align with expectations and are easy to attract buyers (consumers). Consumers, in general, apart from middlemen, also buy

Table 2 Communication Network Actors in Raw Material Issues

No.	Actor	Number of People
1	Tempeh craftsmen who have joined the SPTP Indonesia	185
2	Craftsmen who also act as suppliers of raw materials and have joined the SPTP Indonesia	19

Source: Primary Data (2024)

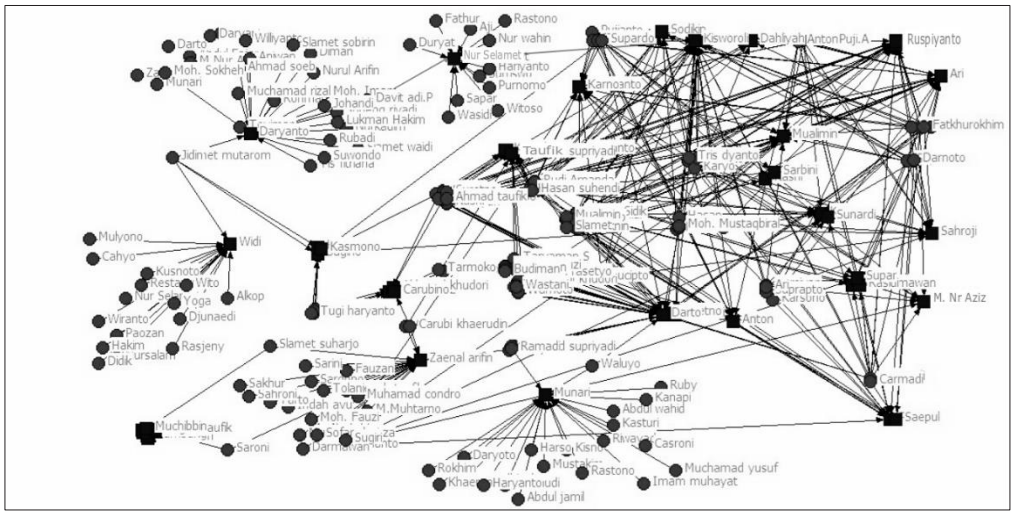

Figure 1 Distribution of Information Related to Soybean Raw Material Issues in the SPTP Indonesia
Source: Primary Data (2024)

retail. Sales in the communication network of tempeh craftsmen who are members of the SPTP Indonesia involve both tempeh craftsmen and those who also act as middlemen, as shown in Table 3.

Sales information is a social process carried out by an individual, group, or organization, to obtain something they need. Through this information, the craftsmen can exchange the results of production in the form of tempeh with a sum of money to meet their living needs. Sales information which is important for tempeh craftsmen is obtained directly from the middlemen. The middlemen apply a ball-picking system (pro-active market orientation) to tempeh craftsmen who want to sell their product. The ease of this information unconsciously makes the craftsmen feel that they no longer need to get information because the tempeh craftsmen have asked directly to the craftsmen who are also middlemen, the things the craftsmen are worried about. The dissemination of information within the communication network of tempeh craftsmen who are members of the SPTP Indonesia, Tangerang Regency branch, is illustrated in Figure 2.

Figure 2 shows a marketing communication structure composed of several subgroups. Several actors appear to occupy central positions with a high number of connections, such as Taufik, Darto, and Saepul, who serve as the primary centers of interaction within the network. The dominance of the main components and the formation of cliques indicate a strong structural cohesion within the SPTP Indonesia network. In addition, certain actors function as bridges between clusters, thereby playing a crucial role in maintaining the interconnectedness of the marketing

Table 3 Communication Network Actors in the Issue of Distribution Sales Information

No.	Actor	People
1	Tempeh craftsmen who have joined the SPTP Indonesia	185
2	Craftsmen who also act as middlemen who have joined the SPTP Indonesia	19

Source: Primary Data (2024)

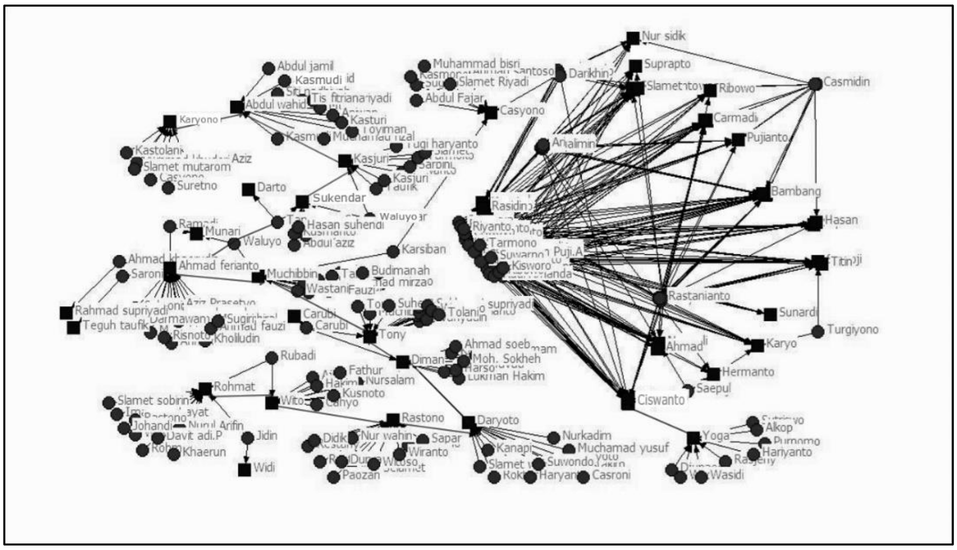

Figure 2 Distribution of Information Related to Sales Information in the SPTP Indonesia
Source: Primary Data (2024)

network. The network also demonstrates variations in the level of cohesion among groups with some clusters exhibiting denser and more intensive relationships compared to others.

SPTP Indonesia Communication Network Structure

The analysis of the communication network structure was carried out with component indicators, cliques, bridges, hubs, cutpoints, and isolates in two issues, namely the fulfillment of raw materials and information on sales and distribution. The results show the component indicators regarding the fulfillment of raw materials. Grouping of actors (nodes) that have at least one link in the network. Based on UCINET analysis of the communication network of tempeh craftsmen who have joined the SPTP Indonesia organization, 204 actors were identified as components.

As seen in Figure 3, component 1 has 154 nodes (75.5 percent of the total network), indicating that it is the largest component and is the main core of the communication network. Component 2 has 37 nodes (18.1 percent), component 3 has 12 nodes (5.9 percent), and component 4 has only 1 node (0.5 percent), which means component 4 is an isolated node.

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COMPONENTS
--------------------------------------------------------------------------------

Input network dataset:               untitled (C:\Users\ASUS\Pictures\untitled
Output component partition:          untitled-comppart (C:\Users\ASUS\Pictures\untitled-comppart
Output node-component indicator matrix: untitled-compsets (C:\Users\ASUS\Pictures\untitled-compsets

--------------------------------------------------------------------------------
Matrix untitled
--------------------------------------------------------------------------------

Component Sizes

              1       2
           Size    Prop
        ------- -------
    1 1     154   0.755
    2 3      37   0.181
    3 4      12   0.059
    4 2       1   0.005

4 rows, 2 columns, 1 levels.
```

Figure 3 Component Analysis on Raw Material Issues
Source: Primary Data (2024)

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COMPONENTS
-------------------------------------------------------------------------------

Input network dataset:                untitled (C:\Users\ASUS\Pictures\Ucinet Pemasaran Hasil Produksi Tempe\untitled
Output component partition:           untitled-comppart (C:\Users\ASUS\Pictures\Ucinet Pemasaran Hasil Produksi Tempe\untitled-comppart
Output node-component indicator matrix: untitled-compsets (C:\Users\ASUS\Pictures\Ucinet Pemasaran Hasil Produksi Tempe\untitled-compsets

-------------------------------------------------------------------------------
Matrix untitled
-------------------------------------------------------------------------------

Component Sizes

            1      2
         Size   Prop
      ------- -------
    1 1    156  0.765
    2 2     27  0.132
    3 4     11  0.054
    4 3     10  0.049

4 rows, 2 columns, 1 levels.
```

Figure 4 Component Analysis on Production Sales Information
Source: Primary Data (2024)

As seen in Figure 4, component 1 has 156 nodes (76.5 percent of the total network). This shows that the majority of actors in the communication network remain connected to one another within a single large group. Component 2 has 27 nodes (13.2 percent), indicating a fairly significant group, but it is separated from the main component. Component 3 has 11 nodes (5.4 percent), indicating the presence of a small group that has no connection with other components. Component 4 has 10 nodes (4.9 percent), which is also a small group and isolated from the main network.

Meanwhile, with the clique indicator, namely a tighter grouping of actors compared to components, it means that cliques can be marked by the existence of complete and maximum actor relations. Based on the UCINET analysis with a minimum size of 3, several cliques have been formed in the communication network of tempeh craftsmen who have joined the SPTP Indonesia organization on the issue of raw materials and sales of production results.

The clique analysis using UCINET, as shown in Figure 5, revealed several cohesive subgroups within the communication network. Four cliques with a minimum size of three members were identified. The largest clique consisted of four actors, namely Taufik, Darto, Slamet, and Rudi, who were directly connected to one another. These findings indicate the presence of communication groups characterized by high levels of interaction intensity and cohesion within the analyzed social network.

Figure 6 shows a network visualization of a highly dense communication structure with a high level of connectivity (nodes) among actors. The network pattern reveals a concentration of relationships

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CLIQUES
-------------------------------------------------------------------------------

Minimum Set Size:                     3
Input dataset:                        untitled (C:\Users\ASUS\Pictures\untitled)

WARNING: Valued graph. All values > 0 treated as 1
NOTE: Directed graph. You may prefer to symmetrize first.
2 cliques found.

   1:  Ruspiyanto Sahroji Slamet Darnoto
   2:  M.Nr Aziz Ari Fatkhurokhim
   3:  Taufik Darto Slamet Rudi
   4:  Kisworo Moh. Mustaqbiral Darto
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Figure 5 Clique Analysis on Raw Materials Issue
Source: Primary Data (2024)

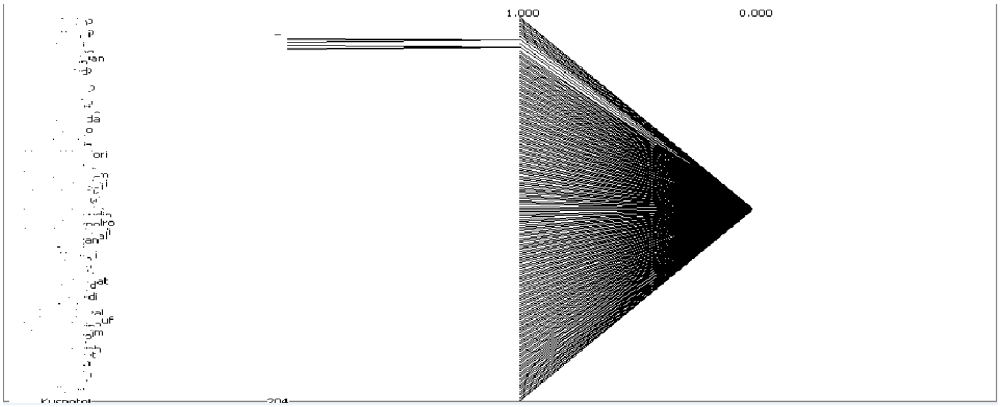

Figure 6 Node in Communication Network on Raw Materials Issue
Source: Primary Data (2024)

around several central nodes, indicating the presence of dominant actors within the communication flow. Furthermore, the converging pattern suggests the possibility of a core–periphery structure, in which a small number of actors possess substantially higher connectivity compared to other members of the network

In the production sales information issues, a different clique pattern was identified. Figure 7 revealed the presence of cohesive subgroups within the marketing network of tempe production. Two main cliques with a minimum size of three members were identified. This finding indicates the existence of groups of business actors who maintain direct and intensive relationships with one another. Several actors appeared in more than one clique relationships, suggesting their central role in maintaining the interconnectedness of the marketing network.

The dense black triangles on the right side of the figure indicate high connectivity in the network, especially within the main clique as show in Figure 8. The looser or empty areas on the left side indicate that there are actors who are less connected in the network or have only limited connections with other nodes. The presence of lines connecting certain nodes indicates the pattern of connections between actors in the network, with some actors being more connected than others.

Hubs are actors with the most connections in the network. It can be seen that the hub in the tempeh craftsmen communication network on the issue of raw materials is actor Ruspiyanto. Ruspiyanto became the actor with the most connections

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CLIQUES
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Minimum Set Size:                       3
Input dataset:                          untitled (C:\Users\ASUS\Pictures\Ucinet Pemasaran Hasil Produksi Tempe\untitled)

WARNING: Valued graph. All values > 0 treated as 1
NOTE: Directed graph. You may prefer to symmetrize first.
2 cliques found.

   1:  Ciswanto Rasidin Dahliyah
   2:  Ciswanto Pujianto Rastani
   3:  Ciswanto Ribowo Carmadi
   4:  Ciswanto Hermanto Saepul
   5:  Hasan Bambang Titin
   6:  Hasan Ahmad Titin
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Figure 7 Clique Analysis on Production Sales Information Issue
Source: Primary Data (2024)

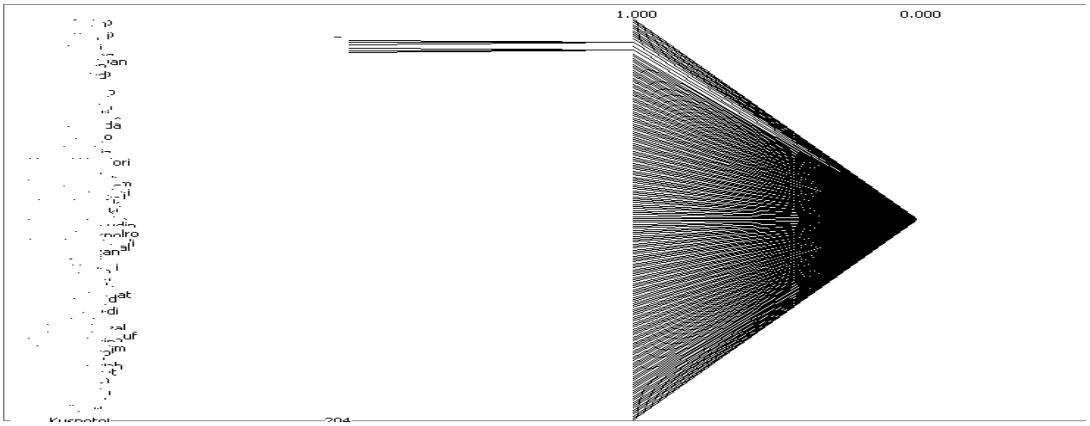

Figure 8 Clique in Communication Network on Production Sales Information
Source: Primary Data (2024)

because he was able to reach actors in the SPTP Indonesia organization. In addition, he established relationships with actors who served as information centers in other small networks, such as M. Nr Aziz, Saepul, Taufik, Sahroji, dan Mualimin. In the issue of selling production results, Ciswanto was the actor with the most connections, or the most hubs. The existence of a fairly intense relationship made the relationship between tempeh craftsmen quite good.

DISCUSSION

Actor Centrality Levels In SPTP Indonesia Communication Networks

Communication network studies can be seen in the overall network structure (complete networks) and in a focus on actors (single). Actors can be individuals, while networks consist of relationships between people. It can also be organizations and institutions. Actors can be seen in their relationships with other actors in a network as a whole. In a communication network, especially in an actor, it is not presented to describe only one or two actors, but all actors in the network (the complete network).

The existence of actors as bridges and hubs demonstrates their strategic function in connecting different subgroups within a network. This suggests that the SPTP Indonesia network structure exhibits a distribution of communication power that is centralized among certain actors. In the isolate indicator, a node that does not have a single edge to other nodes in a network. In the analysis of the communication network of tempeh craftsmen regarding sales information on production results in Figure 2, there are no isolated actors. Although only one link, all nodes are interconnected with each other, or there is no separator in one of the actors.

The absence of isolation in sales issues indicates that every actor has at least one connection within the communication network. In modern network cohesion studies, this condition reflects relatively stable structural integration, allowing information diffusion to proceed without significant obstacles (Everett & Borgatti, 2026, p. 83). This high level of connectedness demonstrates the presence of inclusive mechanisms within the business community, thereby strengthening the

network's resilience to external disruptions (Sholikhah, 2021, p. 139). In the context of marketing communications, full integration between actors increases the effectiveness of direct outreach systems and accelerates responses to market dynamics (Islami, 2021, p. 311). This means that the SPTP Indonesia network demonstrates adaptive capacity in maintaining the continuity of economic information flows.

The dominance of several actors in degree, closeness, betweenness, and eigenvector centrality indicates a stratification of influence within the SPTP Indonesia communication network. Recent literature explains that degree centrality reflects an actor's visibility within the network, while betweenness centrality indicates the ability to control the flow of information between groups (Ilyas & Radha, 2011, p. 2). Eigenvector centrality indicates connections with other influential actors, thereby strengthening the actor's structural legitimacy (Hauck, Schmidt, & Werner, 2016, p. 50). In contemporary marketing communications, actors with high centrality often function as key influencers in distribution systems and economic decision-making (Litterio, 2017, p. 360). Thus, the centrality structure in SPTP Indonesia indicates that control over raw material and sales information is not evenly distributed but concentrated among strategic actors.

Furthermore, important actors in a network do not refer to only one actor, but are spread across several actors (Eriyanto, 2014, p. 34). Therefore, there are several centrality positions, including degree centrality, closeness, betweenness, and eigenvector. The determination of the actor's characteristics and roles of SPTP Indonesia based on centrality positions. The communication network within the SPTP Indonesia organization comprises 204 actors across indegree and outdegree. Level degree centrality and closeness use a scale of 0 to 3. The centrality pattern is described in Table 4.

The data in Table 4 show that Ruspiyanto has high popularity in the communication network regarding raw material fulfillment. This indicates that the interaction established is limited to craftsmen and raw material providers. This can be considered reasonable because raw material providers are the source of information for all; craftsmen have sufficient information and raw materials, even though they communicate only with a few people. Meanwhile, on the issue of selling production results, Tarmono is the actor in the outdegree who most often contacts other actors, with a value of 72, while Ciswanto is the most popular actor in the indegree, with a value of 52. Ciswanto is the person most often contacted by craftsmen to discuss information on selling production results.

Closeness centrality describes the length of an actor (node) to other actors in the network. Closeness can be measured by the number of steps (paths) an actor can contact or be contacted by other actors in the network. Closeness centrality is obtained by dividing the number of shortest paths of one actor to another actor in a network.

Table 4 Centrality Pattern

Centrality	Raw material issues	Production Sales Information
Degree	The actor with the highest degree centrality category is Ruspiyanto with an indegree value of 42 and an outdegree value of 77. Meanwhile, those with the lowest value are 110 actors with the same value as the indegree and outdegree values of 0.493.	Tarmono is the actor in outdegree who most frequently contacts other actors with a value of 72, while Ciswanto is the most popular actor in indegree with a value of 52. At the lowest popularity of the communication network, there are 156 actors.
Closeness	The actor who has the highest level of closeness centrality is only 1 M. Nur Aziz, with an incloseness value of 0.810 and an outclloseness of 0.590. This actor has his own consumers, making it easier for him to interact with the craftsmen. While the level of closeness centrality with the lowest value with an incloseness value of 0.490 and an outclloseness of 0.493, is owned by 101 actors.	The highest level of closeness centrality is Ciswanto, with an incloseness value of 0.865 and an outclloseness of 0.595. While the level of closeness centrality with the lowest value with an incloseness value of 0.490 and an outclloseness of 0.493, is owned by 64 actors.
Betweenness	In this network, the actor with the highest betweenness centrality is Taufik, with a value of 606,222. The actor with the lowest betweenness centrality is 142.	It is known that the actor who is in the highest betweenness centrality position is actor Hasan with a value of 382,673. Meanwhile, the actor who has the lowest betweenness centrality is 172 actors.
Eigenvector	The analysis conducted in this study shows that the actor with the highest value in eigenvector centrality is Kisworo with a value of 0.436. Meanwhile, the lowest actor with a weight value of 0 is 116.	The actor with the highest value on eigenvector centrality is Hasan with a value of 0.321. Meanwhile, the lowest actor is 74.

Source: Primary Data (2024)

In Table 4, the highest value is achieved by actor M. Nur Aziz (incloseness: 0.810; outcloseness: 0.590). This indicates that the level of closeness to other actors is relatively small. While in closeness centrality, the smaller the value, the better. A small value can show the closeness of the actor (node) to other actors in a network. As a provider of raw materials and already having its own consumers, this makes it easier for M. Nur Aziz to interact with craftsmen.

Table 4 shows that Taufik, as a craftsman and raw material provider, becomes the determining actor or actor with information or message control. The actor with the lowest betweenness centrality is the craftsman who communicates only with craftsmen (raw material providers), so this actor does not act as a liaison connecting one actor to another. Betweenness centrality shows the position of an actor as an intermediary (betweenness) of the relationship between one actor and another actor in a network. To see the actor (node) can contact other actors, can contact them directly, or must go through a certain actor intermediary. This betweenness centrality is very important because it is related to the control and manipulation of information. Actors who serve as intermediaries to other actors can determine an actor's membership in the network. People who act as intermediaries have control over information. If depicted in a communication network, the actor's

value is above zero (0). The higher the betweenness value, the more important the value of an actor. The zero value (0) occurs because no interaction is carried out by the craftsmen. Craftsmen feel that the information provided by the craftsmen who also act as direct raw material providers to them is sufficient.

Based on the analysis of actors by centrality level, it can be seen that the actors with the highest centrality values are dominated by Ruspiyanto, M. Nur Aziz, Taufik, Kisworo, Zainal Arifin, Ciswanto, Hasan, Casmidin, and Rubadi. This shows that these actors have an important role in the communication network of tempeh craftsmen in the SPTP Indonesia organization. These actors not only act as tempeh craftsmen but also act as providers of raw materials and middlemen. Their role as tempeh craftsmen, while also serving as providers of raw materials and middlemen, connects the relationships in the study.

Communication Network Model in SPTP Indonesia Organization

Based on the perspective of the cybernetic tradition, the communication network formed in the SPTP Indonesia organization indicates that communication is a complex system. The research findings show a pattern with indicators of actor contribution in the formation of the network and centrality on the two main issues of raw material fulfillment and sales of production results. The pattern shows the degree of closeness, dominant actors, and information traffic on the issue of raw material fulfillment and sales of production results.

Furthermore, the SPTP Indonesia organization acts as a hub that connects various actors in the communication network, both in fulfilling raw materials and disseminating production information. Figure 9 shows a communication network model that connects the SPTP Indonesia organization with various elements. The SPTP Indonesia communication network model has three important components: (1) centrality in the network (left side), (2) SPTP Indonesia organization and issues (middle side), and (3) network structure (right side). The structure of the communication network model connects three main elements, namely the SPTP Indonesia organization, the issue of fulfilling soybean raw materials, and the issue of sales information on production results.

The network structure (right side) measures actors' contributions to components and determines the interactions among elements in the network. Actors, or nodes, represent individuals or organizations involved in the network. Centrality in the communication network is shown in the model on the left. In Figure 9, centrality shows the influence of an entity in determining the distribution of information and resources (such as soybean raw materials) in the network. The degree of centrality in the issue of soybean raw material fulfillment and production sales indicates the number of direct connections owned by the entity (actor). Betweenness centrality in the findings shows the frequency of the entity (actor) being an intermediary in communication within the SPTP Indonesia organization. The degree of

closeness between entities or actors with all network members is indicated by closeness centrality. The influence of connectivity in building influence between actors is shown in the contribution of eigenvector centrality.

In recent communication network analysis literature, large components indicate a high level of integration, whereas cliques indicate a concentration of intense, repeated interactions (Everett & Borgatti, 2026, p. 80). This structure reflects the balance between cohesion and potential network fragmentation, which is an important indicator of community network stability (Rosadi, 2020, p. 29). In the context of marketing communications, clique structures can be understood as micro-network coordination that accelerates the diffusion of information on pricing, supply, and distribution (Permana & Nugroho, 2023, p. 20). Thus, cliques in SPTP Indonesia networks reflect not only social proximity but also efficient mechanisms for economic communication.

The SPTP Indonesia communication network model demonstrates the characteristics of an open system characterized by interdependence among elements within the community supply chain. From a modern organizational network perspective, an integrated structure enables efficient information exchange and more stable collective coordination (Everett & Borgatti, 2026, p. 80). SPTP Indonesia's organizational position as a hub demonstrates an integrative function in reducing uncertainty in raw material distribution and product sales. Within the framework of strategic marketing communications, integration between actors within a single coordination center increases the effectiveness of market information distribution and strengthens community competitiveness (Wang, 2015, p. 69). Thus, this network model confirms that the successful distribution of information and resources within the tempeh artisan community depends on structural integration, the centrality of key actors, and the effectiveness of collective communication.

CONCLUSION

In the communication network of tempeh craftsmen in the SPTP Indonesia organization regarding sales information,

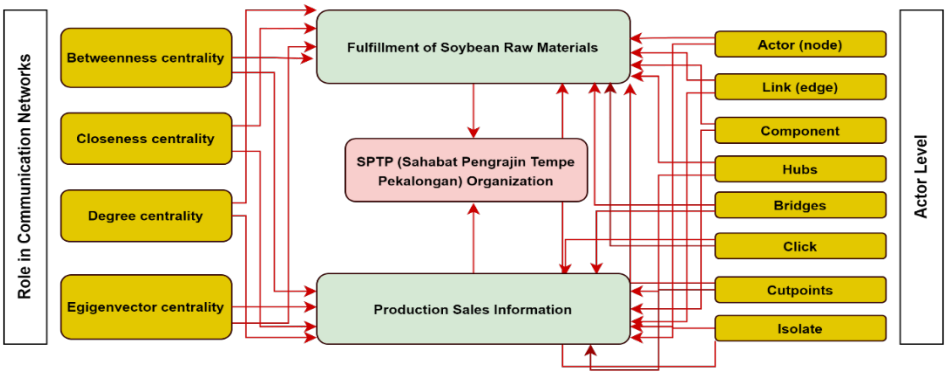

Figure 9 Communication Network Model of SPTP Indonesia
Source: Primary Data (2024)

it is not much different from that of raw materials. The actors who serve as tempeh craftsmen also act as middlemen. With the implemented outreach system, from 204 actors identified as components, it shows that the network structure that is positioned as a bridge, hub, and cutpoints is the tempeh craftsmen who act as middlemen and in addition there are also tempeh craftsmen actors (tempeh craftsmen who act as tempeh craftsmen) the existence of regional authority that is formed implicitly is known that there are no actors who act as isolates. Ciswanto and Hasan are the actors who dominate the tempeh craftsman network in the SPTP Indonesia organization in the issue of sales information on production results.

The SPTP Indonesia organization acts as the communication center and main hub in this network. Large soybean suppliers and main distributors serve as critical nodes for the smooth operation of the network. Tempeh craftsmen form a close sub-community (clique) to share information and resources. Soybean collectors or distribution intermediaries become bridges that connect various components in the network. E-commerce platforms or social media can be used to increase connectivity between actors and reduce isolation in the network. In further research, more specific, in-depth observations should be made regarding the communication network of tempeh craftsmen by paying attention to the novelty or findings of the study. Further researchers should use different communication network discussion issues to obtain research results with new perspectives, such as in marketing communication.

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