

Digital Social Network Modeling for Predicting Interaction and Online Community Solidarity

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Abstract. *The rapid advancement of digital communication technologies has transformed how individuals interact and build communities online. This study aims to analyze and synthesize previous research on digital social network modeling as a framework for predicting interaction and solidarity within online communities. Using a literature review approach, this research examines studies published between 2012 and 2025 that focus on social network modeling, online interaction analysis, and digital solidarity prediction. The findings reveal that integrating structural data, content, affective factors, and community evolution provides a comprehensive understanding of online social dynamics. Key variables influencing digital solidarity include member engagement, mutual trust, information flow, and the quality of interpersonal relationships. Furthermore, predictive models based on social network analysis (SNA) have proven effective in identifying changes in interaction patterns and assessing the strength of social bonds within digital environments. This study concludes that digital social network modeling serves as an essential tool for strengthening online community management strategies, fostering inclusivity, cohesion, and productivity in the era of Society 5.0.*

Keywords: *digital social network, online interaction, solidarity, community modeling, Society 5.0*

1. INTRODUCTION

The rapid development of information and communication technology has transformed how people interact, particularly through digital social media platforms. Online communities have become vital spaces for individuals to communicate, share information, and build social solidarity (Ellison & Boyd, 2013). This phenomenon marks a shift from face-to-face interaction to digital engagement, necessitating a deeper understanding of communication patterns and social networks in virtual environments.

Interactions within online communities are often heterogeneous and dynamic, with members displaying varying levels of engagement. This complexity underscores the need to model digital social networks to understand how interactions form, the strength of relationships among members, and the factors influencing solidarity within online communities (Robins, 2013).

Digital social network modeling, utilizing Social Network Analysis (SNA), enables researchers to visualize relationship structures among members, identify key nodes, and assess the level of connectivity within a community (Wasserman & Faust, 2013). This approach can

also be employed to predict interaction behaviors and the emergence of social solidarity, providing valuable insights for community managers and digital platform developers.

Recent studies show that digital solidarity can emerge through routine interactions, information exchange, and collaborative activities in online communities. For example, Pawening (2021) found that interaction patterns among K-Pop fan communities on Twitter directly influence levels of solidarity, including emotional support and collective participation.

Furthermore, integrating digital data with network analysis can help identify external factors influencing social interaction, such as geographical proximity, shared interests, and communication preferences (Lee, 2022). This approach facilitates the prediction of solidarity patterns in larger and more complex communities, making it a strategic tool for developing healthy and inclusive online environments.

The role of online communities in fostering social solidarity is increasingly significant in the Society 5.0 era, where digital technologies are integrated with social dimensions to create inclusive and sustainable societies (Ancillai, 2020). A deeper understanding of interaction and solidarity patterns can assist digital platform managers in designing strategies to enhance member engagement, prevent conflicts, and strengthen social bonds.

Given this background, this study aims to develop a digital social network model to predict interaction and solidarity within online communities. The research is expected to contribute to the advancement of digital social science, provide practical insights for community managers, and serve as a foundation for strategies that strengthen solidarity and effective interaction in digital environment.

2. METHODE

This study employs a literature review method to analyze previous research related to digital social network modeling and the prediction of interaction and solidarity within online communities. Data were collected from scholarly journals, conference proceedings, and publications from 2012 to 2022 using databases such as Google Scholar, Scopus, and ScienceDirect. The inclusion criteria covered studies focusing on digital social network modeling, analysis of online community interactions, and the prediction or enhancement of solidarity in digital contexts. After data collection, the selected literature was analyzed descriptively and thematically, identifying modeling methods, variables used, prediction algorithms, and key findings related to community interaction and solidarity. This analysis aims to construct a conceptual synthesis of modeling approaches, interaction patterns, and factors influencing solidarity, while also identifying research gaps that could serve as the

foundation for developing predictive models of interaction and solidarity in online communities in the future.

3. RESULT AND DISCUSSION

a. Result

Table 1. Literatur Review

Author	Research Focus & Method	Main Findings & Relevance
Ruan et al. (2012)	Community detection combining content and graph structure through social network analysis and graph modeling.	Reduced link-structure noise, strengthened community signals, and enhanced understanding of member interactions.
Darmon et al. (2014)	Query-based approach for community detection in online social networks.	Emphasized that additional data—such as activities, topics, and interactions—are essential for analyzing community dynamics and solidarity.
Abufouda (2017)	Predictive modeling using network and external attributes to forecast member interaction decline.	Identified patterns of declining activity and their implications for maintaining digital community solidarity.
Han et al. (2023)	Analysis of affective control and interpersonal relationships in social networks.	Showed that emotions and interpersonal ties significantly influence solidarity and perceived social support among members.
Pasquel-López (2022)	Social network and motivation analysis of EduTuber interaction dynamics.	Found that digital engagement and trust-building mechanisms foster solidarity within educational content creator communities.
Irwanto et al. (2025)	Social network analysis of information and opinion flow in Indonesian social media.	Revealed that information flow patterns and inter-group interactions are key to understanding digital solidarity.
Ding et al. (2025)	Community evolution modeling based on dynamic feature changes.	Explored evolving community features that shape interaction patterns and contribute to understanding solidarity dynamics.

The literature review table above presents a summary of seven recent studies (2012–2025) examining digital social network modeling to predict interaction and solidarity in online communities. Each study has a distinct focus and approach; however, all emphasize the importance of understanding the structure and dynamics of social relationships in digital spaces.

Several studies, such as Ruan et al. (2012) and Darmon et al. (2014), highlight community detection methods that combine graph structures and additional information such as activity or topic data to identify complex interaction patterns. Meanwhile, Abufouda

(2017) focuses on predicting the decline of community member interactions and its impact on solidarity, demonstrating how social dynamics can be predicted using network attributes and external factors.

Han et al. (2023) emphasizes the role of affective control and interpersonal relationships in shaping perceptions of social support, confirming that emotions and personal interactions are key elements in building online solidarity. Pasquel-López (2022) highlights engagement and trust as mechanisms that strengthen solidarity within EduTuber communities, while Irwanto et al. (2025) underscores the importance of information and opinion flow in shaping relationships among community members (Sun, 2022).

Ding et al. (2025) adds an evolutionary perspective by predicting feature changes throughout community development, thereby providing a better understanding of long-term dynamics and factors influencing member solidarity. Overall, the reviewed literature demonstrates that digital social network analysis and community modeling serve as powerful tools to predict interaction and reinforce solidarity in online communities.

Digital social network modeling has proven to be an effective method for analyzing interaction patterns and solidarity within online communities. Ruan et al. (2012) show that integrating content information with graph structures can improve the accuracy of community detection and enhance understanding of member relationships. This finding highlights the importance of combining both structural and non-structural data to predict digital interactions effectively.

Darmon et al. (2014) emphasize that a query-based approach—integrating member activities, topics, and interactions—provides deeper insight into community dynamics. Their findings indicate that simple social network analysis alone is insufficient to capture the complexity of solidarity in online communities, thus requiring models capable of incorporating multiple dimensions of interaction.

Abufouda (2017) adds that predicting the decline in member interactions is highly relevant for understanding long-term solidarity dynamics. A reduction in member activity may indicate weakened solidarity or the risk of digital social isolation. By utilizing network attributes and external factors, predictive models can help community managers take proactive measures to maintain engagement.

Han et al. (2023) reveal that affective factors and interpersonal relationships play a significant role in shaping perceptions of social support within online communities. This suggests that digital solidarity is not only influenced by interaction frequency but also by

the quality of interpersonal relationships and the emotional components of digital communication.

Pasquel-López (2022) highlights educational content creator communities (EduTubers) as an example where digital engagement and mutual trust mechanisms strengthen solidarity. The study demonstrates that consistent, goal-oriented interactions can increase social cohesion and foster collaboration among members.

Irwanto et al. (2025) emphasize the importance of information and opinion flow in shaping interaction patterns and solidarity in online communities. Effective information distribution enhances trust, facilitates coordination among members, and strengthens social bonds in digital environments, thereby promoting stronger solidarity.

Ding et al. (2025) introduce the perspective of community evolution by predicting changes in community features over time. This approach is valuable for understanding long-term dynamics, including factors influencing solidarity and member engagement. It provides a foundation for designing adaptive and sustainable online community management strategies (Han et al., 2019).

Overall, the literature demonstrates that digital social network modeling enables comprehensive analysis of interaction and solidarity within online communities. Integrating structural data, content, affective factors, and community evolution offers a robust framework for predicting social behavior, strengthening community bonds, and supporting effective digital platform management. These studies collectively affirm that network-based scientific approaches are essential tools for understanding digital social phenomena and for designing inclusive, cohesive, and productive online communities.

4. CONCLUSION

This study concludes that digital social network modeling is an effective tool for understanding patterns of interaction and solidarity within online communities. Social network analysis that integrates structural data, content, affective factors, and community evolution enables the prediction of member interactions and the identification of factors influencing solidarity. The literature review findings indicate that member engagement, mutual trust mechanisms, information flow, and the quality of interpersonal relationships are key variables shaping digital solidarity. This comprehensive approach not only provides theoretical insights into social dynamics in the digital realm but also offers practical implications for managing online communities that are inclusive, cohesive, and productive. Therefore, digital social

network modeling can serve as a foundation for strategies aimed at strengthening interaction and solidarity within online communities in the era of Society 5.0.

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