Faculty of Social Sciences
University of Helsinki

Social Network Analysis for Communicative Planning Research

Applications, Advantages, and Limitations

Bokyong Shin

ACADEMIC DISSERTATION

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Helsinki 2021

Publications of the Faculty of Social Sciences 196 (2021)
Doctoral Programme in Social Sciences, Social and Public Policy

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Distribution and Sales:
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ISBN 978-951-51-7023-1 (print)
ISBN 978-951-51-7024-8 (online)
ISSN 2343-273X (print)
ISSN 2343-2748 (online)

Cover image by Bokyong Shin

Unigrafia
Helsinki 2021

Abstract

Many municipal governments today experiment with participatory initiatives to develop better governance and planning practices. They call for public, private, and civil society actors to engage in complex decision-making processes by integrating offline and online elements. While these inclusive practices, such as participatory budgeting, are becoming widespread, the processes themselves have often remained obscure. This introduces the risk that even good intentions of having more communicative and democratic planning turn into bad planning habits, which renew or introduce political biases and limit communications to those already most capable of expressing and carrying out their interests.

Against this backdrop, this thesis critically examines urban planning processes by applying social network analysis (SNA). The thesis has both societal and theoretical ambitions. By scrutinising participatory cases, the thesis contributes to more elaborated planning practices. As for its theoretical ambition, the thesis contributes to the discussion on democratic deliberation and social capital, two essential elements in urban planning, by blending SNA with communicative planning theory. On the one hand, communicative planning theory is an influential research strain that provides a critical framework for examining communicative processes. On the other hand, SNA is a long-standing field concerning the study of relational patterns, recently popularised in many disciplines. The thesis examines the critical roles of social capital and democratic deliberation and how they can be studied more systematically.

The thesis is composed of three peer-reviewed articles. Article 1 combined SNA with time-series analysis to make a novel contribution for assessing dynamic online deliberation processes. Article 2 is a comprehensive literature review to map the landscape of SNA in social capital research. Article 3 used a network model, called the exponential random graph model, to examine social capital determinants in an urban regeneration project. As argued in the synthesis of this dissertation, the results show

that SNA helps communicative planning research in terms of 1) network visualisation, 2) descriptive statistics, and 3) new network models. Empirical results of SNA also exemplify how practitioners can identify and better address ongoing problems during the planning processes. However, the thesis found critical limitations of SNA, restricting its use as a stand-alone method in planning research. SNA is well combined with other quantitative and qualitative methods in a mixed research design; thus, it could become an influential node in a network of planning research methods.

Tiivistelmä

Nykyisin monet kunnallishallinnot pyrkivät kehittämään hallinto- ja suunnittelukäytäntöjään kokeilevien, osallistavien hankkeiden avulla. Julkisia, yksityisiä ja kansalaisyhteiskunnan toimijoita pyydetään osallistumaan monitahoisiin päätöksentekoprosesseihin perinteisten ja verkkopohjaisten elementtien yhdistelmällä. Vaikka tällaiset osallisuutta edistävät käytännöt, kuten osallistava budjetointi, ovatkin yleistymässä, käytetyistä prosesseista itsessään ei usein ole täyttä selvyyttä. Vaarana on tällöin se, että pyyteettömistä pyrkimyksistä kehittää viestintää ja demokraattista suunnittelua onkin seurauksena kehnoja suunnittelutapoja, jotka uusivat tai lisäävät poliittista puolueellisuutta ja rajaavat viestinnän koskemaan vain niitä, joilla on jo entuudestaan parhaat valmiudet etujensa ajamiseen ja esiin tuomiseen.

Tätä taustaa vasten tässä väitöskirjassa perehdytään kaupunkisuunnittelun prosesseihin sosiaalisen verkostoanalyysin (SNA) keinoin. Väitöskirjallaon sekä yhteiskunnallisia että teoreettisia tavoitteita. Se auttaa kehittyneempien suunnittelukäytäntöjen luomisessa osallistavien tapausten tarkastelun kautta. Teoreettisena tavoitteena on edistää keskustelua kahdesta keskeisestä kaupunkisuunnittelun tekijästä, demokraattisesta keskustelusta ja sosiaalisesta pääomasta, yhdistämällä SNA kommunikatiiviseen suunnitteluteoriaan. Kommunikatiivinen suunnitteluteoria on merkittävä tutkimussuunta, joka tarjoaa kriittisen kehyksen kommunikatiivisten prosessien tarkastelulle. Toisaalta sosiaalista verkostoanalyysia on jo pitkään käytetty suhteellisten mallien tutkimusmenetelmänä, jonka suosio on viime aikoina kasvanut monilla opinaloilla. Tässä opinnäytteessä tarkastellaan sosiaalisen pääoman ja demokraattisen keskustelun keskeistä asemaa sekä keinoja tehdä niiden tutkimuksesta järjestelmällisempää.

Opinnäyte koostuu kolmesta vertaisarvioidusta artikkelista. Ensimmäisessä artikkelissa sosiaalinen verkostoanalyysi yhdistetään aikasarja-analyysiin, mikä

tarjoaa uuden lähestymistavan dynaamisten verkkokeskusteluprosessien arviointiin. Toisessa artikkelissa perehdytään kattavasti lähdeaineistoon ja kartoitetaan SNA-menetelmää sosiaalisen pääoman tutkimuksessa. Kolmannessa artikkelissa tutkitaan sosiaalisen pääoman ratkaisevia tekijöitä kaupunkialueiden elvytyshankkeissa hyödyntämällä ns. eksponentiaalista, satunnaista verkostomallia. Kuten tämän väitöskirjan synteesissä on esitetty, tulokset osoittavat, että sosiaalinen verkostoanalyysi edesauttaa kommunikatiivisen suunnittelun tutkimusta 1) verkostojen havainnollistamisen, 2) kuvailevien tilastojen sekä 3) uusien verkostomallien osalta. SNA-verkostoanalyysien empiiriset tulokset ilmentävät myös sitä, miten ammatinharjoittajat voivat tunnistaa ja hoitaa tehokkaammin toistuvia ongelmia suunnitteluprosessien aikana. Opinnäytteessä kuitenkin törmättiin sosiaalisen verkostoanalyysin kriittisiin rajoitteisiin, mikä rajoittaa sen käyttöä yksittäisenä suunnittelututkimuksen menetelmänä. Sosiaalinen verkostoanalyysi on hyvin yhdistettävissä muihin määrällisiin ja laadullisiin menetelmiin, joten siitä voi tulla merkittävä suunnittelututkimusmenetelmien verkoston solmukohta.

Acknowledgements

I started my career as an assistant manager of the physical theatre group, Momggol, in South Korea. The group was composed of audacious people who played an original play, called "Handcart, overturned", which portrayed rural migrants who faced eviction from a scrap of a house. They oppose the invisible force by overturning rattling handcarts but have no chance but to leave with hope. I visited many places during local tours and realised that this drama depicts an endemic problem of South Korea. Since then, my interest gradually shifted from arts to public policy as a way of solving problems. I am grateful to Jong-Yeoun Yoon, Hye-Won Shin, and actors who showed the meaning of art and planted the first seed of urban questions in my mind.

Anne Haila invited me to Finland despite a poorly planned application. She devoted her entire academic life to the questions of urban lands, acclaimed internationally after long strenuous works. Under her supervision, I met a group of critical scholars, including Giacomo Botta, Mika Hyötyläinen, Chaitawat Boonjubun, Haoxuan Sa, Tauran, David Edwin, Pui Man Yeung, Tam Nguyen, and Luying Wang. They have highlighted diverse urban problems under the global turmoil of land privatisation and speculation, showing alternative urban commons. Anne Haila also introduced an international scholar, Patrick Le Galès, who provided an opportunity to visit the Centre for European Studies and Comparative Politics at Science Po in Paris and learn his influential works. Anne's sudden passing is still heart breaking. I appreciate Franklin Obeng-Odoom and Jani Vuolteenaho for tirelessly helping us to move forward and continue her legacy. Rest in peace, Anne.

I decided to continue my journey to urban planning. What happens in the planning process, and how can we make it more democratic? I sincerely appreciate Mikko Rask and Arho Toikka, who have spent substantial time and effort in supervising this thesis. Mikko is the main supervisor who has constantly stimulated me to think about the link between governance theories and real-world problems,

which remains a crucial gap in the field. Arho is like a Haiku poet who makes critical points with simple words, which has helped me build the capacity to address problems. The two scholars have guided me in surviving from a maze of governance studies. I also had a rare chance to meet Nina Kahma, Pekka Tuominen, and Titiana-Petra Ertiö, who have shared profound academic and field experiences under the Politics of Co-creation team. I appreciate research partners from the UK, Norway and Sweden introducing diverse participatory approaches under the COLDIGIT project (Collective Intelligence through Digital Tools).

Several projects are gratefully acknowledged for financial support and research environments. I appreciate the CIMO fellowship, Urban Land Tenure (PI: Anne Haila / Franklin Obeng-Odoom), COLDIGIT (PI: Mikko Rask), TAILOMETRICS (PI: Nina Kahma), and Centre for Consumer Society Research that has provided an excellent research environment under the supervision of Petteri Repo. I also thank anonymous interviewees, editors, and reviewers who substantially helped improve articles. Renowned planning scholars Ward Lyles and Raine Mäntysalo played a critical pre-examiner role for this thesis with their constructive comments.

I also must express my deepest gratitude to the Faculty of Social Sciences academic staff at the University of Helsinki. I cannot even count how many times I made mistakes regarding administrative tasks. They have always been generous and kindly guided me towards the best solutions.

I thank my father and mother, who have always loved and supported me, and my friends Min-Hyeong Kim, Bomi Kim, Eun-Su Cho, Yun-Hui Kim, and Hong-Ki Kim, who have shared precious moments in life.

Finally, I dedicate this thesis to my wife, Seol Song.

Bokyong Shin
September 2021

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List of Original Publications

Article 1 — Shin B and Rask M (2021) Assessment of online deliberative quality: New indicators using network analysis and time-series analysis. *Sustainability* 13(3): 1187.

Article 2 — Shin B (2021) Exploring network measures of social capital: Toward more relational measurement. *Journal of Planning Literature* 36(3): 328-344.

Article 3 — Shin B (2021) Determinants of social capital from a network perspective: A case of Sinchon Regeneration Project using exponential random graph models. *Cities:* 103419.

Report on the Co-authored Original Publication

Article 1

Shin B and Rask M (2021) Assessment of Online Deliberative Quality: New Indicators Using Network Analysis and Time-Series Analysis. *Sustainability* 13(3): 1187.

For Article 1, Bokyong co-authored the paper with Mikko Rask.

Bokyong's contributions to Article 1 include developing the idea; conducting the literature review; conducting data collection; analysing data; and writing the manuscript.

Mikko's contributions to Article 1 include developing the idea; analysing data (after the first version of the manuscript); reviewing and editing the manuscript.

Sincerely yours,

DocuSigned by:
Bokyong Shin
EE84D0BF38224E7...

Bokyong Shin

27 April 2021

Mikko Rask

Mikko Rask

27 April 2021

1. Introduction

1.1 Background

In December 2016, I visited Yeomni-dong, a neighbourhood located in the middle of Seoul, South Korea (Figure 1a). The hillside village that originated from salt merchants' dwellings was desolate without any humans. The old homes, streets, and people will soon be replaced by new homes, streets, and people through a redevelopment project. I found notes on the wall, saying, "Dear residents, the project association must be dissolved. They do not care about us but themselves! […]". In another neighbourhood located a few blocks away, Sinchon, residents were invited to public decision-making for regenerating their community. When they were asked to imagine Sinchon with one word, they noted "everyone", "happiness", "yawn", "connection", "nature", and so on (Figure 1b). The reflection of these voices in urban planning is not merely for the object of desk research, nor protecting my right of residence as a lifetime tenant. It is our urgent problem while witnessing aggravating segregation, marginalisation, and deprivation in and across cities (Le Galès, 2016, 2021; Obeng-Odoom, 2017; Sassen, 2014; Shin, 2021).

Figure 1a. Abandoned homes in Yeomni-dong before redevelopment (taken by the author in December 2016)

Figure 1b. Residents imagine Sinchon-dong with one word (taken by the author in July 2018)

This thesis focuses on new participatory practices, such as participatory budgeting and citizen council, that open new democratic spaces for including the diverse voices of people. Despite a long history of academic debates (e.g., Arnstein, 1969), such inclusive practices have recently become prominent within OECD countries, notably for solving planning, health, and environmental problems (OECD, 2020). City governments are also increasingly investing in digital platforms to integrate offline and online engagement in planning processes (Chadwick, 2003; Dawes, 2008; Ertiö, 2015; Hajer and Dassen, 2014; Wu and Silva, 2010). In a recent participatory budgeting case in Helsinki, Finland known as OmaStadi, residents can now directly initiate, develop, and allocate budgets for improving their communities (Ertiö et al., 2019). Likewise, urban planning has become a crucial testbed for developing better governance practices with technological advancements (Hajer and Dassen, 2014). In response to the ever-changing planning environments, a challenging issue for the planning field is connecting theories with broader methods literature for critical examination.

Against this backdrop, in this thesis I link social network analysis (SNA) with urban planning through communicative planning theory. Communicative planning theory is one of the influential research strains for the last three decades that provides a critical framework for examining communicative practices in planning (for a review, Allmendinger, 2002; Harris, 2002; Hartmann and Geertman, 2016; Mäntysalo, 2005; Sager, 2018). As opposed to the rational planning model based on neutral calculations, pioneers proposed new interpretive and ethnographic methods in the 1990s, arguing for a changing planning paradigm for normative, interactive, and argumentative processes (Fischer and Forester, 1993; Forester, 1987b; Healey, 1992, 1993a; Innes, 1995). Participant observation, interview, and content analysis have become a primary toolset for understanding fine-grained communicative practices (Sager, 2018; Silva et al., 2014).

Since the 2010s, a few studies have started introducing SNA as a formal method for examining multiple stakeholders' networks and their communicative patterns (Dempwolf and Lyles, 2012). Given that planning processes are increasingly networked in online and offline settings, SNA has distinctive merits. Despite the recent popularity in many disciplines, network science is a long-standing field that originated in the 18th century with profound theoretical and empirical applications (Lewis, 2009). However, it is still unclear how SNA could be used to advance our understanding of planning processes. Is it worthwhile for scholars to consider SNA as a new research method? It is also crucial to note that SNA has drawbacks that must be discussed while exploring its advantages. Few social network analyses in evaluation have been conducted to date in the literature, leading to a paucity of using SNA for planning research.

1.2 Research Aim and Questions

My aim in this thesis is to examine the applicability of SNA for communicative planning research. Communicative planning research primarily focuses on governance processes through which stakeholders deliberate and promote the capacity for solving problems together (Harris, 2002; Healey, 1997; Innes and Booher, 2003; Mäntysalo and Bäcklund, 2018). Therefore, SNA applications should not only help visualise and describe political networks but also provide tools for investigating dynamic governance processes. SNA should also provide planners and citizens with practical help to facilitate communications for addressing ongoing governance problems. This thesis examines whether SNA could serve these functions with the following research questions:

RQ1 *In which* communicative planning research areas SNA could be beneficial?

RQ2 What are the significant *advantages* of SNA in analysing the specific areas?

RQ3 Are there any *limitations* of SNA that potentially disrupt empirical understanding?

RQ4 How can we *overcome* the limitations and make SNA more beneficial for planning research?

1.3 Thesis Structure and Article Summaries

RQ1 is a fundamental question to establish a theoretical bridge between communicative planning and SNA, which will offer the rationale for the applications of SNA. In particular, this summary will find two potential research areas of communicative planning theory that SNA could help: deliberation and social capital. RQ2 and RQ3 then explore both advantages and limitations of SNA based on empirical studies. For this purpose, this thesis is an article-based dissertation, consisting of a literature review and two empirical studies presented in different peer-reviewed journals (Table 1).

Table 1. Summaries of three articles.

Article 1 is a single case study that proposes online deliberative quality indicators using network analysis and time-series analysis. Previous studies have primarily focused on analysing content qualities of online deliberation based on various deliberative criteria. Content analysis is indeed critical for empirical research. However, Article 1 argues that deliberation is an interactive process that constantly evolves throughout planning processes. Therefore, the aim of Article 1 was to make a novel contribution by proposing indicators based on a combination of network analysis and time-series analysis. Based on Fishkin's (2009) deliberative criteria, Article 1 develops six throughput indicators and demonstrates their applications in the OmaStadi participatory budgeting project in Helsinki, Finland. The study results demonstrate the applications of SNA for network visualisations and descriptive metrics that will facilitate collective intelligence on ongoing processes and ways to solve problems promptly.
Article 2 is a literature review on network measures of social capital. Although social capital is a relational concept, existing studies have measured it with proximal indicators based on the assumptions that it is an aggregated resource. Article 2 argues that methodological individualism is problematic in planning contexts, in which social capital may benefit some while disadvantaging others. Article 2 found

that communicative planning theory employs the social capital concept as a collective property unequally distributed across stakeholders. In particular, bonding and bridging effects provide competing mechanisms of social capital development. Despite the network approach, SNA has been used less often in empirical research into communicative planning. Article 2 fills that gap by reviewing 58 recent studies retrieved from the Web of Science database through a combination of keyword and hand searches. The results reveal that empirical studies use network measures at the individual, subgroup, and network levels to answer different research questions.

Article 3 is a single case study that examines the determinants of social capital using exponential random graph models. Based on Article 2, Article 3 examines bonding and bridging effects in social capital development in the Sinchon regeneration project in Seoul, where residents participated in formal decision-making processes and partnered with public officials. Exponential random graph models offer a well-established method for statistically testing theorised effects one against the other. Based on a survey and interview data, Article 3 found that the project had a propensity for bonding social capital centred around public officials while residents played inactive roles. In particular, residents remained passive rather than voicing their concerns, indicating the strong presence of traditional bureaucratic actors in planning processes.

This summary presents discussion on detailed theoretical backgrounds and integrates the three articles in an analytical framework of communicative planning. This summary is organised as follows. The second chapter discusses theoretical backgrounds. Section 2.1 and 2.2 provide the rationale of why social network analysis and planning research need each other. Section 2.3 then suggests communicative planning theory as a bridge between the two fields. Section 2.4 provides a comprehensive framework of communicative planning and finds two key elements: deliberation and social capital. The third chapter explains each article's data collection, cases, and methods. The fourth chapter summarises the findings from research by highlighting both advantages and limitations of social network analysis. The fifth chapter discusses the implications for future research.

2. Theoretical Backgrounds

2.1. Social Network Analysis Needs Social Theory

This section invites readers to a distinctive worldview of SNA—"the connected world"—and explains why it needs social theory. Network science is the process of studying relational patterns among entities and their implications. Some scholars found the origin in 1736 when mathematician Leonhard Euler solved how to circumnavigate the bridges of Königsberg by using graph theory (Lewis, 2009). Likewise, the basic idea is to solve real-world problems by studying a network consisting of edges between nodes, representing a system of any kind, such as neurons, people, and mobile devices. Nevertheless, graph theory and relational thinking had not received much attention for over 200 years until sociologists Moreno and Jennings (1938) developed "sociometric" (configuration statistics) and "sociogram" (network graphs), prototypes for today's SNA, to analyse interpersonal relationships in small groups. Their work laid the foundation of SNA for combining social theories (Wasserman and Faust, 1994; Zweig, 2016). For instance, the norm of mutuality (Moreno and Jennings, 1938) is a widely known human behaviour for building trust and solidarity that can be measured by observing relations in a direct form (give and take, see Figure 2: $A \rightarrow B, B \rightarrow A$) or an indirect form (friend of a friend is a friend: $A \rightarrow D, D \rightarrow B,\ B \rightarrow A$) (Molm, 2010).

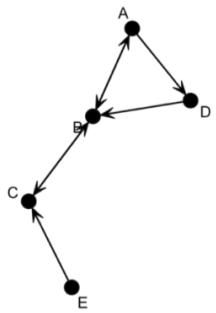


Figure 2. An example of a social network. Note: A network approach helps examine a social system but requires social theory to interpret underlying meanings.

From the network perspective, social life is relational. It is assumed that many social phenomena, including voting behaviour, happiness, pandemic, popularity, and information gain are influenced by relations with classmates, co-workers, and Facebook Friends. The digital era has introduced Internet-enabled services (e.g., Twitter and Facebook) and devices (e.g., mobile devices and the Internet of Things) to link people and other social entities better than ever. We then ask ourselves, are we "well" connected? SNA provides tools for answering this question. For instance, marketing research combines SNA with machine-learning techniques to examine how to connect customers with services (and advertisements) well by clustering customers, detecting influencers, and predicting potential friends, topics, and links (Ma and Sun, 2020). Communication research combines SNA with natural language processing to identify how fake news spreads through social media platforms (Sivasankari and Vadivu, 2021). Biology research develops epidemic models of highly infectious diseases in urban settings or protein-protein interactions (Mason and Verwoerd, 2007). Smart city research studies how to connect people, facilities, sensors, and transportation to provide better services and promote sustainable urban development (Souza et al., 2019).

The diverse applications of SNA have two implications. First, SNA studies *both* social entities and relations to understand social processes of interest (Robins, 2015). SNA assumes social entities are embedded in networks thus do not treat them as independent units. This perspective is distinctive because it defines model assumptions (Hanneman and Riddle, 2005). In standard statistics, social entities are often sampled independently in an extensive social survey aggregated to study the association between individual attributes (e.g., age—obesity). However, in SNA, sampling of social entities is based on contexts (e.g., classroom, organisation, and project), and their relationships are aggregated to study relational patterns (e.g., peer group—obesity). The unique assumptions and goals of SNA differentiate it from

standard statistics, which provides both the advantages and limitations discussed later.

Second, SNA requires social theory because it lacks interpretability. The primary motivation with this thesis starts from the premise that network analysis can represent any kind of social relations. The central question of SNA is then to apply social theory for linking real-world problems. As seen from Figure 2, a social network without social theory is merely a node-and-edge system. SNA and communicative planning, two pillars of the thesis, have played an increasing role in the recent theoretical development of planning, yet isolation from each other.

2.2. Planning Theory Needs Social Network Analysis

This section, in turn, discusses why planning theory needs SNA. At first glance, the link is vague as we barely find common ground in the traditional planning concept. Andreas Faludi (1973a: 1), in a classical textbook, *A Reader in Planning Theory*, defined *planning* as "the application of scientific method—however crude— to policy-making". Similarly, Davidoff and Reiner (1973: 11) defined "a process for determining appropriate future action through a sequence of choices". These definitions highlight that planning essentially refers to a decision-making process for appropriate future action. Here, appropriate entails "judgments concerning preferred states" about 1) the environment surrounding planning (e.g., actors and resources), 2) the purpose of planning (e.g., wellbeing and economic growth), and 3) the guidance of actions for achieving purposes (controlling a series of future actions). Likewise, planning is used in ordinary language when we carry out a plan, for instance, for hiking tours, building a bridge, or writing a thesis. The earlier definitions describe the nature of planning but focus less on planning by whom and for what purpose (Allmendinger, 2002; Thomas, 1979). Later, Yiftachel and Huxley (2000: 907) defined planning as "the public production of space", followed by Lefebvre (1991: 68), which highlights that planning involves "all policies and practices which shape urban and regional environment

under the auspices of the modern state". According to this definition, planning incurs spatial and socio-economic changes, exerting external influence on different stakes. Therefore, planning is a public problem.

This thesis adopts the latter definition in urban planning (city or town planning in the UK context, see Taylor (1998)) often led by city governments in collaboration with public and private actors. Levy (2017) pointed out that planning decisions are conspicuous since they change houses, parks, and roads that directly affect residents' daily lives; thus, there is always a high demand for public participation accompanied with potential conflicts and emotional stakes. This observation implies that planning is not merely about the physical allocation of built environments, people, and activities. Urban space (and land) is not an absolute thing but is relational in that subsumes products and their interrelations with (Lefebvre, 1991: 73)—"living beings, things, objects, works, signs and symbols" (Lefebvre, 1991: 101). In a similar vein, Haila (2016) argued that land is a social relation affected by laws and customs:

> *"Land is used and owned, its ownership is justified with stories, and people are emotionally attached to land. Every now and then land ownership and land use become a social problem as their forms and policies are debated, fought over, and transformed"* (Haila, 2016: xxi).

Planning is a political activity (Davidoff, 1965; Levy, 2017; Wildavsky, 1973). Planning is associated with the involvement of stakeholders who have different land-based interests and power in adversarial political environments (Brand and Gaffikin, 2007; Forester, 1987b; Healey, 1993a; Oren Yiftachel, 1998) that often escalate into social conflicts and movements prominently appeared in the late capitalism (Baeten, 2018; Brenner and Theodore, 2002; Harvey, 1989; Hytönen, 2016; Sassen, 2014). There is also an increasing demand for collaboration among multiple stakeholders by shaping new governance arrangements to cope with urban problems and promote sustainable development (Forester, 1987b; Healey, 1997; Innes and Booher, 1999).

Despite the political nature of planning, planning theory before the 1970s conceived planning as an apolitical and technical process (Allmendinger, 2002; Levy, 2017; Mäntysalo, 2005; Taylor, 1998). Scholars depict the earlier planning model as the *rational* model, aiming to make planning processes rational and comprehensive. During the post-war periods in Western society, urban infrastructures, including homes, schools, factories, and roads, were devastated. Amid the large influx of unemployed populations into cities, there was an urgent need for urban planning on a larger scale with land-use zoning and comprehensive plans. Planners were professionally trained bureaucrats who "saw themselves as being at the forefront of a transforming effort", assumed to work for maximising social welfare in a bureaucratic hierarchy (Healey, 1997: 8). Planning was portrayed as rational decision-making based on a comprehensive survey of a projected area, which required theories *of* planning (Faludi, 1973a, 1973b; Thomas, 1979): theories of how planners define problems, select goals, survey areas, evaluate alternatives and develop and implement plans. In this era, the primary goal of planning theory was to help planners understand standardised guidelines and make rational decisions on X and Y to produce Z results. Cost-benefit analysis, Delphi analysis, and forecasting analysis are examples (Hudson et al., 1979).

More recently, the *smart city* concept has attracted significant attention as a new way of planning in the digital era, using information and communications technology (ICT) infrastructure, automated services, big data analysis, and artificial intelligence-based models (Chourabi et al., 2012; Eremia et al., 2017). The smart city concept lies at the heart of a transformation from automation to autonomy in collecting, learning, and connecting data-driven solutions (Cugurullo, 2020). Smart technologies and algorithm-based decision-making could make a city a living organism evolving through "planning without a plan" (Komninos et al., 2019). However, scholars point out that citizens and history are often excluded in the "smartness" category (Engelbert et al., 2019; Hajer and Dassen, 2014). Citizens are encouraged to provide feedback,

solutions, and negotiation mediated through smart technologies but not challenge or replace the system (Cardullo and Kitchin, 2019). In this regard, Mäntysalo's (2005: 4) comment on the rational planning model still seems valid for the smart city discourse. He pointed out that the rational planning model tends to conceive people as objects, treating them as age group samples, customers, pedestrians, car and bike users with value-free information.

In the 1970s, scholars opposed the primacy of the technocratic-driven planning model, arguing that planning cannot be separate from politics (Davidoff, 1965; Hudson et al., 1979; Rittel and Webber, 1973; Wildavsky, 1973). Planning problems inherently involve people's interests and contexts, characterised by their complexity, subjectivity, and normativity (Allmendinger, 2002)—they are "wicked" (Rittel and Webber, 1973). Therefore, although planners follow pre-defined procedures (e.g., Faludi, 1978: 66), planning processes may not solve situated problems and may even create side effects (Wildavsky, 1973). Another crucial theoretical development was spatial justice (Fainstein, 2000; Purcell, 2002; Soja, 2009) based on two seminal books written by Lefebvre (1973) and Harvey (1973), which enshrines the geographical aspects of justice. The organisation and meaning of a given space are social products; therefore, space could reinforce injustice at all geographical scales (Soja, 1980, 2009). Allmendinger (2002) reviewed that these debates in the 1970s offered a fertile theoretical reference for post-positivism, arguing that it poses a paradigm shift in the planning theory. Post-positivism rejects the notion of planning as a tool for physical land transformation and stresses the contextualised and normative planning aspects (Allmendinger, 2002).

Communicative planning, justice city, and new movements, including new urbanism, emerged against the backdrop (Allmendinger, 2002; Fainstein, 2000). It means that the focus has shifted from the universal procedures and techniques of planning (theories *of* planning, procedural theory) towards diverse environments in which planning operates and applying normative frameworks (theories *in* planning,

substantive theory). In the book *Planning Theory*, Faludi (1973b) established the typology but emphasised the former for theoretical development (Thomas, 1979). This thesis focuses on the latter, which provides the rationale for using SNA to assess planning processes in different urban contexts. Wildavsky (1973: 133) convincingly argued that planners are not only bureaucrats working under administrative fiats: they are "presidents, ministers, bureaucrats, party leaders, scientists, entrepreneurs—anybody whose acts have large future consequences". If planning is the product of politics among multiple stakeholders, SNA could provide tools to assess their networks.

2.3. Communicative Planning as a Bridge between Two Fields

The preceding sections have discussed a common ground between SNA and planning: planning as a communicative process in political environments. The current section then discusses the communicative planning theory as a bridge between SNA and planning. First, the notion of network governance helps locate SNA within the framework of communicative planning.

The term *network governance* refers to governance through (as) networks, which consists of two terms, governance and network. On the one hand, the term governance is a mix of the verb *govern* and the suffix *-nance* that transforms it into a noun, which derives from the Latin *gubernare*, meaning "steer, direct, and rule" (Hughes, 2010: 88). It refers to the "totality of theoretical conceptions on governing" (Kooiman, 1993: 4), covering "any form of coordination of interdependent social relations" (Jessop, 1999: 351). It is an umbrella concept. Governance applies to governing the European Union, a country, a region, a city, a firm, a university, a tennis club, and perhaps a combination of these (Hughes, 2010). On the other hand, in the Oxford Dictionary the term network is defined as "a group or system of interconnected people or things".

In combination, *network governance* refers to a specific governance form (style), distinctive from *hierarchical governance* and *market governance* (Jessop, 1999; Meuleman, 2008; Osborne, 2010). In the post-war era, western countries have reformed governance from public administration (operated in a hierarchical bureaucracy) until the late 1970s to new public management (NPM: operated through arm's length agencies) in the 1980s (Hood, 1995; Osborne, 2010; Pollitt et al., 2007). The NPM reform actively embraced the concept of competition, decentralisation, and incentivisation of the market, resulting in the constellations of non-governmental agencies (Dunleavy, 2005; Hood, 1995). These agencies were efficient in handling specialised functions but regarded as incapable of coping with wicked problems, such as environment, crime, and planning, requiring collaboration across policy "silos" in the 1990s (Osborne, 2010). Also, citizens increasingly engaged in horizontal and multi-jurisdictional arrangements as partners rather than as customers (Agger and Lund, 2017; Kooiman, 1993; Rask et al., 2012; Rhodes and Marsh, 1992). Note that the state still holds final decision-making authority, especially in the European context (Hytönen, 2016; John, 2001; Le Galès, 2002; Peters and Pierre, 1998), but the state is no longer a sole public decision-maker and implementer which needs resources, legitimacy, and accountability from the private and civil sectors (Jessop, 1999; Meuleman, 2008; Rask et al., 2018).

Earlier governance theorists argued that network governance is an emerging phenomenon of how society is governed and focused on identifying its fundamental mechanisms and elements (Sørensen and Torfing, 2005). This resulted in the plethora of terms, such as *governance* (without government) (Rhodes, 1996), *new public governance* (Osborne, 2010), *collaborative governance* (Ansell and Gash, 2007; Emerson et al., 2012), *interactive governance* (Kooiman, 1993), *network governance* (Sørensen and Torfing, 2005, 2009), *multi-level governance* (Bache and Flinders, 2004; Peters and Pierre, 2001), *co-creation* (Torfing et al., 2019; Voorberg et al., 2015), and *good governance* (Grindle, 2004). Planning scholars also created terms like *argumentative turn* (Fischer

and Forester, 1993), *communicative planning* (Innes, 1995), and *collaborative planning* (Healey, 1997) that are of interest in this thesis. Despite various fields, they implicitly work with the assumption of interdependency for solving wicked problems, focusing on "the interactive processes through which society and the economy are steered towards collectively negotiated objectives" (Ansell and Torfing, 2016: 4).

This section has so far conceptualised communicative planning as network governance in the planning context. The governance approach to communicative planning is one among several approaches, influenced by Patsy Healey, Judith Innes, and David Booher (Harris, 2002; Hartmann and Geertman, 2016; Mäntysalo and Bäcklund, 2018; Mattila, 2020). With the lens of governance, I summarised essential elements of communicative planning based on critical references (Albrechts, 1991; Allmendinger, 2009; Forester, 1987b; Harris, 2002; Healey, 1997; Innes, 1998; Mäntysalo and Bäcklund, 2018):

- the concept of *stakeholders* and their diverse interests, power, and resources in a given context
- new *institutional arrangements,* including participatory budgeting, citizen jury, committee, and partnership that brings stakeholders into a political arena
- intersubjective *deliberation* and *argumentation* among stakeholders for collective decision-making and action
- the changing *role of planners* towards a facilitator and mediator

Innes and Booher (2015) called the work of a cluster of scholars who focus on the above topics of planners and planning processes as a communicative planning theory. Since its inception, communicative planning theory has been influenced by communicative rationality and the public sphere (Habermas, 1984, 1987; Mattila, 2018, 2020). A fundamental argument is that public reasoning can be socially constructed through reciprocal communications among stakeholders through which individual

preferences are changed through respectful discussions (Healey, 1997). Here, respect refers to "recognising, valuing, listening to, and searching for translative possibilities between different discourse communities" (Healey, 1993: 242). In this regard, the main aim of communicative planning theory was to facilitate an ideal speech condition in which all affected parties are allowed free access to deliberation; and power inequality among them is neutralised; so that all participants can equally express their voices and exchange ideas for reaching a certain level of consensus (Innes, 2004: 7; Purcell, 2009: 149).

Communicative planning theorists in the 1980s and 1990s highlighted planners' changing roles and practices (Fischer and Forester, 1993; Forester, 1987b; Healey, 1992; Innes, 1995; Sager, 1994). First, they argued that planners are not merely engineers and architects, but they can make the planning process more or less democratic. Planners have the substantial power to "influence the conditions which make citizens able (or unable) to participate, act, and organise effectively regarding issues affecting their collective lives" (Forester, 1982: 67). Ethnographic methods were primarily employed to investigate planners' changing roles based on in-depth interviews and observations. Scholars focused on analysing how planners mediate and balance competing interests, languages, and visions (Albrechts, 1991; Forester, 1987b; Healey, 1992, 1993b; Innes, 1998). Second, communicative planning theory is influenced by pragmatism (Healey, 2009; Hoch, 1984). From this perspective, planning is a process of solving problems that emerged in a unique context. There is no panacea for solving problems. Instead, it is argued that people learn by doing, making mistakes, and interacting with others. By observing the fine grain of daily planning practices, researchers can capture practical obstacles or unplanned effects that stimulate the critical assessment of solutions (Forester, 1987a).

Communicative planning theory has drawn both attention and criticism in the last few decades. Critics point out that the theory neglects structural power inequality in the context of neoliberalism (Brand and Gaffikin, 2007; Fainstein, 2000; Fischler,

2000; Huxley and Yiftachel, 2000; Hytönen, 2016; Mäntysalo and Jarenko, 2014; Purcell, 2009). Scholars have highlighted neoliberal planning as a crucial explanatory factor in shaping urban conditions globally, marked by urban entrepreneurialism and market-led development (Brenner and Theodore, 2002; Gunder, 2010; Peck et al., 2009; Purcell, 2009). Despite geographical variations, city branding, creative-class attraction, and large-scale projects through public and private partnerships are typical examples (see Baeten, 2018). Critics argued that all forms of the communicative process, and network governance in general, are prone to rhetoric without substance, which ultimately contributes to the production of neoliberal space while disempowering marginal groups (Flyvbjerg, 1996; Swyngedouw, 2005, 2009; O Yiftachel, 1998). However, communicative planning theory neglected the structural issues of inequality, marginalisation, and segregation increasingly observed in cities worldwide while focusing on micro-level processes (Brand and Gaffikin, 2007; Fainstein, 2000; Fischler, 2000; Huxley and Yiftachel, 2000; Purcell, 2009).

Communicative planning theorists responded to this criticism reflected in the later development since the late 1990s (Forester, 1999; Healey, 1999, 2003; Innes and Booher, 2015). Mäntysalo (2005) captured the essential difference. Before the 2000s, theorists had focused on communicative planning as consensus-seeking processes operated under power neutral conditions. Since the 2000s, theorists have shifted their focus on mobilising collective capacity for resolving conflicts and promoting collective action (Agger and Sørensen, 2016; Cars et al., 2002; Goodspeed, 2016; Hajer and Wagenaar, 2003; Healey, 1997, 1998; Hillier, 2000; Innes and Booher, 1999, 2003; Legacy, 2017; Olsson, 2009; Polk, 2011). Scholars point out that the book *Collaborative Planning: Shaping Places in Fragmented Societies* by Patsy Healey made a critical contribution to this turning point (Fainstein, 2000; Harris, 2002; Purcell, 2009). In the book, Healey (1997: 34) argued that communicative planning is a new form of governance "through which stakeholders and local political communities can come together to work out what to do and how to act". Communicative planning scholars

have employed the notion of *network* and *web* to enshrine how local stakeholders address collective matters through networks, arguing that power is relational thus could be generative rather than authoritative (Booher and Innes, 2002; Healey, 1997; Hillier, 2000).

2.4. Analytical Framework of Communicative Planning

By concluding their discussions on the governance of planning, Mäntysalo and Bäcklund (2018: 246) called for a framework for communicative planning research. A framework could benefit common data collection strategies, indicators, and methods that would otherwise produce isolated knowledge (Berke and Lyles, 2019), a timely and challenging topic given the multi-faceted and context-sensitive nature of governance (Rask and Ertiö, 2019).

As discussed below, Agger and Löfgren (2008) presented an analytical framework for communicative planning research. They deliberately developed an all-encompassing framework covering critical democratic aspects of governance in planning, leaving room for new research methods in different contexts (Agger and Löfgren, 2008: 159). In particular, they urged scholars to apply new methods for "a practical evaluation study of actual collaborative networks" in planning yet did not explicitly connect with SNA and digital environments (Agger and Löfgren, 2008: 159). In response to the call, this section discusses how the thesis connects SNA to the framework.

Agger and Löfgren (2008) developed an analytical framework with two dimensions. The first dimension regards governance as a political system and assesses its democratic legitimacy in input, throughput, and output (Agger and Löfgren, 2008). This classification is a long-standing framework originated in system theory that critically examines legitimacy problems of governance practices in terms of input (e.g., who participates with what agenda), throughput (e.g., how stakeholders interact and

build consensus), and output (e.g., what are the results and who holds accountability) (Bekkers et al., 2007; Easton, 1957; Scharpf, 1997; Schmidt, 2010).

The second dimension is five democratic criteria. In the book, *On Democracy*, Dahl (2015: chapter 4) proposed five normative standards of democratic processes. That is, members will legitimate given governance practices when they have equal and effective opportunities for (1) expressing voices (*effective participation*), (2) voting (*voting equality*), (3) hearing the viewpoints of others and learning from them (*enlightened understanding*), (4) agenda-setting (*control of the agenda*), and (5) engagement (*inclusion of adults*). If any of the criteria are violated, Dahl argued that the members would not be politically equal, and the process fails to be considered democratic (Dahl, 2015). Agger and Löfgren (2008) elaborated these criteria as follows:

- Access: a norm about influence and equality in the channels for influence
- Public deliberation: a norm about public debate for planning processes
- Adaptiveness: a norm about the development of an adaptive political system
- Accountability: a norm about developing political accounts
- Political capabilities: a norm about developing political identities (e.g., what is good, who they are, whom they want to be) and capabilities (e.g., capacity-building)

Based on the two dimensions, Agger and Löfgren (2008) developed a framework for assessing democratic aspects of communicative planning, as shown in Table 2. This framework demonstrates that communicative planning, and network governance in general, is a multi-faceted process that any attempt to answer all these questions in a single analysis with a single method is almost impossible. Therefore, I did not aim to connect all elements with SNA in this framework but focused on the two shaded cells in Table 2. First, SNA could serve for assessing the quality of

deliberation processes (Article 1). Second, it could help assess social capital development, a critical element of institutional capacity-building (Articles 2 and 3).

Table 2. Democratic Assessment Framework for Communicative Planning

Norms	Input	Process	Output/Outcome
Access	Who are invited to participate? Which channels for participation exist?	Do the institutional settings for the processes favour some types of participants?	Are the outcomes biased in terms of fulfilling the wishes of only certain groups of participants?
Public deliberation	Are different types of knowledge included in the deliberations?	**Article 1**: What is the quality of deliberation processes in terms of, for instance, reciprocity and continuity?	To what extent do the debates produce something perceived by the participants, as essential for the decision-making process?
Adaptiveness	Are there clear rules for the network process before the deliberative process?	Is the network capable of handling conflicts?	Is the network's work secured sustainability and continuity in terms of, e.g., competencies?
Accountability	Is there an explicit political mandate from politicians which can be held accountable?	Are the processes transparent?	What are the opportunities for accountability when implementing the outcome of the networks?
Political capability	—	To what extent do the processes of the networks contribute to endowment and empowerment?	**Article 2 and 3:** Have the processes contributed to the institutional capacity-building?

Revised from Agger and Löfgren (2008: 160)

The primary reason for focusing on deliberation and social capital is that these research areas have remained underdeveloped within the planning literature regarding SNA applications. Some planning-related fields have already applied SNA for other criteria. For instance, stakeholder analysis actively uses SNA to map multiple stakeholders and examine the inclusiveness and integration within stakeholder networks (Holman, 2008; Lienert et al., 2013; Lyles, 2015; Paletto et al., 2015; Prell et al., 2009). The institutional collective action framework uses SNA to investigate how multiple actors collaborate under institutional conditions based on game theory and the common pool resource (Feiock, 2009, 2013; Hawkins et al., 2016; Lee et al., 2012). These fields have demonstrated that SNA contributes to the access and adaptiveness criteria. This thesis also demonstrated adaptiveness (governance resilience) by providing indicators for online discussion networks. However, the main aim of the thesis is to fill the research gap by focusing on deliberation and social capital. The following subsections elaborate on why these two topics are crucial for communicative planning theory and why SNA is necessary.

2.4.1. Deliberation

Public deliberation has been widely advocated to promote empowered participation (Cars et al., 2002; Fung and Wright, 2001; Hajer and Wagenaar, 2003; Healey, 2002; Innes and Booher, 1999; Rask et al., 2012, 2018). By engaging in the deliberation process, ordinary citizens have opportunities to voice their views and influence public decision-making. The core notion of deliberation is "the process by which individuals sincerely weigh the merits of competing arguments in discussions together" (Fishkin, 2009: 33). Likewise, deliberation is a relational concept; it involves communication and argumentation to reach a consensus among members that precedes democratic decisions (Manin, 1987). Deliberative democracy theorists have focused on deliberation as an alternative or complement to conventional electoral models, such

as voting (Fishkin and Laslett, 2003; Gutmann and Thompson, 2004; Habermas, 1990; Rawls, 1997), especially when discourses are conflictual and divided (Dryzek, 2005).

Elstub (2010) summarised the development of deliberative democracy research into three generations (see also, Mäntysalo and Jarenko, 2014). The first-generation scholars assumed that preferences are constructed through inter-subjective communications until members reach a certain level of consensus (Cohen, 2003; Habermas, 1994; Manin, 1987; Rawls, 1997). Therefore, they focused on an idealised speech situation, procedures, and skillsets that allow members to involve more informed and discursive processes. While first-generation theorists laid the theoretical foundation, second-generation scholars focused on institutionalisation in different contexts, marked by conflict, rules, and power inequality (Dryzek, 2005; Fishkin and Luskin, 2005; Thompson, 2008). Unitary consensus-building is hardly achievable, and deliberation is often combined with other decision-making forms (e.g., vote) in practice (Gutmann and Thompson, 2004). Therefore, scholars have relaxed Habermas's ideal conditions that mutual justification is enough for legitimacy (Elstub, 2010: 296; Mäntysalo and Jarenko, 2014: 39) and diversified deliberative criteria, including respect, reciprocity, diversity, inclusion, according to different online and offline settings (Dahlberg, 2001; Fishkin, 2009; Gastil and Black, 2007; Steenbergen et al., 2003). Elstub (2010) pointed out that the two generations paved the way for third-generation scholars to explore many empirical cases, ranging from micro forums to macro deliberation.

Mäntysalo and Jarenko (2014: 39) observe that today's communicative planning theorists focus on how conflictual stakeholders engage in deliberative processes to exchange argumentations and resolve conflicts (see also Mattila, 2020). I further argue that the recent surge of digital platforms has changed the deliberation process from face-to-face interactions of small groups to many-to-many interactions in hybrid environments, pointing to the importance of network analysis. The existing literature on deliberative democracy emphasised the extent of consensus-building among a

relatively small number of people, by which content analysis was crucial. However, as new participatory practices emerge with Internet technology, it is crucial to investigate "who discusses with whom" to detect inter-group interaction patterns based on resources (e.g., information). Mattila (2020) points out that online deliberations are more than traditional argumentative discourses, as people now share images, videos, and emojis rather than sitting and "listening carefully" to others' argumentations.

Overall, deliberation is a crucial process of communicative planning but does not automatically promote democracy. It needs an assessment. Article 1 argues for the importance of network analysis as a tool for assessing dynamic deliberation processes.

2.4.2. Social Capital

Social capital is another crucial topic of communicative planning theory. A primary reason is that communicative planning is a long-term mobilisation process, not an episodic event. A community may develop lasting social networks, local knowledge, and political power throughout planning processes even after a project is completed (Agger and Jensen, 2015; Polk, 2011). Scholars conceptualised "institutional capacity" to capture this evolving collective property (Booher and Innes, 2002; Coaffee and Healey, 2003; Healey, 1998, 2006; Innes and Booher, 2003). By capacity, it means "the ability of the institutional relations to work collectively towards the creation of better and fairer quality living environments" (González and Healey, 2005: 2056). Since stakeholders collectively develop this capacity throughout planning processes, institutional capacity is conceived as a planning outcome (Agger and Löfgren, 2008).

Scholars suggest that institutional capital measures institutional capacity that contains three elements: intellectual, social, and political capital (Healey, 1998; Innes et al., 1994). The concept of capital is used to highlight that institutional capacity is not depleted through use. Therefore, it is not a stock, but can develop through coordinated

actions in the long run (Healey et al., 2013; Innes et al., 1994). Communicative planning scholars have mainly employed qualitative methods to investigate social capital development (Agger and Jensen, 2015; Cars et al., 2002; Healey et al., 2013; Hillier, 2000; Polk, 2011).

In this thesis, I argue the usefulness of SNA in measuring and analysing social capital development. Communicative planning scholars focus on "webs" and "social networks" that connect various stakeholders (Cars et al., 2002; Hajer and Wagenaar, 2003; Healey, 1998). Their empirical questions focus on the inequality of social capital:

> *"Some are well integrated, well connected, and well informed, and can mobilise readily to act to capture opportunities and enhance local conditions. Others are fragmented, lack the connections to sources of power and knowledge, and the mobilisation capacity, to organise to make a difference"* (Healey, 1998: 1531).

Communicative planning theory raises questions regarding network morphologies, insiders and outsiders, and information flows in line with social network scholars who study structural social capital components (Borgatti et al., 1998; Burt, 2001; Coleman, 1988; Lin et al., 2001). This thesis attempts to link SNA and social capital with two articles—a literature review that theoretically finds the use of SNA and various network measures for planning research (Article 2) and an empirical study examining social capital determinants (Article 3).

3. Data and Methods

3.1. Social Network Analysis

This section explains fundamental concepts of social network analysis (SNA). SNA is the study of social relationships between social entities, which relies on three mathematical foundations, including graph theory (for simplifying real-world relations), statistical and probability theory (for building models), and matrix algebra (for executing complex calculations) (Wasserman and Faust, 1994). In SNA, a network represents a social system consisting of a set(s) of nodes and their relations (Wasserman and Faust, 1994). For instance, suppose that we observed romantic relationships between Tom, Jane, and Mary and found that Tom and Jane loved each other while only Mary loved Tom. We try to represent this sad story with a $G_{love} = (V, E)$, consisting of a set of vertices, $V = \{Tom, Mary, Jane\}$, and a set of edges, $E = \{\{Tom \rightarrow Jane\}, \{Jane \rightarrow Tom\}, \{Mary \rightarrow Tom\}\}$. The symbol " $\rightarrow$ " represents the direction of love, but it does not indicate its weight (e.g., the degree to which Tom loves Jane). This type of graph is called an unweighted digraph, among four types: weighted digraphs (direction), unweighted digraphs, weighted graphs (no direction), and unweighted graphs. A network also contains attribute data, including actors' attributes (e.g., gender and height) and ties' attributes (e.g., advice and friendship). SNA represents a social network by combining different data types—individual attribute data and network data.

A social network in the real world is often not regular. In SNA, a graph is *regular* if all nodes have the same degree (the number of edges incident with each node in a graph). In the previous example, Tom received attention from both Mary and Jane but Mary received none. Likewise, social networks are often characterised by a few influential nodes, such as social influencers in social network services, with many inactive and isolated nodes. Furthermore, edges are distributed unequally at a group

level. We often find some subgroups consisting of more powerful and integrated individuals that influence network activities. Communicative planning scholars have explicitly focused on network morphology, arguing that it "may define how accessible networks are, who are insiders and outsiders, as well as the nature of power relations within and beyond a specific network" (De Magalhães et al., 2002: 56).

SNA can offer three types of analysis for this inquiry. The first type is network visualisation, as shown in Figure 2. The visualisation technique is an undeniable benefit of SNA because it allows readers to identify abnormal relational patterns intuitively. Since it offers a good starting point for further network research, network graphs are included in almost every network study. Network scholars have developed diverse graph types and algorithms to enhance network literacy (Brandes et al., 2006; Moody et al., 2005).

The second type is descriptive network statistics. There are well-known measures of central tendencies, such as mean, median, and mode; SNA offers various centrality measures, such as degree, closeness, and betweenness centrality, to identify influential individuals within a network (Wasserman and Faust, 1994). This type of descriptive network statistics provides quantitative information describing a particular feature of the observed individuals, groups, and networks.

The third type is the statistical network model. A model is an abstraction of a real-world situation (more specifically, data) to capture essential real-world aspects of interest. Generalised regression models are most widely used to estimate parameters of the population data based on independent observations. In contrast, a statistical network model refers to a statistical model for network-based social systems, which assumes interdependence among observations (Robins, 2015). According to van Duijn and Huisman (2011), network models are classified into actor-level and tie-level models. On the one hand, actor-level models aim to explain or predict actor attributes using network data (e.g., general linear models) or to categorize groups within a given

network (e.g., stochastic block models); on the other hand, tie-level models aim to explain the correlation between networks (e.g., quadratic assignment procedure), network formation (e.g., exponential random graph models), and evolution (e.g., stochastic actor-oriented models). I used all three types of network analysis in this thesis, as discussed in Chapter 4.

3.2 Case Selection

This thesis demonstrates SNA applications by studying two participatory cases: the OmaStadi participatory budgeting project in Helsinki, Finland (Article 1), and the Sinchon regeneration project in Seoul, South Korea (Article 3). Each article provides detailed contextual backgrounds. In short, both cases were municipal-led pilot projects which aimed to engage citizens in decision-making processes directly. Although this thesis does not analyse these cases in a comparative setting, it is worth explaining the similarities/differences to present the rationale of the case selection.

A society could be classified into three sectors—the first (public), the second (for-profit), and the third sector (non-profit)—among which the latter involves a wide range of civil actors, including socio-economic (e.g., Greenpeace), political (e.g., labour unions), community-oriented (e.g., grassroots organisations) non-profit organisations, as well as professionals (e.g., researchers and activists) (Brandsen et al., 2005; Brandsen and Pestoff, 2006). While households, families, and other informal communities have also been vaguely included in the third sector, Brandsen et al. (2005: 753) raised the need for a new category, namely the fourth sector, to characterise their informal and spontaneous activities. From this approach, the OmaStadi and the Sinchon cases show that the first and the fourth sectors were the most viable, while the second sector was minimal. Based on a literature review, Rask et al. (2020) found four features of recently emerging fourth sector involvements regarding objectives, outcomes, actors, and tools that provide a basis for the discussion.

Figure 3a. A co-creation event for the OmaStadi project (taken by the author in February 2019)

Figure 3b. A resident committee election for the Sinchon project (taken by the author in February 2018)

First, both cases pursued prosocial and non-profit based aims. The two municipalities invited residents to the process of public budget allocation (OmaStadi) and neighbourhood regeneration (Sinchon) for promoting residents' roles in improving the well-being of neighbourhoods. Second, participants remained informal and did not evolve into formalised institutions. Most participants in both cases were ordinary residents who voluntarily spent individual time and energy in participation in an ad-hoc manner. Third, these participants and forums did not represent the population. While the OmaStadi project invited all residents (who reside in the city) to the process, Rask et al. (2021) found that minority groups, including immigrants and the Russian-speaking community, were inactive. In the Sinchon project, residents had to be elected to become committee members who could then officially participate in formal decision-making (Figure 3b). However, the elected members did not automatically represent the population as only a portion of social groups, including long-term elderly residents and merchants, became members. Sinchon is known as a university town that hosts two universities and associated students and staff. Students who reside around adjacent universities were the majority group, but no one engaged in the committee. Overall, both cases share features in terms of prosocial objectives, voluntary, and non-representational participation.

However, the two cases used different participatory tools. While the OmaStadi project employed an open-source digital platform and open applications to promote public participation in online and offline environments (Ertiö et al., 2019), the Sinchon project preferred face-to-face meetings with a minor focus on online participation. Studying different instrument choices and effects in different urban settings is an intriguing subject (see Lascoumes and Le Galès, 2007), yet it is not the main interest of this thesis. Instead, I studied the two cases in a single case design to demonstrate different applications of SNA.

3.3. Data Collection

This thesis consists of three peer-reviewed articles with different data and methods centring around SNA, as shown in Table 3. While Article 1 studied deliberation, Articles 2 and 3 studied social capital. This section explains the data collection and methods of each article.

Table 3. Topics, data collection and methods of three articles

Article	Topics Covered	Data Collection	Methods
	Deliberation		
1	Case study: Assessing the online deliberative quality of OmaStadi participatory budgeting, Helsinki.	Web scraping	Social network analysis and time-series analysis
	Social capital		
2	Literature review: Network measures of social capital	Data retrieval (Web of Science)	Systematic literature review
3	Case study: Determinants of social capital in the Sinchon regeneration project, Seoul.	Network survey and interviews	Exponential random graph models

Articles 1 and 3 are single case studies. Article 1 employed SNA to assess the democratic qualities of online deliberation for the OmaStadi participatory budgeting project. In contrast to offline deliberation, online deliberation is characterised by thousands and perhaps millions of discussions with metadata (e.g., author, title,

location, and time stamp). Traditional manual coding schemes require substantial labour and time to navigate web pages or databases of interest that might involve human errors. It is a tedious task that quickly loses practicability as the number of online data increases, which is the case of Article 1.

Computer sciences researchers have developed a technique called data mining or web scraping to address this problem. The core idea of web scraping is to program a bot that automatically collects specified data from the database and stores it in a local system for later analysis (Jarmul and Lawson, 2018; Mitchell, 2018). I programmed a web scraper in a Python environment to collect online discussions in the OmaStadi deliberative platform (https://omastadi.hel.fi/). While Article 1 collected a large amount of online data using a web scraping technique, Article 3 used a traditional network survey to collect social capital information among a small group of actors for identifying critical determinants of social capital. I chose this contrasting strategy, given that communicative planning increasingly occurs in online and offline environments.

Both web scraping and survey methods have pros and cons. A web scraping technique can collect extensive data promptly at almost zero cost, but it may also raise an ethical issue for violating respondents' informed consent and privacy. Article 1 tackled this issue by limiting public discussion data (citizen-generated proposals) with data anonymisation, leading to the limited access of individual attribute data. In contrast, a survey technique applied in Article 3 can collect detailed individual information based on consent, enabling an advanced network analysis, such as Exponential Random Graph Models. However, the network survey for Article 3 required long periods and effort compared with those required for web scraping for Article 1. In March 2018, I gave a public presentation to introduce the survey and asked city officials and residents for their consents. It took three months to receive a complete list of formal participants with survey permission granted by the city authority; then, it took two months during July and August 2018 to conduct an online

and paper-based survey. Based on the SNA results, I conducted in-depth interviews with five key actors to contextualise the quantified findings.

In contrast to Articles 1 and 3, Article 2 is a literature review of network measures of social capital. According to Siddaway et al. (2019), a "literature review" is distinct from "reviewing literature". *Reviewing literature* focuses on a particular topic to find a research gap and claims a need for a new study, a typical scientific research process that provides theoretical backgrounds. On the other hand, a *literature review* has a distinct research design to comprehensively review existing studies with transparent and replicable results (Siddaway et al., 2019). As with other articles, a literature review needs to review the literature to clarify the aim, scope, and methods.

In Article 2, I first reviewed the literature on communicative planning theory to find a network approach to social capital. Based on the process, for Article 2 I conducted a literature review of existing studies (published between 2010-2019) that combined bonding and bridging elements in SNA based on the Web of Science database (Figure 4). Among 14,412 publications that used "social capital" in their topics, I combined a Boolean keyword search with a hand search for retrieving publications of interest, and retrieved 58 records. The collected publications were then summarised according to author, title, year, data collection, network type, bonding and bridging measures, level of analysis, and methods by reading each material.

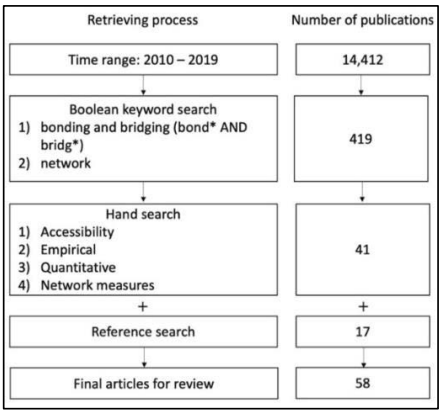


Figure 4. Data retrieving process

4. Results

4.1 Advantages of Social Network Analysis

This chapter reports the results of the three articles by answering the research questions. The preceding sections have answered the first research question by identifying potential research areas in which SNA could be helpful: deliberation and social capital. This section then answers the second research question by discussing the advantages of SNA with applications in terms of 1) network visualisation, 2) descriptive network statistics, and 3) statistical network models.

4.1.1. Network Visualisation

SNA can visualise communicative interactions in governance processes, as shown in two networks in Figure 5. Figure 5a represents an online deliberation network for a southeast Helsinki area in the OmaStadi participatory budgeting project (Article 1). Citizens can create a proposal(s) for improving their neighbourhoods displayed on a web page where other citizens could comment and develop the idea together. Figure 5a captures the communication network in a co-creation period (February-April 2019), during which citizens develop proposals with other citizens and city experts by combining several proposals into a plan. Circles represent individual citizens, green squares are proposals, and yellow squares are plans.

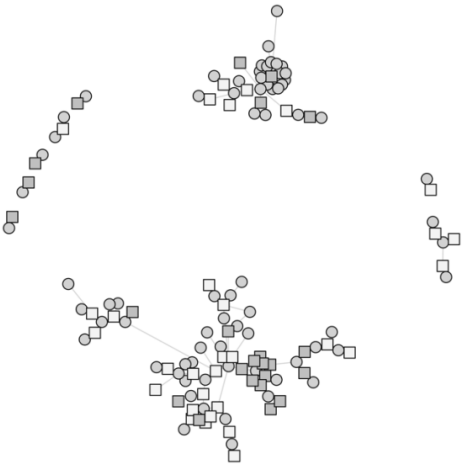


Figure 5a. An online communication network for a southeast area in the OmaStadi case.

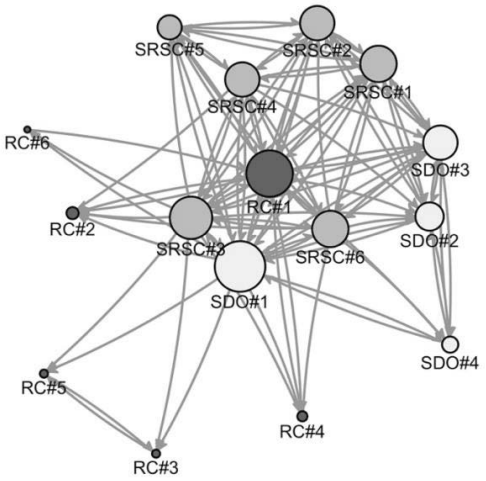


Figure 5b. A face-to-face communication network in the Sinchon case.

In Figure 5a, we can immediately notice two primarily divided groups with no interconnection between them. Rask et al. (2021) provided the contextual background for the southeast area, which reported heavy competition between two proposals for renovating the historical Aino Ackté Villa and improving the schoolyards in Herttoniemi. Voting turnout in the area was three times higher than that in the eastern area, reflecting the context. Partly due to this background, a cleavage between two groups of people and proposals is prominent. This figure implies that the governance process did not promote deliberation across different groups, calling for further analyses.

Figure 5b represents a face-to-face communication network of 16 stakeholders who participated in the Sinchon regeneration project. In the network survey, I asked, "how often have you contacted these listed people during the past year?" then dichotomised the responses (1 = yes, 0 = no) if the communications occurred at least weekly. The communication network consists of three groups: resident committee members (RC, black circles), city officials in Sinchon District Office (SDO, white

circles), and officials in Sinchon Regeneration Support Centre (SRSC, grey circles), a non-government organisation established for the project. The size of each node represents node degrees, meaning that actors with more communication ties have larger nodes. From this graph, we can notice that residents are not important actors in the communication network. First, residents have substantially fewer ties than public officials in the two authorities, forming a clustered subgroup. Second, given the direction of the arrows, residents tend only to receive communication, not vice versa, indicating a passive role in a daily communication network.

These two examples demonstrate that network visualisation could serve as an effective communication tool. Given that multiple stakeholders engage in communicative planning processes, any graphical representation must convey summarised information without requiring technical knowledge. Network visualisation is a window of complex network data, which attracts readers' attention and invites further inquiries.

4.1.2. Descriptive network statistics

Descriptive network statistic refers to a statistic that quantifies a feature of collected network data, and descriptive network statistics refer to the process of analysing those statistics. Network scholars have developed a wide array of descriptive network statistics at the individual, dyad, triad, group, and network levels (Newman, 2010; Scott and Carrington, 2011; Wasserman and Faust, 1994; Zweig, 2016). This section aims not to provide an exhaustive list of them but to provide theoretical reasons why some help assesses communicative planning research. Table 4 summarises descriptive network statistics found in Articles 1 and 2.

Table 4. Summary of descriptive network statistics

Dimension / Level	Measure	Description
Deliberation		

Interaction	Responsiveness	The degree to which online comments generate back-and-forth conversations.
	Inter-linkedness	Interactive patterns among actors and proposals.
	Commitment	The degree to which comments are distributed across actors and proposals.
	Social capital	
Node-level	size, constraint, effective size, efficiency, centrality, E-I index, k-core, transitivity, tie strength, and modularity	Network statistics that describe aspects of social capital at the individual level.
Subgraph-level	reciprocity, transitivity, homophily, bridge, popularity, activity, and heterogeneity	Network configurations that represent essential social norms and mechanisms of social capital.
Graph-level	network density, average degree, (degree) centralization, cross-boundary exchange, k-core, and cut points	Network statistics that describe aspects of social capital at the network level.

Article 1 proposed six online deliberative quality indicators based on Fishkin's (2009) deliberative criteria, arguing that SNA provides crucial information on how people interact with each other. This approach is distinct from previous studies focusing on deliberation contents based on text data or perceptions based on survey data (Beauchamp, 2018; Friess and Eilders, 2015). Among the six indicators, the first three—participation rate, activeness, and consistency—focused on the volume of participation based on time-series data; the other three—responsiveness, inter-linkedness, and commitment—focused on interactions in deliberation based on network data. Likewise, Article 1 proposed new indicators by combining time-series analysis and network analysis, the latter of which will be discussed in this summary.

First, *responsiveness* calculates the proportion of replies in online comments to measure how online comments generate reciprocal communications. Deliberative scholars have highlighted that deliberation is an interpersonal conversation, meaning a group effort to reflect and compete with others' opinions for choosing the best alternatives (Beierle, 2004; Janssen and Kies, 2005). In online environments, initiating

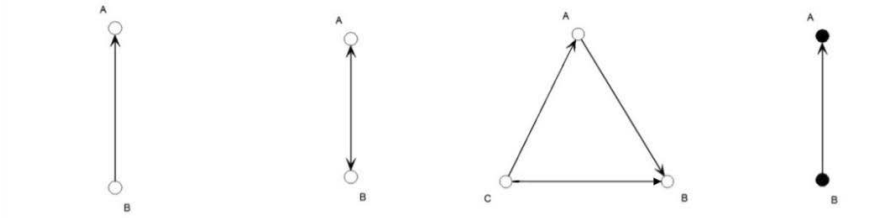
and replying to comments creates discussion threads, simple evidence of deliberation processes. Article 1 created a dichotomic edge-attribute variable (1 = reply, 0 = initial comment) for all comments (n= 3188) collected from the OmaStadi online platform and found that only 13.7% of them were replies. It indicates that most initial comments did not receive replies from others. Second, *inter-linkedness* refers to interactive patterns among actors and proposals. Interactive patterns were graphically displayed (Figure 5a) and measured with metrics, including the mean of comments per actor and the mean of comments per proposal (see Vasques Filho and O'Neale, 2018). Third, *commitment* measures how the number of comments is distributed across actors and proposals. Article 1 found that actors commented less than two times (1.96) in a year-long participatory budgeting process, and proposals received 2.6 comments on average. A handful of active people and proposals was highly active, whereas the majority remained passive, resembling a scale-free network often observed in many cases, such as the World Wide Web or citation networks (Barabási and Albert, 1999).

While Article 1 used descriptive network statistics to assess online deliberation, Article 2 explored social capital measures at the individual, subgraph, and graph level. From the literature review of the 58 collected articles published in broader social sciences between 2010 and 2020, Article 2 found a list of network measures at all levels. At the individual level, existing studies used size, constraint, effective size, efficiency, centrality, E-I index, k-core, average degree, transitivity, tie strength, and modularity to analyse the association between social capital and personal benefits. At the graph level, there are network density, average degree, (degree) centralization, cross-boundary exchange, k-core, and cut points to characterise an observed network either as bonding or bridging. At the subgraph level, previous studies have developed network configurations of reciprocity, transitivity, and homophily as bonding effects and of bridge, popularity, activity, and heterogeneity as bridging effects to examine the formation and evolution of social capital. Technical details of each measure are summarised in Appendix 1.

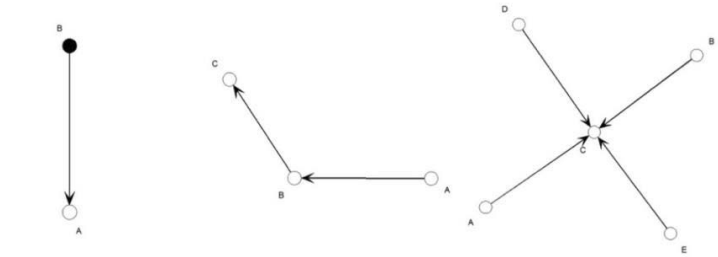
4.1.3. Statistical network model

Descriptive network statistics provide summary information on structural aspects of deliberation and social capital. Communicative planning theory further asks what factors influence social capital formation and evolution in a specific planning context. Do bonding effects or bridging effects explain social capital development? If bonding effects are too excessive, the bonded group becomes isolated from the rest of the society; if bridging effects are too excessive, they have less political power for collective actions (Agger and Jensen, 2015). Using exponential random graph models (ERGMs) (Kolaczyk, 2009; Lubell et al., 2012; Robins et al., 2012), Article 3 examined social capital determinants in the Sinchon regeneration project.

ERGM is a tie-based model, meaning that it models ties between actors based on a combination of network data and node-attribute data. Article 2 found competing bonding effects (reciprocity, transitivity, and homophily) and bridging effects (bridge, popularity, activity, and heterogeneity) that might influence the creation of a tie between pairs of actors, as shown in Figure 6. At first glance, these configurations appear too simple. However, they represent fundamental mechanisms of how people interact with each other in social settings. For instance, the norm of reciprocity (e.g., give and take) can be represented as a mutual relationship between nodes A and B (see Figure 6). If this pattern is observed more than as random chance in the data, we infer that reciprocity influence the network's formation.



Edge (density) reciprocity transitivity homophily



heterogeneity two-path popularity

Figure 6. Network configurations correspond to hypothesised social capital elements

ERGMs allow those specified configurations to be incorporated as parameters and examine their relative strengths in explaining an observed network. ERGM is a class of network models used to explain the likelihood of the observed network as a function of explanatory variables (bonding and bridging effects). More technical information can be found in Appendix 2.

Article 3 included bonding effects (mutuality, transitivity, and homophily) and bridging effects (bridge, popularity, activity), exogenous factors (contact network and participation period), and an edge term in four nested models of a discussion network for the Sinchon Regeneration project. The model estimates show a robust explanation of bonding effects with statistical significance of transitivity and homophily. Bridge and popularity elements were not statistically significant, indicating that bridging effects do not explain the observed network's formation. Another interesting result is the significant effect of the contact network, indicating that face-to-face interactions are crucial prerequisites for building social capital.

Overall, Article 3 found substantial bonding social capital centring around public officials in the Sinchon project. Although the city authority invited residents in an official decision-making body to be “partners”, the study results show residents' passive roles as listeners and spectators.

4.2. Limitations of Social Network Analysis

Like all other methods, SNA has both advantages and limitations. Understanding the limitations will enable us to make the best use of SNA for a research process; thus, it is crucial. This section discusses the fundamental issues of SNA: 1) the quantification of qualitative relationships and 2) structures without context.

4.2.1. Quantifying qualitative relationships

The essential process of SNA is to translate social relationships into mathematical relations. A *relationship* refers to observable objects in the real world, and *relation* is the mathematical structure representing the observed relationship (Zweig, 2016: 6). For instance, SNA translates an advice tie between Tom and Jane into a dichotomic value (e.g., yes or no) or a weighted relation value (e.g., 5 = very much). In this subsection, I discuss the validity of this quantification in communicative planning research.

Article 2 found that empirical studies used various types of relationships as a proxy for social capital, including Facebook Friend, support, contact, information, participation, discussion, interaction, and advice. However, most studies only provided technical explanations without clarifying theoretical reasons why Facebook Friends represent online social capital, for instance. Le Galès (2001) pointed out that the operationalisation of SNA is not convincing enough to reflect sophisticated relationships in urban politics. It is a critical comment yet has not been treated seriously in previous studies. Can SNA represent "mangled communication patterns", including "listening, storytelling, rhetoric, mediation, and use of metaphors" (Sager, 2018: 94) properly and enhance our empirical understanding?

Planning literature has not progressed much in this topic, and nor has Article 3. In Article 3, I approximated social capital by collecting a discussion network based on respondents' reports with whom they discussed project-related matters. A

discussion network is a crucial source of social capital in the planning context, but other crucial networks, such as information and collaboration networks, cannot be overlooked. Therefore, planning research requires theoretical references for choosing, excluding, and measuring social relations for SNA. The lack of theoretical references partly resulted in the divided discourse in the field. On the one hand, SNA research picks arbitrary social relations as a proxy of communicative practices and reports empirical findings; on the other hand, scholars are concerned about the validity (accuracy) of these measures.

Another fundamental yet not generally known issue of SNA derives from unrealistic model assumptions. Revisit a social network example (Figure 2) in section 2.1 and find two pairs of nodes A—B and B—C. Although they have the same configuration, they are different reciprocal processes that contain different social meanings. For instance, Actor A might have a stronger tendency to reciprocate relationships, whereas Actor B has a lower tendency than A. Likewise, every node might have different reciprocity tendencies, but node characteristics are often constrained in their capacity to simplify the model. This assumption is called *homogeneity of isomorphic network configurations*, where parameters are equated if the configurations are the same (Robins et al., 2007). It helps model estimation because the statistic becomes the counts of reciprocal ties, but it is an unrealistic assumption for planning research in which stakeholders interact within fragmented settings.

4.2.2. Structures without context

Another critical limitation of SNA is the lack of ability in dealing with contextual factors. I earlier stressed that deliberation and social capital notions are context-sensitive because people deliberate (Esau et al., 2017, 2020; Thompson, 2008) and build social capital (Healey, 1999; Lowndes and Wilson, 2001; Moody and Paxton, 2009) differently in different settings. Although SNA enables incorporating exogenous variables into models within a case study design (Lusher et al., 2013), no established

framework exists to investigate networks *embedded in* planning contexts. For instance, Article 3 found more potent bonding effects centred around public officials than bridging effects, indicating residents' passive role despite resident-centred rhetoric in the Sinchon project. However, network models do not provide contextual backgrounds of this finding. Therefore, I conducted follow-up interviews and found that public officials dominated the decision-making process in a robust bureaucratic culture.

This limitation is critical from the communicative planning perspective because SNA focuses on what transpires micro-interactions while ignoring conditions under which planning processes are shaped, changed, and manipulated. Communicative planning can be different in Seoul and Helsinki and even in different inner-city neighbourhoods, yet SNA cannot thoroughly reflect the institutional contexts into models. Edwards (2010) described the feature of SNA as an outsider's view because it focuses on structures of social relations and interactional processes, arguing that SNA lacks an insider's view who understands the content of interactions and has a perception of the network.

4.3. Summary of the Empirical Results

This thesis explored SNA applications for two research areas of communicative planning: deliberation and social capital. On the one hand, SNA could help assess the democratic quality of an extensive online discussion network increasingly observed in the digital era. On the other hand, SNA could help understand social capital development explained by bonding and bridging effects. Based on a literature review and two case studies, this thesis has found that SNA helps analyse these elements through network visualisation, descriptive network statistics, and network models.

First, SNA provides visual tools for diverse interactive patterns in communicative processes. Articles 1 and 3 demonstrate how to visualise networks of

multiple actors and citizen-generated proposals connected through online comments and face-to-face interactions. In particular, the two articles showed how network visualisation helps identify abnormal interactive patterns, such as polarisation and centralisation. Second, this thesis has found a wide array of descriptive statistics that provide quantitative information on structural properties. While Article 1 proposed deliberative quality indicators, including responsiveness, inter-linkedness, and commitment, Article 2 found around 20 social capital metrics based on a literature review. Third, Article 3 demonstrates that SNA provides statistical models to test social capital determinants (bonding or bridging). These empirical results also demonstrated that SNA could provide practical tools for monitoring ongoing governance processes.

Despite the usefulness of SNA, this thesis also identified critical limitations that have hindered applications in the literature. First, a necessary procedure of SNA is to translate social relationships into quantified relations, incurring potential loss or distortion of original meaning. Due to the shortness of the history of applications in the planning literature, existing network analyses have not sufficiently provided theoretical backgrounds for operationalisation. Second, SNA has limited capacity in incorporating political and legal institutions into models, which poses significant limitations for explaining the conditions under which planning operates.

5. Conclusions

5.1 General Conclusions: SNA as a Complementary Method

Does communicative planning automatically enhance democratic planning processes? For the last few decades, communicative planning research has shown that there are many practical barriers to empowered participation, and there is no panacea or one best solution for addressing contextual problems. A poorly executed planning process might produce unexpected adverse outcomes directly opposite to initial intentions (Holman, 2008). The core message of communicative planning theory is that communicative planning is not the end product but brings new governance challenges. In recent years, we have also witnessed the surge of new social problems of fake information and right-wing populism, reinforcing hate, conflict and mistrust that polarise our society rather than promoting cohesion and mobilisation (Schroeder, 2019; Vaccari and Chadwick, 2020). Planning research needs to readjust theories and methods in response to the changing planning environments.

The thesis contributes to the communicative planning theory by proposing SNA as a valuable part of a research toolset. Deliberation and social capital are two crucial elements of planning that SNA could be beneficial. On the one hand, SNA could indicate how people interact and mobilise collective actions in online deliberative platforms. On the other hand, SNA helps assess whether people develop bonding social capital (cohesion with the risk of exclusion), bridging social capital (diversity with the risk of fragmentation), or both in a balanced way. Based on one literature review and two empirical studies, the thesis has found that SNA provides critical tools for network visualisation, descriptive statistics, and network models, yet not appropriate for analysing contents and reflecting contexts.

Based on the findings, I propose SNA as a *complementary* method rather than a *stand-alone* method for planning research. I argue that SNA is an indispensable

method to investigate intricate interaction patterns among multiple stakeholders in planning processes, tackling a fundamental empirical question of networked forms of policymaking. However, the limitations of SNA point to an SNA-assisted analysis rather than an SNA-centred analysis. Yin (2018) explains that case study research—a primary planning research design (Silva et al., 2014)—requires data and methodological triangulation to enhance the construct validity of the same phenomenon.

Despite the limitations of SNA, this thesis has found that SNA brings flexible methodological tools well combined with other methods within a case study design. On the one hand, SNA can be well combined with other quantitative methods, such as time-series analysis (Article 1) and topic modelling (Shin and Boonjubun, 2021). The time dimension is crucial for communicative planning research for analysing evolving deliberation processes and resulting capacity-building. Combining SNA with time-series analysis (Hamilton, 1994) or longitudinal network models (Snijders and Pickup, 2016) could enable examining dynamic communicative planning processes under specific institutional settings. A combination of network analysis and natural language processing (e.g., topic modelling) also helps explore diverse topics in planning discourses and identify marginal groups' voices within a network.

On the other hand, SNA is also well combined with qualitative methods (Crossley, 2010; Edwards, 2010; Hollstein, 2014; Hollstein et al., 2017; Yousefi Nooraie et al., 2018). In particular, SNA could "sequentially" assist the research (Hollstein, 2014). A sequential exploratory design starts with the qualitative investigation that provides contexts of social networks, a crucial step for analysts to define relations of interest, network boundary, and survey questions that enhance the validity of the collected data. In contrast, a sequential explanatory design starts with formal SNA, which results in one or more observed networks. This approach could be helpful, especially for comparing communicative planning processes in different contexts. Analysts can identify abnormal patterns and key actors based on quantitative results,

leading to in-depth qualitative investigations. For instance, Article 1 found low responsiveness in the OmaStadi platform in general (13.7% of replies in all comments) with an increasing rate over time (3.4% at the proposal stage; 19.2% at the co-creation stage). This result implies that people gradually engage in more reciprocal discussions, raising the need for follow-up qualitative investigation.

An analysis of a small network is also insightful. Assume that we want to observe a small network of power elites in a planning case in-depth. The number of possible (directed) network states of five people is already 1 million (1,048,576 calculated by $2^{n(n-1)}$), which provides enough sample space to develop models (Lusher et al., 2013: 33). The number of possible networks grows exponentially as the number of actors increases. Combining SNA with qualitative methods could enhance our understanding of the structure and context of the political network.

5.2. Limitations and Future Research

The main contributions of this thesis are threefold. First, it theoretically connects SNA with planning literature via deliberation and social capital. Second, it proposes their network measures. Regarding social capital, this thesis establishes bonding capital measures that include homophily, reciprocity, and transitivity and bridging capital, including bridge, popularity, and activity using network configurations. Each element provides hypothetical effects on social capital development. In terms of deliberation, this thesis offers measures of responsiveness, inter-linkedness, and commitment for assessing interactions in deliberation processes. I argue that these measures will illuminate essential yet unexplored aspects of communicative planning processes. Third, this thesis proposes an advanced network model that enables testing social capital determinants in diverse planning contexts, sharpening SNA toolsets for communicative planning research.

I conclude by discussing the limitations of this thesis and implications for future research. Although this thesis examined SNA applications in deliberation and social capital research, it did not examine whether SNA helps analyse causal links between them. As Agger and Löfgren (2008: 159) noted, the democratic assessment of communicative planning must encompass input, process, and outcome stages. The critical question is how deliberation processes influence social capital development; conversely, social capital creates a favourable environment for future deliberation (Healey, 1998; Healey et al., 2013; Innes and Booher, 1999).

If we conceive deliberation and social capital as two types of social networks, SNA offers promising methods (Cranmer et al., 2017; Lubell et al., 2012). Quadratic Assignment Procedure could be used to test the significance of an association between two networks (Krackhardt, 1987). For instance, this analysis will test whether deliberation and social capital are (positively or negatively) correlated with each other. If one wants to test causal links, one may consider exponential random graph models to include other networks as predictors (Lusher et al., 2013). This analysis will test, for instance, whether a deliberation network influences a social capital network and vice versa.

The following question is why this thesis did not collect deliberation and social capital data from the same case. It is a valid comment that poses another limitation of this thesis. Unfortunately, both cases had practical barriers to collecting both types of data. In the OmaStadi case, online deliberation data were collected, but it was not feasible to collect social capital data because to do so requires a separate survey. Even if a survey were to be conducted, it would be impossible to match online deliberation data for data anonymisation. In the Sinchon case, the city authority permitted collecting social capital data through a survey but limited access to deliberation processes.

However, the surge of digital planning platforms creates new opportunities for empirical research. In particular, public authorities increasingly make available to the public a variety of citizen-generated data sources, including images, texts, voices, and geographical information, to the public through "open data" or "open government" schemes for promoting public participation and more informed decision-making (Attard et al., 2015). The planning literature should utilise the abundance of empirical data that contain citizens' voices and their interactions in different forms. These are compelling yet unexplored areas for communicative planning research.

Urban planning is fundamentally about a decision-making process that shapes the urban and regional environment. It changes our homes, streets, neighbours, memories, and nature in the future. Therefore, we should keep questioning what happens in the planning process and exploring new tools to assess its democratic quality. In this thesis, I provided a critical analysis of social network analysis for communicative planning research, demonstrating that SNA could become an influential node in a network of planning research methods.

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Appendix 1: Notations of Network Statistics

Appendix 1 provides mathematical definitions of network statistics discussed in the thesis. Notations are necessary to avoid lengthy discussions and ensure that the author and readers discuss the same concept. Appendix 1 generally refers to Robins (2015) and other texts (Henning et al., 2012; Newman, 2010; Wasserman and Faust, 1994; Zweig, 2016). First, we define a graph using graph-theoretic notations. Let a graph $G = (V, E)$ has a node-set $V = \{1,2, \dots, n\}$ and an edge-set E between some pairs of nodes. Let $n = |V|$ denotes the number of nodes, called the *order* of G, and $m = |E|$ be the number of edges, called the *size* of G. Due to the diverse metrics in different settings, Appendix 1 deals with digraphs, (undirected) graphs, and weighted digraphs. A relationship between i and j could be expressed as $\{i, j\}$ in an undirected graph or (i, j) in a digraph. Note that the letters i and j are typical to denote an arbitrary pair of actors.

The graph notation $\{i, j\}$ corresponds with a random variable Y_{ij}, an element of an $n \times n$ adjacency matrix Y, where y_{ij} is an observed value of the variable Y_{ij} with

$$y_{ij} = \begin{cases} 1, if\ \{i,j\} \in E \\ 0, otherwise \end{cases}$$

We set notations p_{iq} and m_{jq} to define effective size, constraint, and efficiency (Burt, 1992: 51-54). We assume a digraph for these measures. The presumption is that there are limited time, energy, and resources, so an actor i will evaluate cost-benefits of each tie. From i's perspective, $y_{ij} = 1$ is *redundant* to the extent which (1) i has to invest time and energy to maintain a relationship with another actor, q, (2) to whom j has a strong tie. For instance, to connect with Barack Obama, I have to consider costs for a tie with Michelle Obama who has a close tie with Barack Obama, expressed as $p_{iq}m_{jq}$, where p_{iq} is the proportion of i's investments in the relationship with q:

$$p_{iq} = (y_{iq} + y_{qi}) \Big/ \left[\sum_j (y_{ij} + y_{ji})\right], i \neq j,$$

where m_{jq} is the marginal strength of j's relation with q.

$$m_{jq} = (y_{jq} + y_{qj})/\max(y_{jk} + y_{kj}),$$

where $\max(y_{jk})$ is the largest of j's relations with anyone (It could be Michelle), which ensures m_{jq} is in the range of 0 and 1. Now we calculate $p_{iq}m_{jq}$ of all ties q and add the values to identify the redundant portion of the relationship:

$$\sum\nolimits_q p_{iq}m_{jq}\,, q \neq i, j$$

Based on these notations, Table 1 provides the mathematical definitions of network statistics discussed in the thesis.

Table 1. Mathematical definitions of network statistics discussed in the thesis

Measure	Description	Statistic
	Node-level	
Degree (size)	The number of edges incident with a node i.	$\mathrm{d(i)} = \sum_{j=1}^{n} y_{ij}$
Effective size	The nonredundant portion of the relationship of i's network.	$\mathrm{es(i)} = \sum_j \left[1 - \sum_q p_{iq}m_{jq}\right]$
Efficiency	The ratio of effective size divided by size (0: high redundancy, 1: low redundancy, thus high efficiency).	$\mathrm{ec(i)} = \mathrm{es(i)}/\mathrm{d(i)}$
Constraint	The extent to which i's opportunities are constrained due to investments to reach j.	$co(i) = \left(p_{ij} + \sum_q p_{iq}p_{qj}\right)^2$
(Degree) centrality	The extent to which a node has a high value of degrees.	$C_X(i) = \frac{d(i)}{n-1}$
E-I index	The extent of homogenous ties (internal) or heterogenous ties (external) that can be measured at node, group, and graph level. EL denotes the number of external ties; IL denotes the number of internal ties. Edge values are ignored.	$\frac{EL - IL}{EL + IL}$
(Local) clustering coefficient	The likelihood that the neighbourhoods of i are also connected. $e(i)$ denotes the number of edges between the neighbours of i.	$cc(i) = \frac{2e(i)}{\mathrm{d(i)[d(i)-1]}}$
	Graph-level	
Average degree	The mean number of ties that each node has.	$\frac{2m}{n}$

Density	The proportion of ties present in a given network.	$\frac{2m}{n(n-1)}$
(Global) clustering coefficient	The mean probability that two nodes with a common tie are themselves connected.	$CC = \frac{(\#\ triangles) \times 3}{(\#\ \text{triplets})}$
Mutuality	The percentage of directed edges that are reciprocal. m_r denotes the absolute number of distinct pairs of nodes ($m_r \in E$).	$\frac{2m_r}{m}$
Modularity	The quality of partitions in a graph.	$\frac{1}{2m}\sum_{ij}(Y_{ij} - P_{ij})\delta(C_i, C_j),$
(Degree) centralisation	The degree to which a network is dominated by the most central node (determined by degree centrality). C_X^* denotes the largest value of $C_X(i)$ in a given network.	$\frac{\sum_{i=1}^{n}[C_X^* - C_X(i)]}{\max\sum_{i=1}^{n}[C_X^* - C_X(i)]}$
K-core	A subgraph G_S in which each node is adjacent to at least a minimum number k of the other nodes in the subgraph.	$d_s(i) \geq k$

We further define *modularity* used for identifying cohesive subgroups within a network. The term cohesive is a relative notion that generally refers to "more densely connected than others". Network scholars have developed measures for cohesiveness to examine whether subgroups ever exist (*community detection*), and if so, whether actors collaborate with each other more within subgroups while less across subgroups (Fortunato, 2010; Fortunato and Hric, 2016; Newman and Girvan, 2004; Newman and Newman, 2006). Cohesiveness provides information on whether diverse public and private actors interact cohesively. Another reason for detecting cohesive subgroups and their boundaries is identifying actors' structural position in subgroups (Fortunato, 2010). Actors with a central position in subgraphs may play a crucial role in controlling other members within the subgroup, whereas actors at the boundaries between subgroups may mediate the relationship between subgroups. The Girvan-Newman algorithm is popular for detecting cohesive subgroups for analysing social and biological networks, especially for small networks with less than 1,000 nodes (Fortunato, 2010; Fortunato and Hric, 2016).

We define *subgroup* and *subgraph*. In the set theory, when x is an element of A, it means "x belongs to A", expressed as $x \in A$. If every element of a set B belongs to a set A, and A and B are not equal, we write $B \subset A$, denoting a *proper subset* of A. We refer to the subset of nodes as a *subgroup* and the nodes along with the edges among them as a *subgraph* (Wasserman and Faust, 1994: 252). We may generate partitions of a graph into $C_1, C_2, \cdots C_n$ where their union must be G. If there is no intersection among subgraphs, they are disjoint.

We now partition a graph into several subgraphs. Girvan and Newman (2002: 1) defined cohesive subgroup as "the division of network nodes into groups within which the network connections are dense, but between which they are sparser". This means that we detect subgroups by counting internal ties within subgroups and external ties to other parts of the given network. Our following question is then how to measure cohesiveness and identify subgroups that meet the condition. Let us imagine that edges are pipelines designed to enable water to flow among nodes. If we find pipelines that provide the *shortest path (geodesic)* between most pairs of nodes and remove them, it will prevent the water from circulating across subgroups. It is the basic idea of *edge betweenness*, which denotes the fraction of shortest paths passing through between pairs of nodes (Girvan and Newman, 2002). If we consider a random edge e, and consider the probability that e is on the shortest path from i to j, it is defined as:

$$EB(e) = \sum_{i \in V} \sum_{j \in V} \frac{\sigma_{ij}(e)}{\sigma_{ij}},$$

where σ_{ij} is the number of shortest paths between i and j; $\sigma_{ij}(k)$ is the number of shortest paths between i and j that go through $e \in E$. Girvan and Newman (2002) proposed a divisive algorithm that calculates edge betweenness, known as the Girvan-Newman algorithm. A dendrogram is a tree diagram that displays a series of partitions and their nodes in the graph. The following question is how to define the

optimal decomposition of the given network: is it 2 or 3, or more subgroups are optimal?

Modularity is a measure of the quality of graph decomposition, calculated by comparing the density of observed edges in a subgraph and that of randomly distributed edges in the subgraph (Newman and Girvan, 2004). Modularity has a function Q = (fraction of edges within subgraphs) – (expected fraction of edges). A higher value of modularity Q indicates a better division of a graph. We define Q as follows (Newman and Girvan, 2004):

$$Q = \frac{1}{2m}\sum_{ij}\left(Y_{ij} - P_{ij}\right)\delta\left(C_i, C_j\right),$$

where δ is the Kronecker delta and c_i is the label of the subgraph to which i is assigned. Therefore, if i and j are in the same subgraph, $\delta_{c_i c_j} = 1$, and 0, otherwise. Although it is a graph-level measure, Article 2 classified it as a node-level measure because collected publications reassigned modularity values to individual attributes for measuring bridging social capital (Brooks et al., 2014; Norbutas and Corten, 2018).

Appendix 2: Exponential Random Graph Models

Appendix 2 defines the general form of Exponential Random Graph Model (ERGM) based on critical references (Lusher et al., 2013; Robins et al., 2007; Snijders et al., 2006). Basic notations follow Appendix 1. ERGM is a class of tie-based network models employed in this thesis to infer what factors influenced the formation of ties among actors. Suppose that we explain the likelihood of the observed network y as a function of a collection of explanatory variables. The joint probability of the observed network y, $\Pr(Y = y)$, could be expressed as a linear function:

$$\Pr(Y = y) = \eta_1 g_1(y) + \eta_2 g_2(y) +, \cdots \eta_A g_A(y),$$

where $g_A(y)$ denotes the network statistic corresponding to configuration A (recall mutuality and reciprocity); η_A is the parameter. Since the response variable must stay within a range of the probability (between 0 and 1), a logarithmic transformation is applied:

$$\log \Pr(Y = y) = \eta_1 g_1(y) + \eta_2 g_2(y) +, \cdots \eta_A g_A(y)$$

We get a simpler form with an exponential term on the right side:

$$\Pr(Y = y) = \exp\left\{\sum_A \eta_A g_A(y)\right\}$$

The right side of the equation must be normalised to ensure that the sum of $\Pr(Y = y)$ is unity, which is one over all possible networks as follows (Anderson et al., 1999):

$$\Pr(Y = y) = \left(\frac{1}{k}\right) \exp\left\{\sum_A \eta_A g_A(y)\right\},$$

where k is a normalising constant that makes all the possibilities sum to one. This is a general form of ERGM (Robins et al., 2007). This equation conceives a network

as a stochastic process that takes the observed network y as the one realisation over all possible networks. Therefore, if we add a new node to the original network, the cardinality of the network increases exponentially, making it difficult to compute the maximum likelihood estimation using the constant k. Hence, we need another version of the model that does not depend on the constant (Anderson et al., 1999).

Now we consider the probability of a tie creation instead of a network formation.

$$\Pr(Y_{ij} = 1) = \eta_1 g_1(y) + \eta_2 g_2(y) +, \cdots \eta_A g_A(y),$$

where the response variable Y_{ij} is binary ($Y_{ij} = 1$, if a tie is present, 0, otherwise) in this example. We apply a logistic function to ensure a probability distribution:

$$\Pr(Y_{ij} = 1) = \frac{\exp\{\eta_1 g_1(y) + \eta_2 g_2(y) +, \cdots \eta_A g_A(y)\}}{1 + \exp\{\eta_1 g_1(y) + \eta_2 g_2(y) +, \cdots \eta_A g_A(y)\}}$$

The range of response variables stays between 0 and 1, and the range of explanatory variables stays between $-\infty$ and ∞. As in standard logistic regression, ERMGs transform the response variable from the probability scale to the log-odds scale, namely log-odds (logit) transformation, to simplify the linear equation form in the right side of the equation:

$$odds(Y_{ij} = 1) = \frac{\Pr(Y_{ij} = 1)}{\Pr(Y_{ij} = 0)}$$

$$log\left(odds(Y_{ij} = 1)\right) = log\left(\frac{\Pr(Y_{ij} = 1)}{\Pr(Y_{ij} = 0)}\right) = logit(\Pr(Y_{ij} = 1))$$

We get a logit probability of a tie Y_{ij} with a linear regression function.

$$logit(\Pr(Y_{ij} = 1)) = \eta_1 g_1(y) + \eta_2 g_2(y) +, \cdots \eta_A g_A(y)$$

The advantage of logit scale is that we do not have to rely one the constant k. Nevertheless, the model is for the probabilities of individual ties, Y_{ij}, assumed to be

independent from Y_{ik}, making it unrealistic in highly networked environments, such as planning processes. Therefore, we need a final modification that ensures the model is for the probabilities of ties *conditional on all the other relational ties in the network* (Anderson et al., 1999; Strauss and Ikeda, 1990). We define the odds of a link Y_{ij} by considering Y_{ij}^{c}, denoting all other ties except Y_{ij} in the network; Y_{ij}^{+} as a tie Y_{ij} forced to be present; and Y_{ij}^{-} as a tie Y_{ij} forced to be absent.

$$\frac{\Pr\left(Y_{ij}=1|Y_{ij}^{c}\right)}{\Pr\left(Y_{ij}=0|Y_{ij}^{c}\right)}=\frac{\exp\left\{\eta\cdot g_{A}(Y_{ij}^{+})\right\}}{\exp\left\{\eta\cdot g_{A}(Y_{ij}^{-})\right\}}=\exp\left\{\eta\left[g_{A}\left(Y_{ij}^{+}\right)-g_{A}(Y_{ij}^{-})\right]\right\}$$

From the above equation, we finally define a tie-based model in the logit form:

$$Logit\left(\Pr\left(Y_{ij}=1|Y_{ij}^{c}\right)\right)=\sum\eta_{A}d_{g_{A}}(y),$$

where $d_{g_{A}}(y)=\left[g_{A}\left(Y_{ij}^{+}\right)-g_{A}(Y_{ij}^{-})\right]$ denotes the change in the network statistic, $g_{A}(y)$, when Y_{ij} changes from 0 to 1. We should have special caution to interpret results in the logit form. For instance, a parameter η_{1} represents the change in the log-odds that would result from a one-unit change in the variable $g_{1}(y)$, when all other variables are fixed.