Knowledge Networks

WORKING METHODS FOR KNOWLEDGE MANAGEMENT

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Knowledge Networks

BY

DENISE BEDFORD

Georgetown University, USA

AND

THOMAS W. SANCHEZ

Virginia Tech, USA

United Kingdom – North America – Japan – India – Malaysia – China

Emerald Publishing Limited
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INVESTOR IN PEOPLE

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Introduction to the Series – Working Methods in Knowledge Management

Knowledge sciences as a discipline has a rich and diverse history dating back to the 1950s. In the past 70 years, the discipline has drawn theory and practice from economics, engineering, communications, learning sciences, technology, information sciences, psychology, social sciences, and business and organization management. To craft this discipline, we have developed our own language and terminologies, established our own peer-reviewed journals and built a rich research foundation, created a gray literature, and established a series of networks and conferences. Over the decades there have been many knowledge management education programs, but there is no consistent curriculum and few have sustained. It has been challenging for new practitioners to gain an understanding of the field. And, while the practice of knowledge management is growing around the world, it has not yet achieved the expected organizational stature. For knowledge management to rise to the stature of other business functions and operations, it must be able to speak the language of business, align with and support the way the organization works.

This series is designed for business and knowledge management practitioners. Working Methods in Knowledge Management is a multi-year and multi-volume series designed to address each and all of the methods required to establish and sustain an organization-wide knowledge management function. The goal of the series is to provide a business perspective of each topic. Each book begins by grounding the method in the business context – then translates established business models and methods to a knowledge management context. It is often the case that this translation expands and extends the business model and method.

The knowledge management literature is rich with introductory handbooks, guidebooks, cookbooks, toolkits, and practical introductions. This literature is an important starting point for anyone new to the discipline. We recommend all of these books as a way to build a fundamental understanding of the scope and coverage of the field. These texts will provide a good 10–20 page introduction to all of the key issues you need to be aware of as you embark on a new career in the field or have been assigned a new knowledge management role or responsibility. Once you have that grounding, though, we recommend that you look to the Working Methods in Knowledge Management texts as an intermediate source for understanding "What comes next? What now?"

Just as this series is not intended as a starting point for the field, neither is it an ending point. Each text is designed to support practical application and to foster a broader discussion of practice. It is through practical application and extended discussion that we will advance theory and research. The editors anticipate that as practice expands, there will be a need to update the texts – based on what we are learning. Furthermore, the editors hope the texts are written in a way that allows business managers to extend their work to include knowledge management functions and assets. We will learn most from expanding the discussion beyond our core community.

Joint Enterprise, Mutual Engagement, and a Shared Repertoire

From the outset, the publisher and the editors have established a new and different approach to designing and writing the books. Each text is supported by a team of authors who represent multiple and diverse views of the topic. Each team includes academics, practitioners, and thought leaders. Every author has grappled with the topic in a real-world context. Every author sees the topic differently today than they did when the project began. Over several months, through weekly virtual discussions, the scope and coverage were defined. Through mutual engagement and open sharing, each team developed a joint enterprise and commitment to the topic that is enduring. Every author learned through the discussion and writing process. Each project has resulted in a new shared repertoire. We practiced knowledge management to write about knowledge management. We 'ate our own dog food'.

Acknowledgments of Early Support

The series is a massive effort. If there is value in the series much of the credit must go to two individuals – Dr Elias Carayannis, George Washington University, and Dr Manlio Del Giudice, University of Rome. It was Dr Carayannis who first encouraged us to develop a proposal for Emerald Publishers. Of course, this encouragement was just the most recent form of support from Dr Carayannis. He has been a mentor and coach for close to 20 years. It was Dr Carayannis who first taught me the importance of aligning knowledge management with business administration and organizational management. Dr Del Giudice has been generous with his guidance – particularly in setting a high standard for all knowledge management research and practice. We are grateful to him for his careful review and critique of our initial proposal. His patience and thoughtful coaching of colleagues are rare in any field. The field will reach its full potential as long as we have teachers and editors like Dr Del Giudice.

Dr Denise Bedford, Georgetown University
Dr Alexeis Garcia-Perez, Coventry University

Preface

Overview of the Subject Matter

Knowledge networks draw from two fields – network science and knowledge sciences. Its foundation is in knowledge sciences, specifically the study of knowledge flows, grows, and changes in any context. Knowledge sciences teach us how to characterize knowledge assets, audit them, and create inventories of our knowledge stocks. Knowledge sciences also teach us how to model and measure these flows. We apply network sciences to knowledge flow models to track and quantitatively explain knowledge transactions and impacts in the knowledge economy.

Network science is an emerging discipline driven mainly by the rapid advances of technology in telecommunications, transportation, and disease surveillance. While it is a reasonably recent applied science, it is grounded in the well-established and tested statistics and analysis fields. The rapid growth and adoption of social media and social networking tools provide many new, rich opportunities to advance our understanding of human networks. Looking beyond social media, network science offers significant opportunities for modeling and monitoring knowledge flows.

The economic landscape of the early twenty-first century is transforming from an industrial to a knowledge-based economy. This shift has been in progress for the past 70 years. This shift was first observed by Machlup (1962) in the 1960s and has been further chronicled and characterized by other leading economists and researchers. Since the 1950s, economists have attributed the shift to the rise in importance of services, information, an increasingly educated and trained workforce, technology, and increasingly virtual work environment and increases in artificial intelligence and automation. The common element to all of these perspectives is the increased value of knowledge. In the twenty-first century, knowledge becomes a primary factor of production. It is equivalent to financial and physical capital in the industrial economy and to land and physical labor in the agricultural economy. The shift in the value and priority of capital – knowledge capital – means that organizations must now manage and monitor their knowledge assets and transactions as they historically treated financial and physical capital.

While the knowledge sciences literature provides an extensive treatment of knowledge flows, the research is fragmented. Knowledge flows are often studied in single case studies and defined as knowledge sharing, knowledge transfer, knowledge exchange, and knowledge translation. These characterizations reflect

psychological and behavioral science, social science, and communications science factors. The economic perspective and characterization are generally absent. The alignment of network sciences and these fundamental knowledge science concepts provides an opportunity for us to rigorously model and analyze these transactions.

Where the Topic Fits in the World Today?

Neither knowledge sciences nor network sciences are a new topic. The intersection, though, is a new area of research. There is a significant amount of literature entitled or described as addressing knowledge networks. In preparing to write this book, the authors learned that little of the existing literature provides in-depth coverage of actual knowledge transactions. While referred to as knowledge networks, much of the extant discussion focuses on general human networks. It reflects the evolving shift from an industrial economy, where network analysis was applied to the machine or non-human agents (e.g., traffic networks, telecommunications networks, disease transmissions), to a knowledge economy, where human networks are prominent. The challenge is that this evolution has not yet progressed to a focus on knowledge assets.

The knowledge networks' current treatment provides critical applications and translations of network analytics and metrics to human networks. It does not, though, focus on actual knowledge capital assets. The current treatment of knowledge networks represents an organizational design perspective. It explains how people are organized within organizations, how they communicate, and with whom they interact. It does not, though, focus on knowledge as the transaction. It portrays people as nodes but does not guide how to model a node as a knowledge producer or knowledge consumer.

Where the Book Fits in the Literature Today?

This text draws extensively from the work of intellectual capital management research in modeling knowledge assets. The authors characterize knowledge assets based on their economic properties and behaviors, drawing from knowledge and information economists' ground-breaking work. We draw from the social sciences and knowledge sciences literature to model knowledge transactions and to represent the factors that influence their behaviors. Additionally, we draw from both the peer-reviewed and the grey literature (e.g., open and non-peer-reviewed) on organizational network analysis to focus and structure the work in a way that is effective for everyday business managers. Finally, we interpret all of this good work in the context of economics.

Description of the Target Audience

This text is written for business managers who are experiencing and need to understand the factors causing the changing economic landscape. The book is written for organizational executives who need to begin transitioning what they manage

and managing their organizations from an industrial to a knowledge perspective. The book is written for human resource managers whose future role in knowledge organizations will be pivotal or non-existent depending on how they navigate that future. The book is written for knowledge management professionals and practitioners who need or are willing to synthesize and interpret the existing research on knowledge sharing, transfer, and exchange as network knowledge flows and transactions. Finally, the book is written for knowledge auditors and accountants to translate current financial and physical capital audits and accounting methods to knowledge capital.

Structure of the Book

The book is organized into four sections and 16 chapters. Section 1 is comprised of three chapters and introduces the reader to the role of networks in the knowledge economy. Section 2 is comprised of three chapters. This section provides a detailed exploration of network structures and behaviors. Section 3 is comprised of three chapters. This section explores different types of knowledge networks from the practical world. Finally, Section 4 is comprised of seven chapters. This section focuses on assessing the current knowledge network landscape, building knowledge network capacity, and defining network roles, responsibilities, and competencies.

Chapter Summaries

The summaries of all 16 chapters are provided below. The reader will also find extensive references to literature, to thought leaders and practitioners in that topic.

Chapter 1. Networks in the Knowledge Economy
In this chapter, the authors highlight the emerging discipline of network sciences and the evolution and adaptation of human networks. The change is considered in a shifting economic landscape and the importance of knowledge in the twenty-first-century knowledge economy. The chapter offers a fundamental definition of networks and explores the shifting geography of networks. Specifically, the authors explore door-to-door, place-to-place, and person-to-person network geographies. The authors model economic systems as networks and explain the role of human, structural and relational capital as nodes, messages, and links in networks.

Chapter 2. Network Structures and Components
This chapter focuses on the treatment and characterization of networks as an emerging discipline. The classic definition of networks is offered. The authors call out and explain the importance of network domains, network geographies and topologies, network behaviors, network nodes, network links, relationships and flows, and network messages. While network sciences provide a strong foundation for research and analysis, the authors note the lack of knowledge networks within

the broader networks discipline. This chapter highlights the need to expand coverage to include knowledge networks.

Chapter 3. Knowledge Networks
This chapter provides a deep dive into knowledge networks. An inclusive definition of a knowledge network is offered, with nodes as sources and targets of knowledge, relationships as knowledge links, and messages as knowledge transactions and flows. The authors note how knowledge networks differ from other types of networks, specifically their dynamic and chaotic state and continuous transactions. These peculiarities reflect the economic properties and behaviors of knowledge. The elements of networks described in Chapter 2 are elaborated for knowledge networks. The chapter calls out knowledge network domains, geographies, typologies, nodes, messages, and relationships.

Chapter 4: Network Nodes and Knowledge Sources
This chapter explores the role of nodes in knowledge networks. Knowledge nodes are defined by the type of actors they represent, including individual human agents, collective human groups and teams, explicit non-human objects and resources, and non-human agents and machines. Knowledge nodes are also characterized in terms of their role in the network, including as producer, consumer, or broker of knowledge. And in terms of the stock of knowledge, they represent their capacity to absorb knowledge made available in the network.

Chapter 5. Messaging Knowledge
This chapter explores the role of messages in knowledge networks. Messages are characterized in terms of the type of knowledge they represent and their attributes. Messages represent knowledge transactions in a network. The authors describe the type of message in terms of the knowledge capital it contains. The chapter considers what is involved in making all forms of knowledge capital available, accessible, and consumable in a network. Making knowledge available involves articulation – semantic, linguistic, visual, acoustic, and kinesthetic. Making knowledge accessible means encoding the knowledge, formatting, and packaging it as a message. The chapter also addresses factors that influence knowledge consumption, including coherence, completeness, verifiability, usefulness, relevance, orientation, freshness, and redundancy. The authors also provide examples of messaging human, structural, and relational capital.

Chapter 6: Network Links, Knowledge Flows, and Relationships
This chapter focuses on network links as knowledge flows and relationships. Knowledge links are defined as channels for communicating and distributing knowledge. The literature on network links is aligned with the literature on knowledge sharing, transfer, exchange, and appropriation. This chapter focuses on the peculiar attributes of knowledge network links, including the direction of the link, the length of link and distance between nodes, the strength and durability of the link, the concentration and congestion of links, the velocity of and impact of

links, the meaning and intention of a link, and the coverage and spread of links. The authors also describe standard configurations of knowledge networks.

Chapter 7. Developing a Knowledge Networks Strategy
This chapter highlights the importance of strategically managing knowledge networks. Strategic management is defined as being aware of current knowledge networks, understanding current knowledge stocks, and identifying gaps. It also involves assessing the knowledge needs of business units and ensuring that those needs are addressed. The chapter also highlights the importance of having a vision of a healthy knowledge network.

Chapter 8. Designing and Operationalizing the Knowledge Network Analysis
This chapter explains how to design and operationalize a knowledge network analysis. The authors walk through a nine-step methodology that addresses each stage of the process. The nine-step process is the result of an in-depth review of the theoretical and applied literature. The authors explain how and why each step contributes to the quality and goodness of the analysis. The risks of skipping or sub-optimizing steps are explained. The step-by-step process highlights the dependence of a knowledge network analysis on data sources. The authors explain the importance of identifying, collecting, and curating sources.

Chapter 9. Building Capacity for Knowledge Network Analyses
This chapter describes capacity building as a general concept and as a networking capability specifically. There are two essential components to building capacity. The first is building the network capacity, building relational capital, and sharing knowledge. The second is building the capacity to support knowledge network analyses. The authors offer a set of key questions for determining the health of networking capacity at the strategic, operational, and individual levels. The chapter also describes the roles and competencies required for network analysts, managers, and general employees.

Chapter 10. Scientific and Research Networks
This chapter focuses on scientific and research networks. All six facets of knowledge networks are described. The importance of three facets is called out, including domain, knowledge, and nodes. The authors provide profiles of five networks, including an invisible college in chemistry, a professional association network in engineering, an editorial network, a national biological observation collaboration, and a national science museum.

Chapter 11. Learning Networks
This chapter focuses on learning networks. All six facets of knowledge networks are described. The importance of three facets is called out, including geography, topology, and nodes. The authors provide four networks, including pedagogy networks – teachers, certification and professional learning networks, school networks, and informal and collaborative learning networks.

Chapter 12. Industry and Business Networks
This chapter focuses on business and industry networks. All six facets of knowledge networks are described. Three of the six facets have particular importance for these networks, specifically domain, relationships, and how messages are managed and controlled. The authors provide six network profiles, including health care industry networks, fashion industry networks, technology industry networks, food production industry networks, building industry networks, and transportation industry networks.

Chapter 13 Community and Group Networks
This chapter focuses on community and social group networks. All six facets of knowledge networks are described. The importance of three of the six facets is called out, including geography, domain, and the messages exchanged across the network. The authors provide profiles of five networks, including family networks, neighborhood networks, issue and support networks, community organization networks, gangs and criminal networks, and sports and gaming networks.

Chapter 14. Protective and Emergency Service Knowledge Networks
This chapter focuses on emergency and hastily formed knowledge networks. All six facets of knowledge networks are described. The importance of four of the six facets is called out, including domain, topology, nodes, and relationships among the networks' members. The authors provide four network profiles, including emergency and disaster response networks, law enforcement networks, military networks, and militia and vigilante networks.

Chapter 15. Civic and Political Networks
This chapter focuses on civic and political networks. All six facets of knowledge networks are described. The importance of three of the six facets is called out, including topology, domain, and messages exchanged across the network. The authors provide three networks' profiles, including civic and governance networks, advocacy networks, and political parties and networks.

Chapter 16. Networks of Things
This chapter focuses on networks comprised of explicit sources of data and information, and machines. All six facets of knowledge networks are interpreted for these types of networks. Given these networks' peculiar nature, three facets have particular importance, including geography, topology, and relationships. The authors provide several illustrative networks, including concept networks, semantic networks, citation networks, database networks, telecom networks, computer networks, energy networks, and robotics.

How this Book Impacts the Field?

The authors intend to provide a holistic picture of knowledge networks to help business managers understand how to better leverage the value embedded in their knowledge stocks and provide a foundation upon which to ground and grow

more productive and high-performance networks. The authors hope the practical coverage of the issues will give managers the insights and guidelines they need to develop healthy and high-performance knowledge networks.

The book aims to create a new dialog among knowledge scientists, network scientists, economists, business managers, organizational designers, and human resource managers around knowledge networks. We hope the experimental treatment will encourage those in the business community to expand this overview and introduce practical, working strategies. Bridging these perspectives and areas of practice is essential for success in the knowledge economy. This new context calls for a coalescing of perspectives and practices and a new focus on knowledge networks. Until this dialog begins, each area of practice will operate in isolation. Until this dialog begins, each area of practice will focus on part of the solution. Until this dialog begins, no one area of practice will effectively address the challenge. The authors hope this book will be a catalyst for that dialog.

How to Read this Book?

This book represents a blended practical and academic approach. How you read the book depends on your purpose. Suppose you are reading this book to learn how to translate and interpret network analysis to knowledge organizations, begin at the beginning. The book will walk you through the interpretation of ideas from related disciplines. If you are reading the book to gain a practical, real-world perspective of practical, everyday knowledge networks, begin with Section 4. Section 4 is comprised of chapters that define and explain how our everyday communities and institutions can be modeled as knowledge networks. From Section 4, you can refer back to the earlier chapters that provide context and explanations. If you are a manager who needs to design and implement an organizational knowledge network strategy and analysis, begin with Appendix A. Appendix A provides an easy-to-follow, step-by-step project plan. Regardless of how you read the book after reading the book, the authors encourage you to take your thoughts and experiences to your communities – to expand the dialog.

Note from the Authors

The authors have collaborated on this text during a period of significant change. The issues we had chosen to address were issues we all experienced firsthand. Our working environments changed from rich in-person physical interactions – at a local and international level – to sequential virtual activities. Our primary networks blended with our secondary networks. Networks were no longer associated with places or institutions but instead were all accessible through a single view. Zoom became our window to the world, and all of our networks were deliberate, intentional, and structured. Rather than serendipitous conversations and communications, our worlds became more deliberate, intentional, and scripted. We were forced to redesign kinds of events that had become commonplace (e.g., conferences, office hours and meetings, hallway conversations, brainstorming around a whiteboard, happy hours, and collegial dinners) to something entirely new.

Our work and home environments have blended. Becoming more virtual has opened our homes to our coworkers. What were previously segregated work networks have now become part of our home and neighborhood networks. Where work-related transactions happen is now – by definition – at and from home. When knowledge exchange happens is now whenever we have the time. Everyone has now become a part-time knowledge producer, broker, and consumer. The COVID-19 pandemic of 2020 propelled most societies into a knowledge economy. The pace of transformation accelerated dramatically. This dramatic change brought the economic changes into a clearer focus. Interactions and transactions designed for the physical environment have been forced to adapt to the virtual environment. The shift continues – we may not know the current situation's true effect for several years to come. We hope that the way we have framed this topic has value as we all navigate this shift.

Section 1

Networks in the Knowledge Economy

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Chapter 1

Networks in the Knowledge Economy

Chapter Summary

In this chapter, the authors highlight the emerging discipline of network sciences and the evolution and adaptation of human networks. The change is considered in the context of a shifting economic landscape and the importance of knowledge in the twenty-first-century knowledge economy. The chapter offers a fundamental definition of networks and explores the shifting geography of networks. Specifically, the authors explore door-to-door, place-to-place, and person-to-person network geographies. The authors model economic systems as networks and explain the role of human, structural, and relational capital as nodes, messages, and links in networks.

Why We Care About Networks?

Networks are inherent to human survival – we are social beings and rely on one another to prosper. Networks have been inherent to our social and economic structures, but they have been largely implicit. Networks have evolved from simple social structures to increasingly complex economic structures to today's knowledge networks (Castells, 2004, 2007, 2011a, 2011b, 2015). The rise of technology and communication technologies enables us to more visibly link people, institutions, and knowledge – we begin to see these networks and how they behave.

With the advances in technology and social media, these networks are now becoming visible. The number and types of networks have exploded over the past 50 years. We have become increasingly aware of networks and their effects. Knowledge scientists have realized the importance of making networks visible. Exposing invisible networks can help us to see how and where knowledge exchange and sharing occur.

In the knowledge economy, knowledge is the primary factor of production. The secret to understanding how knowledge is produced, consumed, and flows through communities, organizations, or societies is by observing how it flows through and affects knowledge networks. We have the opportunity to understand these

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structures, how they work and how we can leverage them in the twenty-first century. We must take and leverage this opportunity to ensure we're optimizing their value in the knowledge economy.

Networks – Definition and Characterization

In its simplest form, a network is an interconnected or interrelated chain, group, or system. Networks are the underlying structures of any phenomenon we understand to function as a system (Haythornthwaite & Wellman, 1998; Wellman & Berkowitz, 1988; Wellman & Frank, 2001). Networks connect computers to exchange and transmit data and information. Telecommunications networks are the foundation of modern communications. Transportation highways are networks that we use to support the mobility of people and things. Personal and social networks are formally or informally interconnected groups or associations of individuals at the base of society. Also, our economic systems can also be understood to be a network where producers and consumers engage in transactions and exchanges.

What do we mean by "network"? The essential network elements are nodes and links. Nodes are sources and targets of knowledge. Links are the relationships or communication transactions. Nodes can be thought of as origins, destinations, and transfer points of activity, energy, or information flow. Like nodes, which can have a large variety of characteristics that differentiate them from each other, the links between nodes also vary in how or whether communications occur. Social networks provide a relatively simple to understand example of links. For instance, whether two persons are linked when they "know" each other, influenced by the frequency and intensity of their communications with each other (Freeman, 2004; Hamel, 2014; Haythornthwaite, 1996; Haythornthwaite, Wellman, & Mantei, 1995; Ogburn, 1950a, 1950b; Parsons & Smelser, 1998; Wasserman & Galaskiewicz, 1994). From a social perspective, "knowing" has a wide range of meanings, values, or weights. Simple social networks assume homogenous or reliable ties, but other types and strengths can play very important roles in the overall network structure (Granovetter, 1973). Strong ties are assumed to consume a significant amount of time and energy, potentially limiting the number of possible connections for a node or person. Weak ties may serve to sustain a connection and facilitate communications but not be resource-intensive as the strong tie. In other words, a person may have a small number of strong ties with substantial flows of information, but only to a relatively small cluster compared to a person with many weak ties and thus, having a more extensive network.

Networks connect two or more points and serve as a transmission or distribution channel for any kind of goods or services. Over the millennia, we have leveraged the basic elements of networks to better understand the working of social systems, communication systems, economic systems, and the development of scholarship. Networks are of particular interest to knowledge scientists because they are the structures through which all forms of knowledge flow.

Shifting Geography of Networks

Every kind of network involves the exchange and transmission of something. Over the millennia, networks have evolved from the growth and development of mobility and technology. The earliest forms of networks were "Door-to-door." Door-to-door networks have geographies that are limited to neighborhoods and villages, where the individuals or groups acting as nodes are familiar to one another and where what is distributed is generated and consumed within the village or city boundary. As mobility increased and trade expanded, our networks evolved to "Place-to-place." In these types of networks, the range of reach of links among nodes expands to cover a much larger space. The most common cause of this expansion is the development of roads across countries and regions. When the geography of these networks expanded, so did our economic and social systems. The final stage of network evolution is the "Person-to-person" network. This new network geography is attributable to the expansion in communications. The geography of networks is no longer bounded by local structures or defined by places but now connects people directly.

Expanded network geographies coincide with the evolution and growth of our economic systems. The authors suggest that door-to-door network geographies are characteristic of agricultural economies. We suggest that place-to-place network geographies are characteristic of industrial economies. Finally, we suggest that today's person-to-person network geographies are fundamental to the knowledge economy.

Door-to-door Network Geographies

Door-to-door network geographies connect individuals or groups who are known to one another – they live in the same neighborhood (Fig. 1). People acting as nodes in these networks walked to visit each other. Communities or whole networks were spatially compact and also densely knit in their relationships and connections (Bodemann, 1988). Most commonly, these geographies represent agrarian villages, trading towns, or neighborhoods within a larger town. Mobility is physical. Typically, the networks in these geographies had less than 1,000 individuals. What is transacted among trusted partners who know one another? Routes for travel or exchange are limited and known. Communities are well-bounded, and most relationships occurred within those boundaries rather than across or outside them. Foot power was the primary communication resource. Mobility was physical, and it was limited to those who had the means to travel. Communication was constrained to close proximity. Additionally, the transfer of ideas and information was spoken and direct in these geographies. This means that the exchange was limited to real-time and was perishable.

These network geographies had effects on economic and social systems. Economic systems remained within neighborhoods in villages and trading towns. Social class was based on control over labor power and resources – economic concentration was defined by what existed in the location. An individual's position within the social structure and their access to resources were defined by the local community. Only the wealthiest or those with the highest status and resources traveled to larger market towns, universities, and resorts.

Fig. 1. Graphic Examples of Door-to-door Networks.

These early network geographies had many challenges and inequalities. Individuals were limited to readily available resources and the supply of those resources. Densely knit local communities made command and control social and economic systems the norm. Tightly managed boundaries meant that few resources moved outside those boundaries without control. Perhaps most significant of all, there was only one dominant network – the only alternative to this tightly controlled networked economy was to leave the economy. This meant that who produced and consumed was limited traditionally to those who held resources and power. It means that what was exchanged was limited to commodities locally produced and sourced and to local knowledge. The value of commodities exchanged was also locally defined, and exchange may have taken the form of barter rather than a currency exchange. Exchanges and transactions were also local. Local control and access also resulted in the bounding and impediment of knowledge flows. The Door-to-door network geography aligns with the earliest forms of knowledge representation and knowledge exchange. In this geography, the key characteristics of knowledge are that (1) when it is encoded, proximity and physical access are determinants; (2) interactive exchanges are highly local, and (3) knowledge exchange is limited to existing relationships and channels, dependent upon the longevity of those channels, perishable and high risk. The limited proximity of knowledge assets and flows has inherent constraints on the rigor and review of those assets.

Place-to-place Network Geographies

Place-to-place communities operate in a contextual vacuum – automobile travel, telephones, and mail (Fig. 2). Place-to-place network geographies link households that are not in the same neighborhoods. In these geographies, people go somewhere

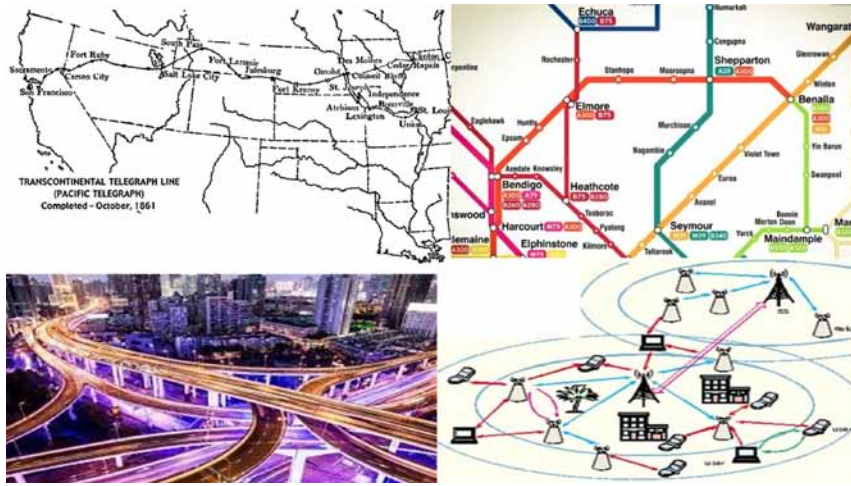

Fig. 2. Graphic Examples of Place-to-place Network Geographies.

to meet someone. People telephone somewhere to talk to someone. Community networks now contain high proportions of people who enjoy interacting with each other and low proportions of people who are forced to interact because of juxtaposition or colocation. In these networks, the basis for relationships is more voluntary and selective than the public communities of the agricultural economy (Ogburn, 1950a, 1950b; Wellman & Leighton, 1979; Wellman & Wetherell, 1996).

In Place-to-place network geographies, there is a shift away from individual households in neighborhoods that were so important in the door-to-door network. Communities extended beyond neighborhoods to spatially dispersed communities. Individuals develop social relationships and interactions across larger spaces. Community is defined along with a different set of parameters than simple proximity. Social and economic systems are built and maintained through phoning, writing, driving, railroading, transiting, and flying.

These network geographies emerged with and were driven by revolutionary developments in both transportation and communications. The developments began with the emergence of movable type, the pony express, the telegraph, and the telephone. The movable press meant that far greater numbers of people could receive and consume information – assuming they could interpret the information. This development leads to an increased demand for writing and reading skills. This represented a major shift away from the spoken transmission of ideas in the door-to-door geography. The telegraph represents the introduction of communications divorced from place and physical transportation. It increased the speed of routine communication. The telephone further affected the spatial and social structure of communities. It increased the speed of communication further and exponentially increased the number of nodes in a network.

The scale of transactions also expanded with these new geographies. Printing technologies allowed the scale of reproduction to increase rapidly, and transportation technologies extended the reach these materials could be distributed. In the nineteenth century, the advent of electronic communications with the telegraph meant the speeds and distance of information transfer could be increased dramatically. But this also meant that a physical network would be needed, creating links between users so that electronic signals could be sent and received. Again, the need to physically connect points of communication remained a barrier. However, initially, this gave rise to a hub and spoke configuration of network connections. It was several years after the telegraph that wireless radio was invented. In theory, the communications network could be infinite within geographic proximity (limited by signal strengths) because anyone with a radio receiver could become a node on the network. Radio and then later, television "networks" greatly expanded the footprint for transferring information, entertainment, and commerce. The airwaves, and regulation thereof, controlled the access and expansion of mass wireless communication activity. The history of this is well documented, and the influence of these forms of communications will be discussed later.

Each technological advance enables people and institutions to reorient and redefine relationships. These developments have also affected our economic relationships significantly. As transportation improved – networks expanded beyond village or distances that could be managed – consider the growth of networks with trade routes such as the Silk Road and the rapid advance of knowledge with marine trade routes and then highways. The industrial economy was the full beneficiary of a Place-to-place network geography. These networks expanded to include more complex relationships and chains for the supply, production, marketing and promotion, consumption of manufactured goods.

These network geographies affect the nature of our social and economic systems. Individuals now have the ability to connect across classes. There is decreased control over individuals' behaviors and decreased commitment to members' well-being. Instead of single dominant network geography based on proximity, individuals now have multiple and fragmented networks and greater choices of networks to join. It becomes easier for individuals to disengage from networks – to become lurkers. In these geographies, individuals can re-establish relationships quickly with others who are remote. There are fewer interactions based on inherent characteristics such as age, gender, race, and economic class and an increased number based on achieved characteristics developed over a lifetime, for example, lifestyles, shared norms, and voluntary interests. In these new geographies, there is still a reduced sense of relationships and a reduced sense of belonging.

At the same time, there are increased opportunities, contingencies, globalization, and uncertainty as economic systems expand exponentially with these new geographies. Who can produce and who can consume is no longer limited to a village or neighborhood. A new economic role of distributor and broker also emerges with these new network geographies. These new economic networks create a more fluid system for accessing capital resources – financial, physical, and knowledge. These new economic networks also enable individuals to switch