Network Optimization in Food Innovation Districts

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DBA 850

May 19, 2020

Abstract

Innovation districts represent a new path forward for economic growth and business development. In particular, food innovation districts lead to new products, advances in production, safety, nutrition, and other advances that have broad societal and enterprise benefits. However, most innovation does not happen in a vacuum. It takes the cross breeding of ideas and efforts in a conducive environment – networking. This paper analyzes existing research to determine the appropriate characteristics necessary to optimize food innovation districts' networking assets. Using a systematic review of 23 scholarly articles, three key themes to consider for optimizing the networking assets of food innovation districts were identified: participants, operational flow, and operational environment (place). This research is helpful to practitioners as it provides insight to enhancing innovative business and economic development. For scholars, this paper advances the literature in innovation, business development, and network design and management.

Key words: Network Theory, Innovation, Small Business, Food, Innovation District, Economic Development, Networking, SME, Public Administration, Public Management

Introduction

Problem Statement

Innovation districts exist as unique geographic areas that attract skilled artisans and entrepreneurs focused on participating within certain industry clusters. These artisans and entrepreneurs, when co-located with anchor institutions, research institutions, and other contributing assets, can drive economic activity and growth through innovation. Innovation districts can take many forms. For example, Hollywood is an entertainment focused innovation district, while Wall Street and Silicon Valley are innovation districts centered around other industries. This research will be aimed food innovation districts (FIDs).

All innovation districts contain economic, physical, and networking assets (see Figure 1). When these three assets combine with a supportive, risk-taking culture, they create an innovation ecosystem - a synergistic relationship between people, firms, and place (the physical geography of the district) that facilitates idea generation and accelerates commercialization (Katz & Wagner, 2014).

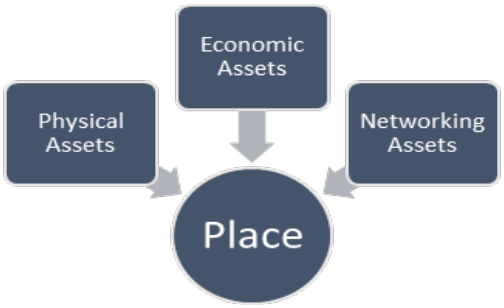

Figure 1. General framework of innovation districts

Networking, as one of the three key assets, allows innovation district members to share information, access resources, face challenges, and improve their competitiveness, along with other benefits (Kuhne, 2014). In the food industry, innovation does not draw purely on firm-level R&D. It involves learning and other processes that benefit from interaction across different enterprises as described in the theory of the New Economy (Avermaete & Viaene, 2002;

Weaver, 2008). Yet, the nature of how networks operate within innovation districts is not clearly defined. Through this research, the relationship between innovation districts and business networking will be explored. With a focus on the food industry, the intent is to determine if there are any key themes associated with network optimization within food innovation districts that help accelerate businesses.

Research Question

Research has shown that industrial clusters / innovation districts can have a positive impact on innovation (Marshall, 1920; Arrow, 1962; Romer, 1986; Glaeser et al., 1992; Jacobs, 1969) and that innovation is a primary driver of national or regional economic competitiveness (Soriano et al., 2018; Benneworth & Hospers, 2007; Cooke, 2017; Lee et al., 2014). Structurally, the Brookings Institute identified networking assets as one of the vital elements of innovation districts (Katz & Wagner, 2014, p. 2). What is not obvious is the criteria or factors needed for companies to find positive value from the networking assets. It can be assumed that different industry clusters may require different compositions of the three assets identified by Katz and Wagner (2014). Thus, for the purpose of this research, the food industry will be the primary lens through which networking assets in innovation districts will be assessed. As a result, an initial research question was proposed: What is the relationship between small business acceleration within food innovation districts and the food networking assets of the districts?

This research question was refined using a PICOC (Population, Intervention, Comparison, Outcome, Context) assessment with the results shown below (Barends, Rousseau, & Briner, 2017):

- **Population**: Businesses within food innovation districts
- **Intervention**: Networking assets with optimal characteristics

- **Comparison**: Sub-optimal or non-existent networking assets
- **Outcome**: Business innovation/development and regional economic growth
- **Context:** Food companies, non-agriculture (farms)

Based on the PICOC assessment, a final research question was derived: What are some key characteristics of networking assets within food innovation districts that help drive business innovation and growth? This descriptive research question was selected to help food innovation districts' key influencers, stakeholders, businesses, and policymakers more adequately manage their districts.

Theory

Theoretical Framework

Network Theory was selected to serve as the theoretical framework for this systematic review. Network Theory refers to a group of methods that help understand and interpret systems that consist of relationships between multiple subjects (Kalso, 2018). The focus of this research is on food companies and their networking interactions within innovation districts. Network Theory is being used because it examines the relationship between individual actors as they pertain to a macro-level social environment (Granovetter, 1973).

Networks operate as a connection of nodes or actors (individuals / firms / organizations) and ties (the relationship between the nodes) (see Figure 2). These ties can be strong or weak and the network itself can be broad or very tight. There are beneficial tradeoffs to each combination (Onday, 2016). The importance of the theory, however, is not just the composition of the nodes and ties, but the interplay of the entire system.

Wellman (1988) posits that there are five core principals of networks to be examined. First, behavior of people is best predicted by examining their relationships. Second, the focus of

analysis should be on the relationships between the nodes, not the nodes themselves. Third, nodes should not be analyzed under the assumption of independence – every actor is inter-related. The fourth principle is that the network is more than the aggregation of ties and nodes; a relationship between a tie and nodes also includes the other ties and nodes in the system. The final principle is that nodes or groups of nodes can have strong or weak boundaries and ties. Networking is more of a complex overlay of relationships than neat connections.

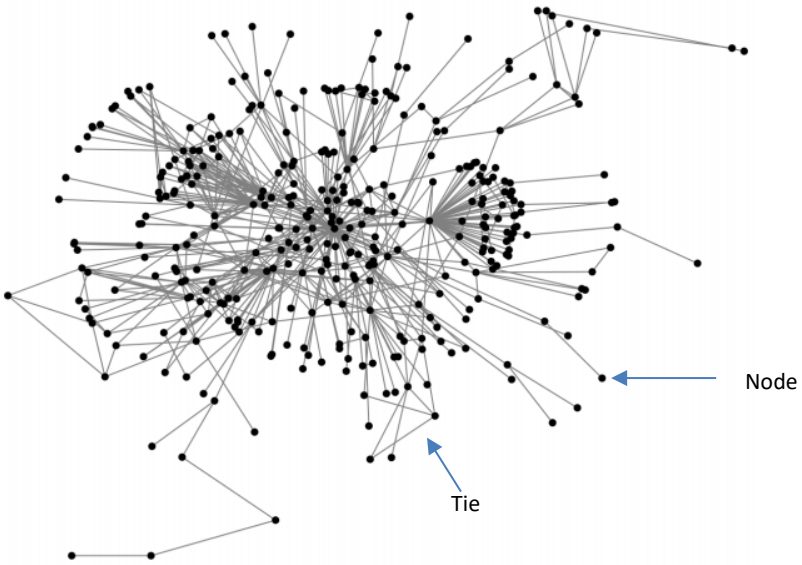

Figure 2: A graphic example of Network Theory. In this representation, the dots represent nodes with the lines connecting the dots representing ties.

This theoretical framework was selected because it allows innovaton district networking to be examined beyond the relational bounds of any one individal business or other innovation district actor. It allows for an examination of the entire network. Additionally, Network Theory has been used frequently to examine business activity (Huggins & Thompson, 2015; Jones, 2008) and economic conditions (Soltész & Zilahy, 2020; Lindstrand & Hånell 2017; Blackmond, 2018) with a focus on the actors within the network.

Theoretical Lens

Positioning Wellman's (1988) five core prinicpals of networks for examination, Onday (2016) suggests that there are three analytical levels from which a network can be viewed, the ego – direct contacts between the nodes/actors, the overall network – all actors and relationships within the network, and network position – an actor's positon within the network. For food innovation districts, the ego represents the individual relationships between the actors. The overall network is the complete collection of actors and relationships within the food innovation district. Finally, network position of each actor should not be viewed as simply the cluster of nodes in which the actor belongs. It should also include the position of the actor's relationships across clusters of nodes.

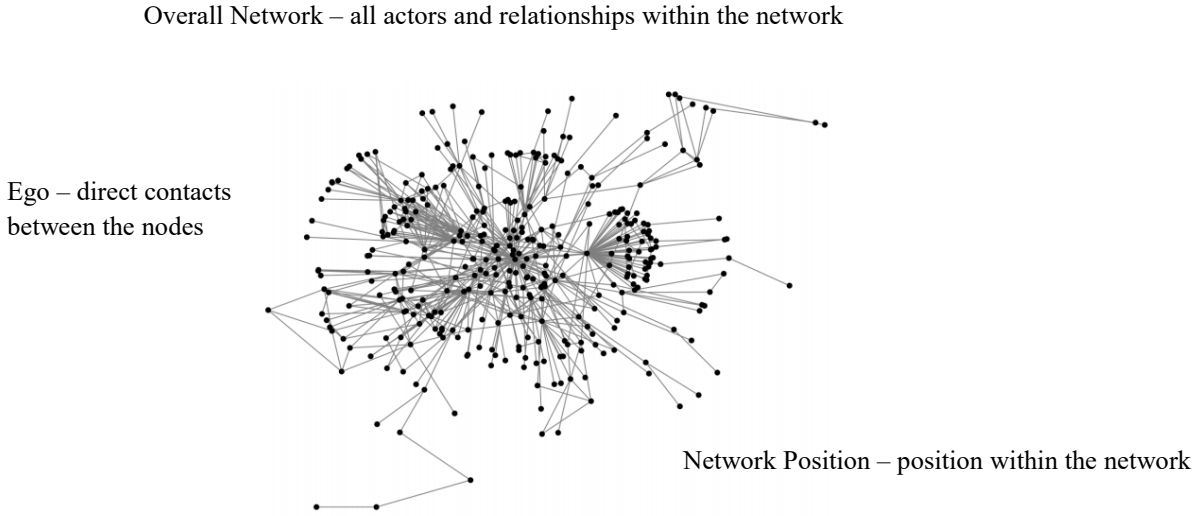

Figure 3: Onday posits that a network can be examined from the perspective of the Ego, Network Position, and the Overall Network.

Additionally, there are key network charactertistics that should be examined (Onday 2016): distance between actors; centrality – how important an actor is in the system; clustering – the number of ties among and ego network; structural holes – the gap in additive benefits within a network; equivelancy – the similiarity of relationship patterns of actors; density – the percentage

of possible relations in a network that are observed; centralization – the level at which some actors well connected and others are not

Conceptual Framework

When applying Onday's three analytical levels of network analysis to the research question, a conceptual framework can be devised as demonstrated in Figure 4. In this conceptual framework, the network exists as an influencer to and is influenced by the district actors and their direct relationships, individual actors' positions within the network, and the complete composition of the actors and relationships. To answer the research question, what are some key characteristics of networking assets within food innovation districts that help drive business innovation and growth, ego, network position, and the overall network of food innovation district networking is assessed via Onday's key networking characteristics.

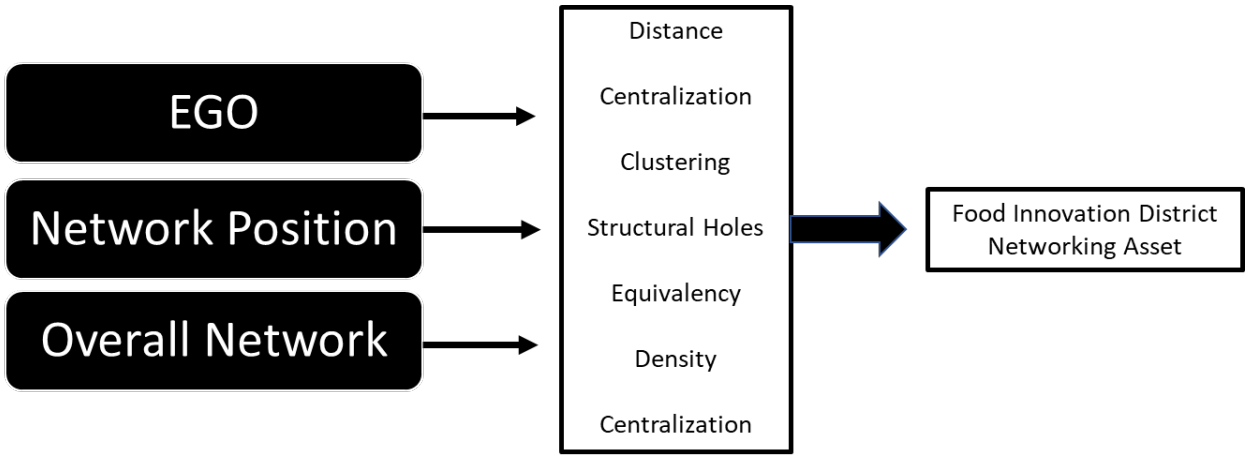

Figure 4. Conceptual framework of Network Theory applied to the examination of food innovation district networking assets.

Alternative Views

Stakeholder Theory was considered as an alternative theoretical framework that could be applied for this systematic review. Stakeholder Theory conceptualizes the firm as a series of groups with different respective relationships to it. Stakeholders consist of internal organizational

members, including employees, managers, and board members; external members, such as owners, customers, suppliers, and competitors; and hybrid members engaged in interorganizational cooperative activity with the firm (Schneider, 2002, p. 211). Additional alternative views considered were Resource-Based View and Resource Dependency Theory. The disadvantage of all three theoretical frameworks as applied to this work is that each of the three theories is focused on the individual actor as it functions within the operating environment, whereas the intent of this research is to understand the operating environment and its impact on the individual actors.

Methodology

Evidence-Based Approach

Evidence-based management encourages the use of the best available evidence and helps organizations to identify evidenced information to keep management informed (Aninag, 2014). The "evidence-based approach to management reduces the potential for irrational thinking, bias, or exhaustion" (Price, 2018; Rynes, Giluk, & Brown, 2007). Evidence-based management is science and data driven (Price, 2018).

This research began with a search string based on words and associated synonyms from the research question. Inclusion / exclusion criteria were then determined, and literature was selected. A critical appraisal of the articles was also performed to assess the quality, with key data then being extracted for review. Coding was then performed to synthesize the data.

Search Process / Literature Selection

An application of the search strings and cited reference search generated 977 total results for consideration. A broad preliminary search consisting of the string: food n5 innovat* AND

district was initially used on the "OneSearch" internet library database advanced search tool. This first search returned 632 results.

Based on the PICOC assessment and refined research question, a librarian-assisted search on "OneSearch" internet library database advanced search tool was completed. This search returned 338 additional results using the following search string: food n5 innovat* n5 AND (expan* OR accelerat* OR invest* OR incubat* OR develop*) AND (anchor* OR institut* OR research* OR universit* OR college* OR corporat* OR partner* or associate* OR foundation* OR investigat*) NOT security.

A Google Scholar and cited reference search was also conducted and yielded 7 additional articles using the following search strings: food AND innovate AND business AND network AND entrepreneur AND district AND growth. The Google Scholar search was not exhaustive as it appeared to duplicate the OneSearch results for the first 15 pages.

After removing duplicates and non-scholarly articles, 291 articles were considered for this research. Screening of titles, abstracts, and publication dates resulted in 268 articles being excluded. A major consideration within the search criteria was the search term “technology” and associated iterations. Most of the articles were focused on food technology and innovation associated with food technology. However, searching with the exclusion of the term “technology” and its iterations severely limited the results and excluded relevant articles. Not excluding the term resulted in a large number of articles that were not relevant. The solution to this dilemma was to allow for technology related articles in the results and manually filter them out.

As a result, 23 research articles were included in this systematic review. The article selection process is illustrated in Figure 5, which includes a flowchart for article selection using

Preferred Reporting Items for Systems Reviews and Meta-Analyses (PRISMA) (Moher, Liberati, Tetzlaff, & Altman, 2010).

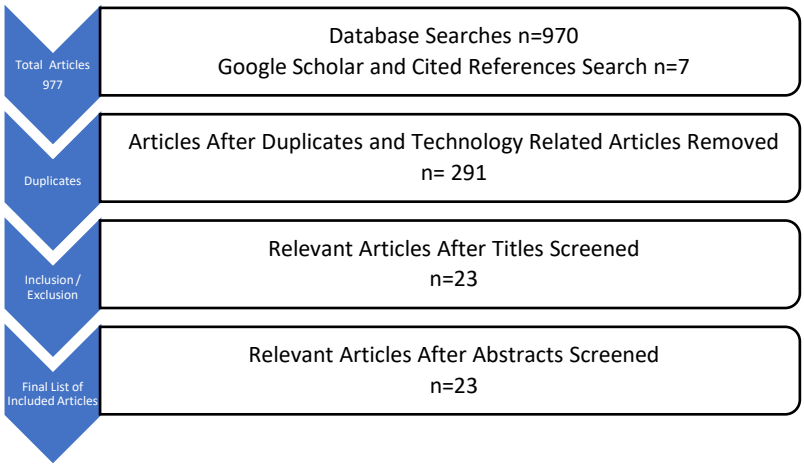

Figure 5. The PRISMA for this systematic review resulted in 23 articles for review.

Inclusion/Exclusion Criteria

For this review, the goal was to ensure that no less than 85% of the articles were published between 2015 and 2020. Articles had to be published in a scholarly journal and had to be published in English. Articles that were identified to not include applicable titles and/or abstracts were disqualified. No constraints were applied related to the location of the research. Additionally, it was important that articles had to be directed toward economic networking, food networking ecosystems, innovation districts or ecosystems, and business growth. To ensure that the research stayed focused, articles centered on food security, food technology, agriculture hubs (often called food hubs), niche food industries, or policy making without a food business networking context were excluded.

Quality Assessment of the Literature

Transparency, Accuracy, Purposivity, Utility, Propriety, Accessibility, and Specificity (TAPUPAS) was selected as the quality appraisal tool for this systematic review. According to Long, Grayson, & Boaz, (2006), TAPUPAS appraisal provides a standardized framework for

constructively assessing the quality of evidence in a body of knowledge. A five-point scale was used to rate each article as either 1 – Very Poor, 2 – Poor, 3 – Average, 4 – Good, or 5 – Excellent. These appraisal ratings were then totaled and presented as scores for each article. Scores were categorized as Low (0 - 11), Medium (12 - 23), and High (24 - 35). The quality appraisal is illustrated in the Quality Appraisal Chart in Appendix A. The appraisal resulted in the 23 articles being rated as High, within the range of 29 and 35.

Data Extraction

Each article offered useful information: sector / population, design and sample size, main findings, effect size, and limitations. Main findings were selected from the findings and discussion sections of each article for synthesis to develop themes. The Data Extraction Chart can be viewed in Appendix B.

Coding, Categorization, and Themes

A thematic synthesis was used in this research in accordance with the research question and the theoretical framework. After completing the quality assessment, the coding of core themes allowed for thematic analysis and synthesis of the data. According to Bowen (2009), organizing data into central themes is a form of pattern recognition, providing an opportunity for integration.

Themes across the 23 studies include: horizontal and vertical networking, application of shared knowledge and resources, generation of knowledge and resources, knowledge and resource transfer, the value of an attractive and inviting environment, decentralized and non-competitive interactions, informal management, and clustering. Additionally, there were actors (nodes and egos) who were repeatedly listed in the literature. This list of network actors

represents the theme of appropriate participants. The themes were then reviewed and evolved into three overarching findings.

Findings

The systematic review resulted in three key findings. This was based on the emerging themes from the coding synthesis. The first finding is that the appropriate participants should be in the network. The literature frequently cited the following actors as participants within observed food innovation district networks: companies, customers, collaborators, suppliers, competitors, farms, science/technology institutions, public research institutions, workforce development agents, and education assets (Kuhne et al., 2015; Lefebvre et al., 2014; Vaz et al, 2004; Radziwon & Bogers, 2018; McAdam et al, 2015; McKelvey & Ljungberg, 2016; Chojnacki & Creamer, 2019; Pittaway et al., 2004). This finding relates to the Egos within the food innovation district. Additionally, the existence of each actor and their involvement within the district impacts the district's distance, clustering, and structural holes. The actors' level of participation impacts the district's equivalency, density, and centralization.

Beyond participants within the network, the second finding can be called the operational flow of the network. This includes the observation that there are two distinct network positions within the network – knowledge and resource application and knowledge and resource generation. The actors identified in the first finding fall into one of these two network positions (Pittaway et al, 2004; Brink, 2018; Nestle, 2019; Vaz et al., 2004; Huggins & Thompson, 2015; Uhm et al., 2018). Additionally, within this finding, the literature supports the notion that information and resources emanate between these two network positions. The literature showed that, in networking, the transfer of information and resources occur in two different directions – vertically, between the actors of the two positions and horizontally, between actors within the

knowledge and resource application network position (Radziwon & Bogers, 2018; Sun, et al., 2018;McAdam et al, 2015; Melvey & Ljungberg, 2016; Kuhne et al., 2015; Markarov & Ugnich, 2015; Brink, 2018; Mo et al., 2020; Soriano, et al., 2018). This finding is impacted by the distance between actors, as determined by the network positions of all actors in the district. This finding could also be affected by the density of the network and the centralization of the actors as they participate in information and resource transfer opportunities.

The final finding identified throughout the literature was the emphasis on the operational environment (place) in which the network exists. This includes concepts such as decentralized organizational structures, informality of participation, organic cultural development, non-competitive interactions and information exchanges, and frequency / availability of information sharing opportunities (Gellynck et al., 2007; Nestle et al., 2016; Vaz et al., 2004; Huggins & Thompson, 2015; Pannekoek, et al., 2005; Pittaway, et al., 2004; Garcia-Cortijo, et al., 2019; Funk, 2014; Garcia & Chavez, 2014; Soriano, et al., 2018; Mo, et al., 2020; Brink, 2018; Roundy, et al., 2018; Markarov & Ugnich, 2015; Esmaeilpoorarabi et al., 2017; Esmaeilpoorarabi et al., 2020). This finding describes a condition of the overall network. As such, it has an impact on all key network characteristics. The operational environment houses the conditions that host the actors, ties, and overall network.

Discussion

Management Implications

As identified in the second finding, innovation district networking can not and should not be centrally controlled. However, leaders who have a stake in food innovation economies can take some actions to influence networking to encourage the optimality of it as an asset. The most

important aspect of the network was shown to be the operational environment of the network (place), finding number three. In economic development, placemaking is the act of creating desired features within a community to make it attractive and more functional. This should be the primary focus of community leaders for network optimization purposes. From a policy perspective, it is important to ensure that policies don't disrupt the ability to create the inviting and productive operating environment identified in finding three. Such unconstructive policy positions could be those that discriminate or otherwise discourage the participation of actors and egos in the network or tax positions that encourages activity to occur in another location.

Managers should also seek to ensure that there are ample opportunities for informal, non-competitive networking within the community. Since the findings identified the settings for the transfer of information and resources as mostly informal, it can be assumed that operating environments with adequate social settings, e.g. nightlife, well-performing schools, social clubs, and other meeting places should also be a key priority for community leaders. This would also include settings that allowed for the display of new technology and artistic creations. This social setting is important for the transfer of information and resources identified in finding number two.

Limitations

This systematic review is limited in several ways. The scope was limited to include no more than 25 articles in the review. The findings are solid and supported. However, a more exhaustive view may uncover more themes, leading to more findings. Many of the studies were based on food innovation districts based outside of the United States. Additionally, many of the studies were focused on networking for the advancement of food technology and artistic creativity. There may be opportunities to explore networking for financing, marketing, and other

food business services. By design, agriculture-based (farming and farming co-op) studies were excluded from this systematic review. This was done to more narrowly focus the research. Finally, this research did not delve into the networking within the clusters of key actors. Doing so would have reduced the ability to answer the research question. However, it could be argued that there is variability with the interaction of the egos and as a result, additional or even different dynamics for food innovation district networking at a more micro level.

Scholarly Considerations for Future Research

The research results and limitations of this study demonstrate that there is ample opportunity for future research on this topic. Of the many potential avenues of research, egos within networks are prime targets for further exploration. It would be useful to understand the nature of horizontal networking between actors within each of the egos in food innovation districts. Additionally, for leaders seeking to develop and/or strengthen food innovation district networking, it would be important to understand the value proposition for the knowledge generation actors necessary for district. Finally, place appeared to be the most important aspect of the network and the aspect that can be impacted most directly by leaders. As such, exploring the attributes of place that most positively correlate with network optimality would not only add to the scholarly knowledge, but could provide significant value at the practitioner level.

Conclusion

This systematic review will help economic development, business, and other leaders improve the functionality of their food innovation districts. Innovation districts, whether they be food related or other industry focused, use networking as fuel for innovation and business development. This systematic review was performed with sufficient transparency and rigor using 23 scholarly articles. Those articles were quality appraised using TAPUPAS with all 23 resulting in High quality ratings. The data extraction and analysis allowed for the evaluation of key data to lead to answering the research question. As a result, the understanding of networking characteristics within food innovation district networks was advanced.

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Appendix A

Quality Appraisal Chart

Author(s) & Year	Transparency	Accuracy	Purposivity	Utility	Propriety	Accessibility	Specificity	Score
Chojnacki, Creamer (2019)	4 There could have been more transparency in the process that each stakeholder took	3 Data was based on the claims of the studies from each stakeholder	4 The methodology taken was a systematic review	5 The information is useful for answering the research question	5 Review was done in an ethical manner	4 Understandable research report	5 Does not appear to violate any standards	30
Esmaeilpoorarabi, Yigitcanlar, Guaralda (2017)	5 Case study approach	4 The information is supported by source documents.	5 The research methods were suitable for the task	5 The information is useful for answering the research question	5 The research was done in an ethical manner	5 The multiple use of tables was helpful for displaying the results	5 Does not appear to violate any standards	34
Esmaeilpoorarabi, Yigitcanlar, Kamruzzaman, Guaralda (2020)	5 Case study	4 The information is supported by source data	5 The research methods were suitable for the task	5 The information is useful for answering the research question	5 The research was done in an ethical manner	5 The multiple use of tables was helpful for displaying the results	5 Does not appear to violate any standards	34
Funk, (2014)	5 Data analysis on 454 nano-tech companies	5 The information was supported by the data	5 The methodology was appropriate	4 The information was useful for understanding networking in innovation, but not food related	5 The research was done in an ethical manner	5 Effective use of tables and graphics to display information	5 Does not appear to violate any standards	34

Garcia, Chavez (2014)	4 Extensive Literature Review	3 Knowledge claims are supported however, with literature reviews there is always a chance for selection bias	4 The methodology taken was a review	5 The information is useful for answering the research question	5 Review was done in an ethical manner	4 Understandable research report	5 Does not appear to violate any standards	30
Garcia-Cortijo, Castillo-Valero, Carrasco (2019)	5 Linear regression on a database of 771 food companies	5 Claims are supported with given data	5 The methods were suitable for the research conducted	5 The results were completely aligned with the research question	5 The research was done in an ethical manner	5 The multiple use of tables was helpful for displaying the results	5 Does not appear to violate any standards	35
Gellynck, Vermeire, Viaene (2007)	5 Survey method	5 The information is clearly supported by data	5 The methods were suitable	5 The results were completely aligned with the research question	5 No ethical concerns with the research	5 Very well-structured report	5 Does not appear to violate any standards	35
Huggins & Thompson (2015)	5 Extensive literature review	4 The information was supported. However, there is always a question of the exhaustive nature of the review.	3 Claims made could have been better supported with original research	5 The information is useful for answering the research question	5 Review was done in an ethical manner	5 The information was put together in a well-structured manner	5 Does not appear to violate any standards	32

Kuhne, Gellynck, Weaver (2015)	5 Process was clearly delineated allowing the reader to understand what was done	5 The information is clearly supported by data	5 Research methods were suitable for the task	5 The information is useful for answering the research question	5 The research was done in an ethical manner	5 The information was organized in a manner that was easy to read and understand	5 Does not appear to violate any standards	35
Lefebvre, Raggi, Viaggi, Sia-Ljungstrom, Minarelli, Kuhne, Gellynck (2014)	5 Choice experiment exercise with 231 firms.	5 All claims clearly supported by data	4 Research method was suitable. The alternative analysis added unique insight	5 Results we informative and relevant to the research question	5 The research was done in an ethical manner	4 Understandable research report	5 Does not appear to violate any standards	33
Brink (2018)	5 Longitudinal study of 30 SMEs	4 The information is supported by source documents.	4 This was a systematic review; thus, the assumption is that the information is suitable	5 The information is useful for answering the research question	5 The research was done in an ethical manner	4 Understandable research report	5 Does not appear to violate any standards	32
McAdam, McAdam, Dunn, McCall (2014)	5 Process was clear (qualitative)	4 Data was presented in a table to support the findings	4 Research method was multi sourced allowing for variability, yet confirmation	5 The information is useful for answering the research question	5 The research was done in an ethical manner	3 Information was clearly delineated. However, could have used more data	5 Does not appear to violate any standards	31
McKelvey, Ljungberg (2016)	5 Clear process - case study with 66 projects	3 Data was sufficient to match findings. However, there could have been more rigor	4 Research method was appropriate	4 The information helped answer the research question	5 The research was done in an ethical manner	4 A table would have helped display the results better	5 Does not appear to violate any standards	30

Mo, He, Yang (2020)	3 The authors clearly showed how they calculated their results and the source. But did not discuss how they captured their data.	5 The information is clearly supported by data	3 Because the authors did not describe how they collected the data, it is unclear if the methods were appropriate	5 The information is useful for answering the research question	5 The research was done in an ethical manner	3 Information was clearly delineated. However, could have used more clarity.	5 Does not appear to violate any standards	29
Nestle, Taube, Heidenreich, Bogers (2018)	4 102 survey responses from multiple firms	5 The information is clearly supported by data	4 Research method was appropriate	5 The information is useful for answering the research question	5 The research was done in an ethical manner	4 Understandable research report	5 Does not appear to violate any standards	32
Pannekoek, van Kooten, Kemp, Omta (2005)	5 Process was clearly delineated allowing the reader to understand what was done	4 Data was presented in a table to support the findings	5 the methods used were appropriate for the research question	5 The information is useful for answering the research question	5 The research was done in an ethical manner	5 The information was organized in a manner that was easy to read and understand	5 Does not appear to violate any standards	34
Pittaway, Robertson, Munir, Denyer, Neely (2004)	5 Systematic review	5 Information was properly cited and supported. This article was cited by many others	4 Systematic review was useful	5 This study is cited often and does inform the research question	5 Review was done in an ethical manner	5 Easy report to read	5 Does not appear to violate any standards	34
Radziwon, Bogers (2018)	5 Interviews and field observations	4 conclusions are supported by material presented	5 the methods used were appropriate for the research question	5 The information is useful for answering the research question	5 The research was done in an ethical manner	5 The use of tables and helped deliver the information effectively	5 Does not appear to violate any standards	34

Roundy, Bradshaw, Brockman (2018)	2 The paper does not show the original research. However, it does show the sources.	4 The information is supported by source documents.	4 this was a systematic review; thus the assumption is that The information is suitable	5 The information is useful for answering the research question	5 Review was done in an ethical manner	4 Understandable research report	5 Does not appear to violate any standards	29
Soriana, Villano, Fleming, Battese (2018)	5 Analysis of government data	4 The information is supported by source documents	5 the methods used were suitable for the data that was used	4 the knowledge generated added to answering the research question	5 The research was done in an ethical manner	5 The information was organized in a manner that was easy to read and understand	5 Does not appear to violate any standards	33
Sun, Zhang, Cao, Dong, Cantwell (2019)	4 Analysis of government data	4 The information is supported by source documents	3 Methods used were suitable, however there is a question about ensuring no bias from government	4 The information is useful for answering the research question	5 The research was done in an ethical manner	5 The information was organized in a manner that was easy to read and understand	5 Does not appear to violate any standards	30
Uhm, Sung, Park (2018)	5 Assessment of 3 internationally known accelerators	5 Well supported claims	5 the methods used were appropriate for the research question	4 The information is useful for answering the research question	5 The research was done in an ethical manner	5 The multiple use of tables was helpful for displaying the results	5 Does not appear to violate any standards	34

Vaz, Cesario, & Fernandes (2004)	5 Clear delineation of the data sources	4 The information is supported by the data presented	5 the methods used were appropriate for the research question	4 The information is useful for answering the research question. However, the study is from 2004. There may be some change in the methods of interacting	5 The research was done in an ethical manner	5 The use of tables in this report was useful	5 Does not appear to violate any standards	33

Appendix C

Data Extraction Chart

Author(s) & Year	Sector / Population	Design and Sample Size	Main Findings	Effect Size	Limitations	TAPUPAS Score
Brink (2018)	Food SMEs in Denmark	Online questionnaire responses from three different food networks; n=93	The findings show severe pressures experienced by the SMEs from the market, competition and regulatory forces. The longitudinal findings show that complementary proximities of geographical, organizational, temporal, technical, cognitive, vision and especially virtual proximities are important for innovation and growth providing predominantly robustness of the SMEs. The summarization of the findings reveals a model for organizing the dynamic interaction of proximities to complement own SME capabilities for utilization of positive open innovation and positive bridging/ bonding of social capital. The proximities have resulted in both short-term cooperation and competition and especially is emphasized long-term collaboration.	Descriptive analytics only	This article was limited to Denmark networks. As a result, there are limits on the transferability of these findings.	

Chojnacki, Creamer (2019)	North Carolina Local Food Systems	Unk	Critical to the initiative's success was the use of professional facilitation services to support the participants in navigating complex topics and identifying mutually agreed upon and achievable outcomes spanning the food system. Local funder engagement early on in the process was important to keep the initiative moving forward and creating successes to leverage for expanded funding opportunities. Finally, responding to identified challenges, such as addressing a lack of critical infrastructure, catalyzed observable growth in areas of the local food economy	Unk	This study provided good findings. However, the methodology, literature review, and other parts of the paper are non-existent.	
Esmaeilpoor arabi, Yigitcanlar, Guaralda (2017)	Food ecosystems in Singapore, Helsinki, New York, and Sydney	Literature review / Case study n=48 journal articles and book chapters	Findings contribute to the efforts in exposing the potential of innovation districts as a new land use type in cities. Form, Function, Ambiance, Image are key factors for place.	Descriptive coding for the themes of form, function, ambiance, and image.	The outcomes are based on a limited number of case studies. However, the results were carefully compared across cases to ensure the negligible impact of the local context on outcomes. Only mature cases of innovation districts were included to ensure the existence of local connections that this study required. The questionnaire covered	

					limited examples of economic, educational, social and recreational potentials offered by innovation districts.	
Esmaeilpoor arabi, Yigitcanlar, Kamruzzaman, Guaralda (2020)	Innovation districts in Sydney, Brisbane, and Melbourne, Australia	Online survey n=1040	(a)Public perception towards the functions of innovation districts is still limited to professional and educational activities; (b) Locating innovation districts across the inner-city suburbs improves public engagement, as communities living around these districts are more likely to perceive innovation districts as places to work-learn-live; (c) Opportunities provided at the innovation districts only fulfil the expectations of the young and highly educated worker population.	Descriptive analytics - no confidences	The outcomes are based on a limited number of case studies. The questionnaire covered limited examples of economic, educational, social and recreational potentials offered by innovation districts. This was similar to the group's previous work.	
Funk, (2014)	US Nanotech Companies	Longitudinal Data Review n=454	Firms can be successful innovators whether they are in the heart of Silicon Valley or in the more remote areas of the American Midwest but doing especially well in either environment requires making the most of where they are.	All models had $p<.05$		
Garcia, Chavez (2014)	Systematic Review	Systematic Review	Key capital category dimensions: Identity, Intelligence, Financial, Relational, Human Individual,	No data	This study was conducted with respect to Monterrey, Mexico. However, the	

			Human Collective, Instrumental-Material, Instrumental-Knowledge Emerging shapes and forms of interactive innovation frameworks involving learning and knowledge sharing are: Development blocks; Complexes; Innovation milieu; Complex products and systems; Competence blocs; Technological regimes; Industrial filigrees; Innovation districts; Sectorial innovation systems; Regional innovation systems; Technological innovation systems; National innovation systems; Innovation networks; Business networks; Value-chains; Clusters		concepts are relevant for innovation districts in general. However, it would be interesting to see the concepts applied directly to other districts for conformity.	
Garcia-Cortijo, Castillo-Valero, Carrasco (2019)	Regional Spanish Agri-Food Companies	Sample of 10 year study from 771 innovative agri-food firms in Castilla-La Mancha, a region in the south-east of Spain; n=771 firms out of 2,689 (28.67%)	the internal factors or characteristics of a company are those that most significantly impact on the propensity to innovate. External factors also assist innovation, especially the level of training in the area, knowledge exchange with research centers and the location of companies in intermediate and peri-urban areas. In short, the spatial dimension, even in the rural periphery itself, is asymmetrical and conditions the	The models estimated were found to be valid. The Fisher-Snedecor distribution with a p-value below 0.05 shows the global capacity of all the model's	Because these policies continue to be based on a classical approach, which does not take into account the systemic nature of the economy, an extremely complex system, with an enormous number of interacting components that are able to exchange information with each other and with their surrounding environment, as well as being able to	

		The study was conducted using a Box-Cox regression model.	regional possibilities of innovation, which implicitly suggests the need to review EU policies for the support and promotion of R&D, to differentially frame support in a spatial context, and specifically in that of the "periphery of the periphery.	explanatory variables. They are models without multicollinearity, with a reciprocal condition number lower than 50. However, the Breusch-Pagan test, with a p-value above 0.05, shows the absence of heteroscedasticity in the models and, thus, the random effects have the same dispersion of the random effects across all	adapt their internal structure as a result of these interactions. These behaviors cannot be attributed to an individual part of the system, or subsystem, but are the fruit of collective action, within a specific scenario. In this sense, regional policies need to meticulously follow the path of how the system functions, using methods, techniques and tools which are appropriate to the system and the objectives to be achieved or managed. Moreover, it is of crucial importance to provide objective positive discrimination in accordance with the region, as a non-neutral space, and specifically, in favor of the peripheral regions of the periphery itself.	

				the observations. Finally, the sum of the residual squares is close to zero		
Gellynck, Vermeire, Viaene (2007)	Food firms in Meetjesland (East-Flanders, Belgium)	Questionnaire; n=81 firms	three significant aspects of innovation are recognized: efforts, activities and results Thevariables represent the strength of the entrepreneur's relation with the regionalTable 1. Characteristics of the clusters.ClustersVariable Non-innovators Followers Innovators SignificanceNumber of respondents (76)** 31 33 12 – Mean differences in one-way ANOVABudget in R&D 0.3a 0.2a 0.3b 0.007*Man-hours in implicit knowledge-acquisition 0.3 0.0 0.3 0.073Number of domains of innovation 1.0a 0.5b 1.2c 0.000*Importance of the innovation 1.0a 0.5b 1.8c 0.000**Significance<0.05 (One-way ANOVA).**Five outliers are removed from the analysis.Procedure: Hierarchical Cluster Analysis (Ward's method) & subsequent K-means			

			method.Distance Measure: Euclidean Squared Distance.Mean scores are standardized scores (Z-scores).Letters in superscript indicates different subsets in Duncan's test, referring to significant differencesbetween group means.			
Huggins & Thompson (2015)	Extensive Literature Review	NA	Regions with higher rates of entrepreneurship and network capital accumulation by entrepreneurial firms will experience higher rates of innovation. Entrepreneurial firms with a greater capacity to accumulate network capital will achieve higher rates of innovation. Entrepreneurial firms with a greater capacity to accumulate network capital will improve the permeability of the knowledge filter. Entrepreneurial firms with a greater capacity to access superior, excludable and miscible forms of knowledge will achieve higher rates of innovation. Entrepreneurial firms with a greater capacity to manage inbound and outbound flows of knowledge will be more effective in accessing superior, excludable and miscible forms of knowledge. Entrepreneurial firms with a	NA		

			greater capacity to access high quality knowledge through selected routes and channels regardless of the geographic location of knowledge sources will achieve higher rates of innovation. Regional innovation rates are partly a function of the spatial configuration of the knowledge networks established by entrepreneurial firms.			
Kuhne, Gellynck, Weaver (2015)	Industries in three EU countries: Belgium - cheese and beer; Hungary - white pepper, dry sausage, and bakery products; Italy - cheese and ham	Survey; n=90 companies	Three clusters of vertical networks were identified with different levels of innovation capacity. 1. vertical networks (direct chains) with overall low scores on the innovation capacity indicators 2. Vertical networks with medium innovation capacity 3. Vertical networks with high innovation capacity. the firms that compose vertical networks of traditional food were not frequently found to network with peer firms. We found that only about one-third of the food manufacturers, one-third of supplier firms, and about one-fifth of customer firms' network with their respective peers (see Table 5). However, we found significant	All p values were below - .215 with most being below p=.094	Sample is not representative of national markets in the countries represented and not the U.S. market. There is not discussion of lagged effects of networking, the link between network activities for innovation and the type of innovation, or the role of network expansion through the vertical networks. There is also a limit on the number of factors that influence innovation.	

			differences among network activities of the supplier and those of customer firms in each of the three clusters. The food manufacturer's activities are similar in networks with their peers in each of the three clusters. The partner firms in each cluster of vertical networks were found to be more active in networks with third parties than with peer firms. Network activities with peers have a greater significant influence on innovation capacity cluster membership than do network actives with third parties			
Lefebvre, Raggi, Viaggi, Sia-Ljungstrom, Minarelli, Kuhne, Gellynck (2014)	Food SMEs in Belgium, France, Sweden, Ireland, Italy and Hungry - SMEs are defined by European Commission as firms with less than 250 employees	Choice experiment using survey; n= 231	SMEs prefer networks that are composed of manufacturers and supply chain members, where information is shared confidentially among network partners, and when the network provides support to help the firm build its own networks of partners for innovation. In addition, SMEs' choice of the network is also affected by the interaction between specific network attributes and two firm characteristics, i.e. the firm's collaborative experience and innovation objectives.	62% choice prediction (76.7% correct no choice; 43% correct choice); very low R-squared .085;	The study incorporated only a limited number of attributes and levels and these were kept to a rather wide level of generality; only a few firm characteristics in our choice model.; relied on the perceptions of SME owner-managers; difficulty to elicit network preferences from firms that do not belong to networks nor have the intention to engage in networking activity; the use of web based	

					instruments for the survey may have determined some bias in the sample due to self-selection, although it remains difficult to assess the representativeness/bias between the sample and the population, as structural information about the sample contacted was not readily available	
McAdam, McAdam, Dunn, McCall (2014)	Food network organizations across Europe	Interviews with producers, notes from network meetings, a reflective learning diary, secondary information, network records, regional government records, participant behaviour; n=10 groups	a complex lifecycle development occurred within the regional SMEnetworks involving the need for different strategiesand methods of explorative and exploitative innovation(PHELPS, 2010; MUELLER et al., 2013; CHIARONI et al., 2011) at different life cycle stages with changes innetwork dynamics between the SMEs. Such development required unique strategies of explorative and exploitative innovation-based knowledge exchange at different life cycle stages with resultant changes in network dynamics between the SMEs.	Descriptive Statistics Only	Limited to only 10 food networks in Europe	

McKelvey, Ljungberg (2016)	Swedish Food Industry	Case Study of collaborative research projects; n=66	the collaborative research between firms and universities supported by the initiative stimulated innovation (i) directly by research projects generating tangible innovative outcomes, such as new products and methods; and (ii) indirectly by strengthening the firms' capabilities to innovative. Three broad categories of intangible innovative outcomes indirectly stimulating innovation were distinguished: knowledge transfer and learning; network development; and signaling effects.	Descriptive impacts were identified but were not quantified	This study was focused on the Swedish food industry, it would be interesting to see if the same impacts are universal across countries. Also, policy doesn't describe the relationship between networks and innovation districts. It does demonstrate the positive impact of networks as supported by policy.	
Mo, He, Yang (2020)	46 industrial clusters in 286 Chinese cities	Summary of National Statistical Bureau and China Urban Statistics Yearbook; n= 41 traded industrial clusters, 5 local industrial clusters	Regional innovation occurs mainly in traded industrial clusters. Regional innovation is positively related to the level of industrial cluster specialization but irrelevant to industrial cluster diversification. R&D is consistently conducive to regional innovation.	industrial clusters play an important role in promoting regional innovation - p=.012; RD is significantly positive, indicating a significant positive impact of firm R&D	No limitations were listed in this study. However, this study was conducted solely in China which has a directed economy. Such a economic policy position, could impact the results of this research.	

				investment on regional innovation - p=.016; impact of total industrial cluster on regional innovation mainly comes from traded industrial clusters - p=.887		
Nestle, Taube, Heidenreich, Bogers (2018)	Cluster initiative in a German high-tech cluster region	Questionnaire ; n=103, Cluster members 57, Non-Cluster Members 46	regulatory body in the cluster significantly influences the emergence of both inbound and outbound open innovation activities by member firms in the cluster initiative through increased trust and reduced information asymmetries.	all values for composite reliability exceed the threshold value of 0.70. The maximum VIF value among all formative constructs was 1.46, providing assurance that our hierarchical measurement models	sample was restricted to German companies. While the sample size was sufficient to evaluate the research model and the proposed relationships using component-based structural equation modelling, the moderation analysis was somewhat restricted to evenly distributed cohorts such as the employed membership of the cluster initiative there is no generally valid theory for the emergence of open innovation in clusters,	

				"network activities", "information asymmetries" and "open innovation culture" are suitable for further analysis. To conclude, we finally assessed measurement properties of the remaining formative constructs "agglomeration effects" and "trust". The structural model analysis was based on an effective sample size of 102 observations. Overall the estimations fit the data well; the R2 is 0.306,	could not capture differences in the increase of open innovation culture stemming from membership in a cluster initiative pertaining to value chain position	

				0.103 and 0.247 for "trust", "information asymmetry" and "open innovation culture". membership of cluster initiative moderates the relationship of trust and open innovation culture by increasing the positive direct effect (β=0.214, p < .10). Furthermore, consistent with Hypothesis 6b, E29membership of cluster initiative also moderates the influence of information asymmetries		

				on open innovation culture by increasing the negative direct effect (β=−0.198, p < .05).		
Pannekoek, van Kooten, Kemp, Omta (2005)	44 Dutch companies	Visitations and structured questionnaire; n=44	The innovative entrepreneur has a strategic vision of how to serve the market and create value. Also, team communication was extremely important. Successful entrepreneurs maintain an open atmosphere and show real commitment to the innovation process. They are in contact with a diverse network of business relations to develop innovations. Intensifying the network relations, e.g. by clustering glasshouse companies, leads to more successful innovation. The more firms in the horticultural production chain were actively involved in the innovation process, the bigger the chances of success. This was especially true for firms downstream toward the market.	78% of incremental innovation was the product of one or more tiers of connections; 86% of radical innovation was the product of one or more tiers of connections.	This was a study of Dutch greenhouses. There is question regarding the transferability of the results.	
Pittaway, Robertson, Munir, Denyer, Neely (2004)	Systematic Review of SME research	Systematic Review - 127 Articles	The principal benefits of networking as identified in the literature include: risk sharing; obtaining access to new markets and technologies; speeding products to market; pooling complementary skills; safeguarding property rights when	36 out of 127 articles scored low		

			complete or contingent contracts are not possible; and acting as a key vehicle for obtaining access to external knowledge. The evidence also illustrated that those firms which do not co-operate, and which do not formally or informally exchange knowledge limit their knowledge base long term and ultimately reduce their ability to enter into exchange relationships. At an institutional level, national systems of innovation play an important role in the diffusion of innovations in terms of the way in which they shape networking activity. The paper provides evidence suggesting that network relationships with suppliers, customers and intermediaries such as professional and trade associations are important factors affecting innovation performance and productivity. Where networks fail, it is due to inter-firm conflict, displacement, lack of scale, external disruption and lack of infrastructure. The review identifies several gaps in the literature that need to be filled.			

Radziwon, Bogers (2018)	12 firms from a single local business district in Southern Denmark	Semi-structured interviews; n=23 and Field observations; n=12 companies	Despite various interdependencies between ecosystem members, the understanding of what innovation and knowledge-based collaboration comprise can differ widely. Path dependencies (in terms of collaborative traditions) influence the extent to which SMEs are open to external sources of innovation. There is also a strong relation to the extent to which local firms risk joining various innovative partnerships.Different ways of organizing open innovation practicesmight not only provide a source of knowledge for the ecosystem members, they might also bring companies closer to one another in terms of potential partnerships on new initiatives.	Descriptive Statistics Only	This study was limited by its selection of region and companies. The also does not explore other (non-ecosystem) factors such as leadership, industry, and other factors.	
Roundy, Bradshaw, Brockman (2018)	Extensive Literature Review	Literature reviewn n=unk	Entrepreneurial ecosystems exhibit self-organization: order that emerges does so without a global controller. Entrepreneurial ecosystems exhibit open-but-distinct boundaries based on geographic and socio-cultural characteristics. Entrepreneurial ecosystems exhibit complexity in their components. Entrepreneurial ecosystems exhibit nonlinearity in	NA	This study could have benefited from a table demonstrating its findings.	

			the relationships among ecosystem components. Entrepreneurial ecosystems exhibit adaptability: the actions of individual agents produce continuous modifications to the ecosystem that allow it to adapt to changing conditions. Entrepreneurial ecosystems exhibit sensitivity to initial conditions.			
Soriana, Villano, Fleming, Battese (2018)	Australian Small Business Food Industry	Australian Bureau of Statistics Business Longitudinal Analysis Data Environment (ABS BLADE) survey results review; n=5 years of review, 984 businesses sampled,	Results show that businesses are more likely to innovate if they collaborate, have higher information and communication technology intensity, and use science, technology, engineering and mathematics skills. We also found that small food businesses, even at the subsector level, do combine different types of innovation when innovating. The propensity to innovate also increases for small businesses that have flexible working arrangements, face moderate-to-strong market competition, operate overseas and seek finance through debt and equity. The relative importance of these factors was found to vary between agricultural and nonagricultural food subsectors.	statistical significance at the 5 per cent level for all three key business characteristics (i.e. collaboration, use of STEM skills and ICT intensity)	This is a study of food businesses that are operating in Australia.	

Sun, Zhang, Cao, Dong, Cantwell (2019)	Suzhou Dushu Lake Science and Education Innovation District (China)	Case study, publicly available data, interviews, focus groups; n=44 people	SEID's policy and expectations towards universities lacked clear priorities and stability. SEID-funded research labs and facilities have low utilization rate. The level of collaboration between local universities and firms is low and fraught with difficulty. The gap between the higher technology level between SEID companies and relatively young universities makes it hard to collaborate. SEID government actively coordinates key innovation projects among universities and industry, but more informal connections are needed. Innovation/entrepreneurship services are predominantly provided by the government, while such services provided by social organizations are lacking and procedures difficult. Government support and services focus on 'elite' firms with high-tech designation yet neglect other grassroots firms. Many local venture capitalists have a government background with government influence in decision making and firm operation.	All findings had 3.8 or above out of five for agreement index. This indicates moderate to high correlation between data and findings.	This study was conducted in China. There is a much stronger control of government, education systems, and business which reduces the transferability of these results.	

Uhm, Sung, Park (2018)	Three internationally recognized Accelerators	Archived data for three major accelerators. Multiple data collection methods.	The results of this study show that there are a number of differences between Accelerators of the two countries in terms of the resources they support for early-stage start-ups. The findings also show some similarities. However, in Korea, the Accelerator landscape is limited, where mentorship, resources and investments are not readily accessible, resulting in low success rates for Korean start-up companies. These limitations have had a negative trickle-down effect when providing entrepreneurs with strong access to resources and investors, which highly affects the success rates of early-stage startups.		First, this study needs to conduct empirical analysis to show the statistical values of Accelerator. Second, although this study attempts to show comparative analysis for major cases of Accelerators in both Korea and the USA, an in-depth interview and detailed document research and clarifications of noted activities are required to conduct a future study. Third, we did not conduct a rigorous case analysis using the triangulation technique, a technique that uses two or more methods to identify the results of the same target.	
Vaz, Cesario, & Fernandes (2004)	323 small and micro food companies from 11 regions in Europe	Field engagements and questionnaire; m=323	Four types of innovation groupings: Multiple innovators, non-innovators, focused innovators - low performance, focused innovators - high performance	Multiple Innovators - 175; Non-Innovators - 84, Focused innovators - low performance - 31; Focused	The estimation of the model can be refined through the questionnaire and by using bigger sets of firms to allow the definition of more specific behavioral patterns. An appropriate questionnaire to enable the dynamic elements to be more easily	

				innovators - high performanc e - 33	captured would improve the potential for further testing with multivariate analytical methods. Econometric techniques could also be applied providing discrete variables could be avoided	