ABSTRACT

Scientists in the multidisciplinary domain of network science have contributed a lot in this literature in regard to structure of complex networks and introduced different structure models such as network link formation, prediction and adoption models at individual level in order to explain and predict network structure or product adoption by individuals at a future time step. From the other side, economists and management scientists have made great contributions in the areas of innovation generation, diffusion and adoption at individual level such as firm or at group level such as cluster of firms or an industry sector. There have been some studies in the literature which attempted to link network structure and innovation generation such as how firm or cluster of firms’ size and position in the network affect firm or cluster of firms’ innovation generation. Moreover scientists have also investigated how individual linkages’ strength (weak-strong) impact network innovation generation, e.g. how firms’ frequency of formal and informal interaction affect firm’s innovation generation; but there is a gap in the literature to address impact of network structure on network innovation at cluster level, i.e. how intra- and inter-cluster coupling impact cluster innovation generation, diffusion or growth.

Innovation is known to be interactive, cooperative and cumulative, where its emergence requires many sources of knowledge (scientific, educational, public, private institutions) aggregated into network clusters with industrial, academic or public players interacting within clusters (intra-cluster) and between clusters (Inter-cluster). Cluster is defined as ensemble of components such as firms that interact via formal agreement and transactions or informal occasional meetings and they collectively contribute to innovative outcome. Interaction among clusters for the purpose of innovation (innovation diffusion) is defined as the process by which an innovation is communicated through certain channels over time among members of a social system.

Although network is a solution to access to external knowledge which is required for innovation generation; not all networks are innovative. Innovation networks refer to those where valuable knowledge is created by self-organizing process (without hierarchy or central guidance). These self-organizing networks demonstrate common properties such as directed or undirected network structures following scale-free degree distribution, with continuous growth based on preferential attachment, or demonstrate multi-layer structure, and finally contain ties with varying strength, and clusters with range of coupling that influence on cluster innovation.

Following the above-mentioned gap in the literature, definition of innovation and its relation with network as a solution to innovation generation, I aim to address this gap and investigate how network structure causes network innovation at cluster level, i.e. intra- and inter-cluster structure are causal factors for change in cluster innovation.
The thesis proposal is structured in the following way:

In the introduction, I review the literature in order to first provide existing knowledge in the field, second make prerequisite for the follow-up conceptual framework. For this purpose, I need to define some concepts such as complex network structure, innovation, innovation network, and network cluster and finally inter-cluster diffusion of innovation in order to cover knowledge behind our phenomena of interest “network structure causes network innovation at cluster level”.

In the conceptual framework section, I investigate causality between network structure and innovation and growth such as 1) loose-tight cluster coupling and innovation diffusion, or 2) network structure and network growth. Through this section, I will discuss the concepts and theoretical development applied to all my publications in a more coherent fashion, starting from structural properties of complex networks, growth of social networks, inter-cluster coupling and diffusion of innovation, and finally inter-SME diffusion of innovation. For this purpose, I consider network cluster as unit of analysis, and cluster innovation generation, diffusion and growth as dependent variables, whereas network cluster structures and inter-cluster structures (initial-subsequent link, weak-strong tie, loose-tight coupling) are the independent or explanatory variables in order to explain and predict the network outcome.

In the methodology section, I use both analytical and empirical methods for the first three publications, whereas the last two publications are fully conceptual and theory based. In the first subsection I will discuss directed network link formation mechanisms used in our first publication “Directed Networks’ Distinctive Link Formation Mechanisms Causing Degree Distribution Distinction”, in the second subsection I will discuss subsequent inter-cluster link formation used in our second publication “Why Subsequent Inter-Cluster Links and How They Are Different From Initial Links”, in the third subsection I will discuss sampling and cluster analysis used also in our second publication “Analytical Modeling of Social Network Growth Using Multilayer Network Projection” also in our future work “Impact of Intra- and Inter-Cluster Dynamics on OSS Project Cluster Innovation” and in the fourth subsection, I will discuss multilayer network growth used in our third publication “Analytical Modeling of Social Network Growth Using Multilayer Network Projection”.