


# Chapter 17

## Social Networks and Graph Theory in the Search for Distant Knowledge: Studying the Field of Industrial Engineering

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### ABSTRACT

*This chapter presents how the analysis of social networks supported in graph theory contributes to the search for “distant knowledge” in the field of industrial engineering, discipline of engineering that in its current form began in the early 20th century when the first engineers began to apply scientific theory to manufacturing. In particular, the case of Chilean documented scientific production in this area of engineering is analyzed as a category of the web of science distinguishing its degree of connection with the great knowledge, generating organizations worldwide, determining its high dissociation with the great contemporary theoretical referents, and recommending the way to reduce these problems in the future.*

### INTRODUCTION

This chapter presents how the analysis of social networks and graph theory contributes to the search for ‘distant knowledge’ in the field of industrial engineering, the discipline of engineering in its current form, began in the early 20th century when the first engineers began to apply scientific theory to manufacture (Daneshvar-Rouyendegh & Feryal-Can, 2012).

DOI: 10.4018/978-1-5225-9380-5.ch017

Industrial engineering creates engineering processes and systems that improve quality and productivity, besides is concerned with the development, improvement, and implementation of integrated systems of people, money, knowledge, information, equipment, energy, materials, analysis and synthesis, as well as the mathematical, physical and social sciences together with the principles and methods of engineering it design to specify, predict, and evaluate the results to be obtained from such systems or processes (Pinar, Günther & Fazleena, 2016). Frederick Taylor is been well known as the pioneer expert in management, engineer and the leader of the engineering movement by developing methodologies to improve efficiency in manufacturing without using the term, in those times, 'industrial engineering' as a concept (Maynard & Zandin, 2001).

Economic theory realizes that the efforts of industrialization and the increase of human capital with advanced knowledge, generate better conditions adding value to production and consequently greater progress to society (Solow, 1957). In this aspect, the industrialization technique generated in the field of Industrial Engineering should be a fundamental pillar, which justifies the importance of its study and academic progress. (Maynard & Zandin, 2001).

Particularly in the case of Chile, for a university system of sixty institutions of higher education, despite importance of this engineering field, there are only two doctoral programs in industrial engineering accredited by the National Accreditation Commission (2019) and knowledge that the country produces in the category of 'Engineering, Industrial' of WoS (2019) barely reaches 0.251% of the world knowledge production of the last forty years (1978-2017). And therefore, it needs to be incorporated into 'knowledge cluster' of this discipline, to at least access the knowledge spills studied by Gambardella and Giarratana (2010) and the collective generation of architectural knowledge, through network interaction routines (Tallman, Jenkins, Henry and Pinch, 2004: 265-266, Nilsson, 2019).

On the other hand, Giuliani (2005) warns that similar meso-characteristics, such as geographic and relational proximity, do not necessarily originate shared knowledge flows. Vega, Benítez & Yévenes (2005) also conclude that in order to take advantage of the multiple synergies of a cluster, the actors must consider and comply with certain norms and conditions they favor systemic action and strongly accentuate information flows. To which Huggins (2008) adds that many actors do not acquire their knowledge in their closest environment, because they promote their growth in innovation, and therefore require obtaining international border knowledge. In addition, actors with greater capacity for absorbing knowledge manage to remain more connected to global knowledge networks and not only depend on the local knowledge network.

Thus, as a result, it is possible to identify Chile's position in the 'cluster of knowledge' of Industrial Engineering and define the best approach strategy to contemporary actors of global reference, to take advantage of this.

## **SOCIAL NETWORKS AND GRAPH THEORY**

According to Cárdenas-Tapia, Klingler-Kaufman and Rivas-Tovar (2012), graph theory is a discipline of discrete mathematics, with its own development; that contributes to the analysis of social networks by providing precise concepts to refer to properties of the social structure, quantification methods of those properties, through the actors representation (nodes) and their interactions (arcs) through a graph. Thus, already Lozares (1996), account for as from origin of his mathematical theory of graphs has given

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