Chapter 1
Quantum Modeling of Social Dynamics

C. Bisconti
University of Salento, Italy

M. De Maggio
University of Salento, Italy

A. Corallo
University of Salento, Italy

F. Grippa
University of Salento, Italy

S. Totaro
University of Salento, Italy

ABSTRACT

In this paper, the authors apply models extracted from the Many-Body Quantum Mechanics to understand how knowledge production is correlated to the innovation potential of a work team. This study is grounded in key assumtpions. First, complexity theory applied to social science suggests that it is of paramount importance to consider elements of non-objectivity and non-determinism in the statistical description of socio-economic phenomena. Second, a typical factor of indeterminacy in the explanation of these phenomena lead to the need to apply the instruments of quantum physics to formally describe social behaviours. In order to experiment the validity of the proposed mathematic model, the research intends to: 1) model nodes and interactions; 2) simulate the network behaviour starting from specific defined models; 3) visualize the macroscopic results emerging during the analysis/simulation phases through a digital representation of the social network.

INTRODUCTION

In recent years new organizational forms are emerging in response to new environmental forces that call for new organizational and managerial capabilities. Organizational communities, interdisciplinary teams and industry consortia are becoming the governance model suitable to build a sustainable competitive advantage, representing a viable adaptation to an unstable environment. The theoretical framework used in this research is known as complexity science (Clippinger, 1999; Newman, 2003). According to this approach, teams are considered complex adaptive systems (CAS): they co-evolve with the environment because of the self-organizing behavior of the agents determining fitness landscape of market opportunities and competitive dynamics (Lewin, 1999). A

DOI: 10.4018/978-1-4666-1788-9.ch001

system is complex when equations that describe its progress over time cannot be solved analytically (Pavard & Dugdale, 2000). Understanding complex systems is a challenge faced by different scientific disciplines, from neuroscience and ecology to linguistics and geography. CAS are called adaptive because their components respond or adapt to events around them (Levin, 2003; Lewin, 1999). They may form structures that somehow maintain their integrity in the face of continuing change. The components of a CAS may follow simple rules and yet produce complex patterns that often change over time. Organizational teams share many of the characteristics that are used to define a complex adaptive system. A number of methods have been developed in recent years to analyse complex systems. Amaral and Ottino (2004) identify three types of tools belonging to well known areas to physicists and mathematicians: Social Network theory, Quantum Mechanics, Statistical Physics. Many scholars have shed light on some topological aspects of many kinds of social and natural networks (Albert & Barabasi, 2002; Barabasi & Réka, 1999; Newman, 2003). As a result, we know that the topology of a network is a predictable property of some types of networks that affects their overall dynamic behaviour and explains processes such as: the diffusion of ideas in a firm, the robustness to external attacks for a technological system, the optimisation of the relationships among the network components and their effects on knowledge transfer.

Next paragraph introduces the main contribution we rely on to define the model able to recognize the emergence of innovation within organizational teams.

THEORETICAL BACKGROUND

Social Network Analysis (SNA) represents a widely adopted methodological approaches generally applied to the study of organizational networks during the past years (Wasserman & Faust, 1994). SNA is based on a set of methods and tools to investigate the patterning of relations among social actors. It provides a visual and dynamic representation of social and economic phenomena and relies on the topological properties of the networks to measure the characteristics of the phenomena.

The main limitation of SNA is to be mainly a structural method. Its unit of analysis is not the single actor with its attributes, but the relations between actors (e.g., dyads, triads), defined identifying the pair of actors and the properties of theie relation. By focusing mainly on the relations, SNA might underestimate many organizational elements which might influence the ability of an organization to reach its goals. Perceptive measures are sometimes ignored by SNA researchers. What seems to be missing in current SNA research is an approach to study how the individual actors' characteristics change the network configuration and performance. Furthermore, the empirical work on network information advantage is still considered "content agnostic" (Hansen, 1999). Paying attention only to the structural facets of community interactions is like considering all the ties as indistinguishable and homogeneous. In this perspective, actors performing different activities, or involved in different projects are detected simply as interacting members, with no distinction among sub-categories that might change over time. A recent field within SNA is Dynamic Network Analysis, that uses longitudinal data to perform an evolutionary study of the organizational networks

The principle that many natural laws come from statistics brought many physicists to apply the models of statistical physics also to the study of behavioural models and to study the dynamics of generation of the organizational networks. Statistical physics is currently applied to several interdisciplinary fields like biology, information technology, and social sciences, and physicists showed a growing interest for modeling systems also far from their traditional context (Svozil & Wright, 2005).