A Model to Increase the Efficiency of a Competence-Based Collaborative Network

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ABSTRACT
This article provides a model based on the Multi Agent System (MAS) paradigm that acts as a methodological basis for evaluating the dynamics in a collaborative environment. The model dynamics is strictly driven by the competence concept. In the provided MAS, the agents represent the actors operating on a given area. In particular, the proposed agents are composed of three distinct typologies: (i) the territorial agent, (ii) the enterprise agent, and (iii) the public agent. Each agent has its local information and goals, and interacts with others by using an interaction protocol. The decision-making processes and the competencies characterize in a specific way each one of the different agent typologies working in the system.

Keywords: Collaborative Network, Competence Evaluation, Multi Agent System

INTRODUCTION
The rapid evolution in customer requirements is forcing major changes in the overall industrial system. One possible strategy for facing these changes is based on the adoption of a collaborative way of working where different abilities and competencies are brought together with the goal of exploiting benefits and sharing the risks. This idea is supported by the increasing relevance of the collaboration as new multi disciplinary research field (Camarinha-Matos & Afsarmanesh, 2004).

This article aims at providing a model for understanding the dynamics of a network composed of heterogeneous actors, and suggests a competence-based collaborative way of working, where the competence is defined as the ability to perform activities by using a combination of knowledge, skill and attitude. As Camarinha-Matos and Afsarmanesh (2006) argue in their work, the definition of a model
certainly represents one of the main topics concerning the collaborative network organization research field.

The model represents actors working on a given geographical area, where the area boundaries are both physical, and due to the existence of consolidated business connections among the actors. A typical example for explaining the model environment is an industrial district defined as a socio-territorial entity where there is a community of people, firms, public entities and agencies for local development (Molina-Morales, 2001).

The model is based on the concepts of competence measure and competence map used in Confessore, Liotta, and Rismondo (2006) to solve the problem of assigning to collaborative enterprises the activities required for carrying out an emerging business process. In particular, the competence measure of an enterprise is defined as the distance between the competencies required for executing a given activity and the capability of the enterprise to perform the activity.

We provide a Multi Agent System -MAS- (see Jennings & Wooldridge, 1995) model consisting of a set of agents that encapsulate the behavior of different entities within the real system (Tah, 2005).

This model represents a territorial system in which the actors share information about their degree of competence in doing the activities without revealing private data. In fact, the competence represents an aggregate data based on a local evaluation, and all the actors measure themselves with respect to the same set of competencies given by the competence map (see also Hammami, Burlat, & Champagne, 2003). On the basis of the previous MAS, the new model considers new agent typologies and new features for the decision-making processes in order to allow the evaluation of the impact of new configurations of the network with respect to key performance indicators. The new configurations of the network are generated whenever emerging business processes and possible public funding (e.g., as calls for National and European research project) arise, and it is required to define the roles and responsibilities through the actors. Our approach is to consider the execution of business process as distributed problem solving carried out by co-operating agents (Kuhlmann, Lamping, & Massow, 1998). In particular, the article shows that decisions making processes are always less dependent on a single subject but are the outcome of different decisions of several agents acting in the same system. Specifically in this model, as suggested by Vanderhaeghen and Loos (2007), two decisional levels (global and local) are considered.

The rest of the article is organized as follows: the next section describes the scenario of model application; the third section introduces the static model based on multi agent theory and in the fourth the dynamics of this model is described. Finally, the last sections are committed to model validation and conclusion.

**THE SCENARIO**

The article provides a model for the understanding of the dynamics of a collaborative network. The network is represented by a coordinator and private/public actors. The coordinator makes decisions for increasing the territorial attractive capacity with respect to new investments and new projects. Its main tasks are:

1. The monitoring of new business opportunities by doing intensive market analysis. The outputs are: the proposal of activities to the agents in order to meet the business opportunities; the identification of new possible attractive industrial sectors that could be exploited with the actual territorial resources;
2. The monitoring of call for National and International research projects. The output is to suggest possible combinations of actors in order to create the suitable composition of partners meeting the call requirements;
3. Providing to the actors the competence map in order to meet both the business and funding opportunities while using a
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