Knowledge-Intensive Service Organizations as Agents in a Business Ecosystem

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Abstract—This paper discusses a new approach to modeling organization populations containing knowledge-intensive service organizations. Knowledge-intensive services are a growing sector both in volume and in economic importance. In many aspects they are distinctive and do not fit to the traditional concepts explaining a business organization. Thus they benefit of new ways to interpret and study organizations and organization populations. This paper presents the concept of business ecosystem, and the agent-based modeling of it, as a possibility to understand the complex environment where knowledge-intensive service (KIS) organizations operate. This paper covers the distinctive features of knowledge-intensive service organizations first and then explains how these features can be taken into account when modeling a population of organizations containing KIS organizations as agents. This research is based on literature review and thus the conclusions are on the conceptual level.

Keywords: Knowledge-intensive service; Business ecosystem; Agent-based modeling

I. INTRODUCTION

Knowledge-intensive organizations are a reflection of the knowledge society. Knowledge-intensive service organizations are especially interesting, because they represent this rise of knowledge, and also the growing importance of service sector. Knowledge-intensive services include a wide array of services, and e.g. the innovation capability and technology intensity vary significantly inside the sector. However, they have not been very well recognized. Services are regarded as a residual class, and their importance has not been understood [1].

Agent-based modeling has increased its popularity in the area of social sciences during the past decade. The origin of agent-based modeling is in the development of artificial intelligence, from where the complexity science adopted it quickly. Nowadays agent-based modeling is exploited in various areas of scientific research, and even in enterprise management.

This paper discusses the general features of knowledge-intensive service organizations from the point of view of their relations. The main question to be answered is how these features could be taken into account when constructing an agent-based model of an organization population containing knowledge-intensive service organizations. Linked to this main question, the paper discusses the nature of business relations, such as cooperative relation, competitive relation and co-opetitive relation on conceptual level. This discussion is ought to be done before the generation of an agent-based model. The point of view of this paper is the one of an organization population, thus the discussion focuses on the characteristics, that are observable in the relations of an organization to its environment.

II. CONCEPTUAL MODELING

A. Features of Knowledge-Intensive Services

According to Starbuck [2], the term knowledge-intensity refers to the similar dependence as capital-intensity and labor-intensity, and thus a knowledge-intensive firm is one where knowledge is the most important input. According to Miles [3], in knowledge-intensive business services the required input knowledge is professional. Knowledge-intensive service organizations exploit and produce high-level knowledge, which distinguishes them from information-intensive service organizations.

For knowledge-intensive business service organizations close supplier-client relationships are critically important [4]. This importance is due to the fact, that the products they sell are partially produced in those relationships. Also the knowledge that a knowledge-intensive service firm possesses is partly learnt in client-supplier relationships. Knowledge-intensive service organizations are also parts of innovation networks, and important nodes in them [4]. This view has been contradicted e.g. by Larsen, who claims that knowledge-intensive business service organizations are not as important contributors to e.g. innovations in manufacturing firms, as is often proclaimed [5]. However, knowledge-intensive service firms are often considered to be important knowledge and innovation transfer agents, which is also the starting point of this paper.

Participation in various innovation and business networks causes that knowledge-intensive service organizations are parts of many different complex systems. Because relationships are important for knowledge-intensive service organizations, they are prone to face co-opetition in their business environment. Co-opetition is a concept, which indicates that there is both competition and cooperation present in the same business relation. Figure 1 illustrates that situation with a simplified presentation of an organization population consisting of seven organizations.
In the figure, relation number one is a pure supplier-client relationship, which does not include cooperation in significant amount. Relation number two illustrates a cooperative relation, which may be for example a relation between a hardware manufacturer and a software designer, who produce together a certain application. Third relation is a purely competitive relation, for example between two organizations producing similar products and competing for same customers. Relation number four is a co-opetitive relation. A co-opetitive relation may exist e.g. between two companies, that compete on one market and cooperate on another. This is the case in many industries due to the interconnected business. For example outsourcing and joint R&D projects may cause that situation.

Thus this paper regards the following aspects as significant when considering knowledge-intensive service organizations as parts of a population of organizations: close relationships with partners, wide collaboration networks, participation in complex systems, and co-opetition. The study of knowledge-intensive organizations as parts of business ecosystems is based on these starting points.

B. A Business Ecosystem

Business ecosystem is a relatively new concept which has been introduced by Moore [6], who describes business ecosystems as an organization group crossing many industries working cooperatively and competitively in production, customer service and innovation. In this paper the definition used for a business ecosystem is the following: Business ecosystem is “a dynamic structure which consists of an interconnected population of organizations. -- Business ecosystem develops through self-organization, emergence and co-evolution, which help it to acquire adaptability. In a business ecosystem there is both competition and cooperation present simultaneously” [7]. Thus business ecosystem is a concept which emphasizes interdependence, self-organization, emergence, and co-evolution of agents.

If we consider a population of organizations containing knowledge-intensive service organizations, the aspects that are emphasized in those organization populations are present also in the concept of business ecosystem. The interconnectedness between different actors and the presence of co-opetition due to that interconnectedness are central concepts in both of them.

The concept of business ecosystem also provides us with a link to complexity science. A business ecosystem contains various organizations, which together build up a complex evolving system (CES). Complex evolving system is a concept of complexity science, presented by Mitleton-Kelly [8]. Complex evolving systems are systems consisting of interconnected and evolving agents, which are in this case considered to be organizations. The development of agent-based modeling is deeply intertwined with complexity science: the study of complex systems needs agent-based modeling, and the use of agent-based modeling and design is understandable through complexity science.

III. AGENT-BASED MODELING OF ORGANIZATION POPULATIONS

A. Agent-Based Modeling in Social Sciences

It is possible to model complex evolving systems and simulate their evolution by agent-based modeling (ABM) (fig 2). Using simulation as a research method in social sciences is a relatively new idea, gaining increasing popularity in the area of social sciences. It became quite common in 1990s, when personal computers increased their computation power enough to enable simulations to be run on them [9], and simulation software was developed alongside computers.

Simulation requires quite a lot of work, because the construction of a model is not an easy task. However, it is considered to be useful in many cases. The benefits of modeling and simulation realize as a better understanding of the system under study. Even the construction of a model requires a lot of reflection and often reveals the most important aspects of a system. In complex systems, there are emergent properties, which cannot be anticipated on the basis of knowing the separate components of a system. Simulation helps to make experiments that reveal various kinds of emergent phenomena.

If we attempt to model a population of organizations or a business ecosystem (such as a supply network etc.) the problem contains many levels. In an organization population, there is communication between agents, agents are highly complex and still relatively few if compared to natural or physical systems. Thus, according to Gilbert and Troitzsch [9] a multi-agent model seems to be a suitable one for modeling them.
The computational modeling and simulation is useful, because the behavior of a complex evolving system is often very difficult to predict. This unpredictability is due to the interaction of local components and it leads to self-organization, emergence and thus to creation of new order. Concerning further study it is important to keep in mind that modeling and simulation are only tools. Thus it is important that researcher knows well the field of research and is capable of drawing conclusions from results of a simulation. Used in a right way modeling and simulation provide a method to research the complex business environments, where knowledge-intensive services are considered to operate.

To be able to build an agent-based model, one must choose the properties that are considered to be important from the point of view of the research question, which is to be answered. In this paper the point of view is the one of an organization population, and thus the most important characteristics are those linked to the relations between knowledge-intensive service organizations and other organizations.

B. A KIS Agent

Now we take a closer look on the characteristics of a knowledge-intensive service organization and its relations from the point of view of agent-based modeling. If we consider the construction of a model, we have to define the characteristics of an agent clearly enough to reveal the behavior of the system.

Participation in complex systems is considered to be a feature of knowledge-intensive service organizations. This is a prerequisite for modeling to be reasonable. If the systems that an organization participates are not complex, they may be modeled in easier ways. The benefits of agent-based modeling are the greater the more complex the environment, in which an organization is operating, is. This benefit is due to the difficulties to understand the dynamics of a complex system because of the emergent properties of it. Thus this feature need not be modeled, because it is a prerequisite for modeling and the model implicitly holds this assumption.

Interconnectedness, which is present through the importance of relations, is a central characteristic of those organization populations containing knowledge-intensive service organizations. For a group of organizations to be recognized as an organization population, such as a business ecosystem, it is necessary to be interconnected. However, the level of interconnectedness varies from organization to another. Knowledge-intensive service organizations are densely interconnected with other organizations; they are the “highly linked species” of a business ecosystem. Organizations may be interconnected by many kinds of relations. These interconnections may be competitive, cooperative, co-opetitive, exploitative etc. A high level of interconnectedness may be modeled by two characteristics: a great tendency to form a business relations and a bias to aim at long-lasting relationships instead of e.g. single deliveries. It is good to remember, that a high level of interconnectedness is a relative measure, and may be related to the size of an organization. Thus, an agent presenting a knowledge-intensive service organization has got greater tendency to form relationships and maintain them, than the other organizations of the same size.

A characteristic related to the maintenance of relationships is the closeness of relations. However, the closeness is a characteristic, which is way more difficult to model. The closeness of a relation implies that there is information and knowledge sharing and mutual trust in the relation, and also that there is creation of new knowledge in the relation. The close relations are not likely to be competitive, but they may be co-opetitive. An example of a close relation may be the
relation between a consult firm and their client. A close relation may be advantageous for both of them, because they have possibility to learn from each other and develop efficient knowledge and information sharing systems between them. The learning and knowledge sharing aspect is difficult to model by any tool. Agent-based modeling is more suitable for it than any other modeling tool, but however it does have its limitations. To model learning has been and still is a stumbling block for simulators, are they either modeling organization populations or trying to create artificial intelligence. Often the problem is solved by simplifying learning so much that it is easy to implement. This is a feasible way if organizational learning is not the main focus of a study. The same holds for knowledge and information sharing, and creation of new knowledge.

Co-opetition is a challenging phenomenon to model. This is because the internal structure of companies may be very complicated, and co-opetition may be a result of differing interests of different parts or divisions of organization. If co-opetition is present so that a single unit faces both cooperation and competition, the situation set restrictions for information sharing and mutual learning. In that case there is likely to exist definitions of the information and knowledge, which is shared and which is not. How is this to be modeled? The main thing is that cooperative and competitive relations are not mutually exclusive between organizations.

Actually, a competitive relation is difficult to define, because it could also be claimed that the relation between competing entities is not direct, but it is realized in indirect way in other relations. Is there a relation between two entities, if there is no information exchange between them? Is it reasonable to define competitive relationships, because they are usually informal, while cooperative relations exist also on formal level? However, also cooperative relationships contain important aspects, which are informal. If we consider that in cooperative relationships there is voluntary exchange of information, in competitive relationships information exchange is often based on public announcements and on information and knowledge gathered by the competitive intelligence processes in both organizations. It is not reasonable to suppose that there is voluntary information exchange in a competitive relationship. Is a competitive intelligence process an expression of an existing relation between two organizations? Should we define, that all organizations competing for same customers do have competitive relationships, or should there be some kind of mutual consciousness of competitive relationship? In business to business -markets it is easier to recognize competitors, but on consumer markets it is less clear to recognize all competitors. Here, we conclude that a competitive relationship is a concept, which is dependent from the point of view. From the point of view of a chosen organization a competitive relationship exist between the chosen organization and an organization, which is recognized to be a competitor. However, the applicability of this definition is largely dependent on the definition of relationship.

After all, the existence of a co-opetitive relationship is much dependent on the perceptions of an organization. Co-opetition is present, if there is a relationship, where an organization sees both shared and conflicting interests. Actually, this definition is wider than which is usually understood to be co-opetition, because this covers also conflicting interest on other areas than market. In this paper, a co-opetitive relationship is taken into account in modeling by restricting the information sharing and learning with those organizations, that encounter conflicting interest on an area concerning that information.

IV. CONCLUSION

Modeling of an organization population containing knowledge-intensive service organizations is challenging, because the relations are various and their role is important. The conceptual work done in this paper aims at enabling the construction of an agent-based model. An organization population containing knowledge-intensive services is likely to have cooperative, competitive and co-opetitive relations.

Relations of a knowledge-intensive organization are numerous and some of them are close relations with sharing of knowledge, learning and innovation. A co-opetitive relation is usually defined as a relation that contains both competitive and cooperative aspects. One big challenge is to define a competitive relation, because the recognition of it is fundamentally subjective. In this paper a co-opetitive relation is defined as a relation, where an organization sees both shared and conflicting interests.

The features of a KIS agent constitute of, but are not limited to, following: a great tendency to form relationships and maintain them; a great tendency to share knowledge in cooperative and co-opetitive relationships; and cooperative and competitive relationships are not mutually exclusive. These characteristics will be studied empirically at a later stage of the ongoing research project.

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