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The co-evolution process in the Internet of Things sector: what role for incumbents firms

ROBERTO PARENTE[*] ROSANGELA FEOLA[•] VALTER RASSEGA[♠] VALENTINA CUCINO[**]

Objectives. *The Internet of Things (IoT), in the context of the fourth industrial revolution called Industry 4.0 (Blanchet et al. 2014; Schmidt et al. 2015; Wahlster 2012), has been considered among the "Top Ten Strategic Technologies" in 2016. The term Internet of Things (IoT) was used for the first time in late 1990's to better define ubiquitous and pervasive computing that "has the potential to change the world, just as the Internet did". But only in 2005 the International Telecommunication Union (ITU) formally introduced the definition of IoT, according to which it represents "the future of computing and communication, and its development depends on dynamic technical innovation in a number of important fields, from wireless sensors to nanotechnology" (Itu Report). The basic idea of the IoT is that virtually every physical thing in this world can also become a computer that is connected to the Internet, consequently the spread of these technologies can be considered a radical revolution that led "from anytime, anyplace connectivity for anyone to a connectivity for anything".*

The development process of IoT technologies could be investigated from different, yet intertwined, perspectives (i.e. institutional, technological, managerial). The development of IoT, in fact, can be considered as a co-creation process (Dosi, 2000; Parente, 2008) based on an interplay between science and technology development, public policy choices, business model design of new and old economic players, and the change in lifestyle and values of citizens.

In our paper, we focus on the managerial perspective in order to analyze how economic players, both new innovative firms and established innovative-oriented companies, are contributing to the development of the IoT sector.

Academic debate on the role of new and old firms in the development of new technology and sector has a very long track record. According to the Schumpeterian line of thought (Schumpeter, 1934) the dominant paradigm of analysis is that new entrepreneurial ventures will be the vehicles introducing new technology onto the market, and in the long run will replace the old population of existing firms (incumbents) that have grown thanks to mature technologies (Hannan and Freeman, 1977). However, some more recent studies show that sometimes the relationship between new and old firms is more complex, and it goes beyond the traditional paradigm were old firms are replaced by new comers (Dosi et al., 2008; Hockerts and Wüstenhagen, 2010; Erlinghagen and Markard, 2012; Parente and Feola 2015). These studies show that in some cases, in fact, there is a positive but specific role for both new and old companies and a leading role is played by networking initiatives between technology start-ups and the established firms. One of the plausible explanations for this apparent contradiction lies in the ability showed by large companies that have embraced the Open Innovation philosophy (Chesbrough, 2008), to integrate technological assets and skills developed outside them, generally by young start-ups. The open innovation is the use of "purposeful inflows and outflows of knowledge to accelerate innovation internally while also expanding the markets for the external use of innovation" (Chesbrough and Crowther, 2006). This model involves strategic, managed exchanges of information with actors outside of the boundaries of an organization, aimed at integrating their resources and knowledge into the organization's own innovative process. The Open innovation philosophy represents a big opportunity for both actors of industry evolution, new comers, generally young start-ups, and old firms.

For start-up firms without any established internal resource base or market position, internal and external resources and networks are potentially even more important than for incumbent firms (Colombo, Grilli, and Piva 2006). For a start-up, the adoption of an open innovation approach, and in more general terms a more strong openness to collaboration, could be an effective way to overcome the liability of newness (Stinchcombe,1965), the liability of smallness (Birch, 1987; Brüderl and Schüssler,1990) and the entry barriers that generally decreases the likelihood, scope and speed with which firms can enter a market and establish themselves as competitors to incumbents (Bain, 1956; Shepherd, 1979; Penrose, 1959).

For incumbents firms, open innovation is a way to overcome their organizational inertia (Hannan and Freeman, 1977) gaining access to new skills, ideas, talent and markets and to accelerate disruptive innovation in their companies.

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In the open innovation perspective, the evolution of a sector, should not be seen as a replacement process of old players with new comers actors, but as a co-evolution process (Dosi, 2000; Dosi and Marengo, 2007) in which the interaction between different form of economic organizations and their strategies, business model, resources and competences, become a key element.

In this perspective, recent studies (Dosi et al., 2008; Hockerts and Wüstenhagen, 2010; Erlinghagen and Markard, 2012; Parente and Feola, 2015), show that the role of co-evolution between new and old players is particularly relevant in sectors (such as ICT, biotechnology, renewable energy, smart grid technologies) characterized by:

- *the nature of technology they are based on that is generally disruptive and research based;*
- *the nature and entity of resources and competences necessary to keep these technologies at an industrial level.*

In this co-evolution process, start up firms, that on average show a stronger propensity to patent and to generate more disruptive innovations than old companies (Nanda et al., 2015; Tantau et al., 2015) but do not have the necessary resources to finalize the process of exploitation of innovation, can act as creators of new knowledge. Incumbents, on the other side, are limited, because of their inertia, in the discovery of new disruptive technologies but have the necessary resources to develop them. Interactions between these different subjects become necessary conditions to develop and exploit new technologies.

The IoT sector, one of the most growing sectors in the next years, announced as the fourth industrial revolution, fit perfectly with this scenario. With specific reference to IoT, in fact, there are many evidences that in the last years the growth of the sector is mainly driven by an increasing number of start-ups focused on technologies related to IoT industry that are also attracting the interest of financial investor, venture capital and crowdfunding. In addition, in the last years we can observe a growing number of initiatives and projects promoted by large companies (Accelerators, Start Cup Competition, Seed Capital) to intercept and attract technologies developed by start-up firms, based on the idea that young start ups represent, in a perspective of open innovation strategy, an opportunity of external innovation, able to reduce the time and risk of innovation development process.

Starting from these premises, the objective of the paper is to investigate the forms and specific characteristics of co-evolution process between incumbents and new entrepreneurial firms and to analyze how incumbents companies in the IoT sector are changing their innovation strategies in order to intercept external technologies developed by young start ups.

Methodology. *Our research design follows a two steps approach. The first step, mainly based on secondary data, aims to build, at an Italian and International level, a picture of incumbents firms involved in the specific context of IoT sector. In the second step, conducted through secondary data and the consultation of specialized database, we analyze initiatives (classified as Accelerators, Start Cup Competition, corporate venture capital, co-generated publications and patents) promoted by old companies to integrate competences and technologies developed by start-ups.*

Findings. *The research will make possible to build a picture of the role of incumbents firms in the development of IoT sector. In particular, the study has allowed to identify a growing number of initiatives promoted by incumbents in order to attract and intercept technologies developed by innovative start ups, that are considered the real driving of innovation in the Iot sector. The results obtained could be interpreted as a clear signal of the alertness of new ventures in the exploitation of emerging opportunities and of their greater ability to react to the changes in competitive rugged landscapes (Levinthal, 1997). At the same time, the results obtained gives evidence of the difficulties for incumbents to manage changes in technological paradigms that are "competence destroying", difficulties that incumbents firms are trying to overcome through a change in the innovation model, with the ship from a vertical integrated model to an open innovation one.*

The research gives important evidence about the nature of the development process of IoT sector, a process that could be characterized in terms of co-evolution between new and old innovative firms. According to some previous studies (Dosi et al., 2008; Hockerts and Wüstenhagen, 2010; Erlinghagen and Markard, 2012; Parente and Feola, 2015) our results suggests that, in the IoT sector, there is a positive but specific role for both new and old innovative forms: new firms could act as creator of new knowledge; old innovative firms could act as developer of that knowledge through the collaboration with new firms and through a co-sharing of their business models.

Research limits. *Our findings are explorative in nature and this limits their transferability. Further and similar research should be conducted in other sectors to observe whether incumbents play a similar role there. Moreover, with specific reference to IoT sector, it could be useful to further develop the research through an in-depth analysis of some case studies in order to achieve a more detailed understanding about strategies adopted by incumbents to exploit opportunities arising from the innovation processes and the development of new disruptive technologies.*

Practical implications. *The implications of the paper are twofold: theoretical and managerial. From the theoretical point of view, our research could contribute to the theory on the forces and actors that drive the transformation of economic sectors. From the managerial point of view, our research has important implication for policy makers and for the definition of adequate policies to stimulate the development of the IoT technologies. At the same time, our research could have relevant implications for the management of new and old firms involved in Iot industry, showing the necessity for them to adopt a more open approach in their innovation processes.*

Originality of the study. *The research, focusing on the dynamics of interaction and co-evolution among different actors, puts in evidence the different roles played by start-up and incumbent firms in the birth and evolution of emerging sector. In particular, according to more recent studies, our research shows that sometimes the relationship*

between new and old firms is more complex and it goes beyond the traditional paradigm, now widely accepted in the established literature on the subject, were old firms are replaced by new comers.

Key words: *Internet of Things; co-evolution; open innovation; incumbents; new entrepreneurial firms.*

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