

Inter-clustering as a network of knowledge and learning: Multiple case studies



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ABSTRACT

Despite inter-clustering being an important specific form of inter-organizational network, it has rarely been investigated. So, from an inter-organizational network perspective, this study aims to deepen knowledge about inter-cluster relationships as a way to share knowledge and learning in six clusters/cases in Portugal. These cases give some interesting insights into these issues. With interviews applied to the executive directors of the selected clusters, together with documentary analysis, the empirical evidence obtained lets us conclude that inter-clustering is seen as a network promoting the share of knowledge and learning among the actors involved, and allowing improvement in the activity carried out, the product or service provided, at both the firm and regional level. This study presents some contributions as regards identifying some categories/topics for the challenges of inter-clustering: (1) inter-clustering as the share of knowledge, (2) restrictions and benefits of inter-clustering, and (3) size of the inter-cluster network and future expectations. Moreover, we extend the existing literature on knowledge management, organizational learning and inter-clustering. Inter-clustering relations also offer also a new framework to analyze a network of knowledge and learning that has seldom been studied.

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Introduction

The globalization process and change in the technological and communicational paradigm causes significant effects on firms' competitiveness and sustainability. Whereas the industrial economy valued vertical integration, the knowledge economy stimulates and is stimulated by the formation of inter-organizational relationships and business arrangements constructed in a network. According to [Molina-Morales, Belso-Martínez, Más-Verdú, and Martínez-Cháfer \(2015\)](#), recent studies highlight the importance of identifying key factors in order to achieve successful collaborations between organizations. This interest emerges from the critical importance of collaborative relationships in creating innovation, particularly through common spillovers of learning and knowledge ([Asheim & Gertler, 2007](#); [Kay, Youtie, & Shapira, 2016](#)).

In this context, according to [Sohn \(2015\)](#), the importance of clusters is highlighted as a type of inter-organizational network that contributes to regional development and competitiveness. This author and [Cusin and Loubaresse \(2018\)](#) also mention the relevance of studies on industrial clusters operating as an inter-organizational

network, and how they are associated with regional development and competitiveness. Here, competitiveness moves from a one-directional, individual and endogenous process in the business domain to become an open, multi-directional, collaborative and network process. Conceptually, the term cluster will be used in this study as a synonym of productive agglomeration (associated with production or service provision) ([Felzensztein, Gimmon, & Deans, 2018](#)).

[TerWal and Boschma \(2009\)](#) argue that industrial clusters are networks of a social nature and include different stakeholders who interact, evolve and contribute to performance in a specific geographical context. So networks are appropriate structures for a thorough analysis of firms' interactions ([Molina-Morales et al., 2015](#)). According to [Ahuja, Soda, and Zaheer \(2012\)](#), the origins and dynamics of network structure warrant additional research since despite existing studies about endogenous mechanisms that lead to network development (e.g., [Rivera, Soderstrom, & Uzzi, 2010](#)), there is little research about the development of relational architectures and about changes over time in the characteristics of inter-organizational bonds.

[Calantone, Cavusgi, and Zhao \(2002\)](#) and [Kay et al. \(2016\)](#) state that contemporary organizations need a strong learning orientation to be able to achieve a competitive advantage and identify four components of the learning orientation: commitment to

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learning, shared vision, an open mind culture, and intra-organizational knowledge. These researchers also underline that many aspects related to the dynamics of network formation require deeper study.

In these circumstances, clusters become important as a form of inter-organizational network that can contribute to regional development and competitiveness (Sohn, 2015). For Cusin and Loubaresse (2018), from this perspective, inter-clustering is a synonym for cooperation. As noted by Lorenzen and Mudambi (2015: 213) and Goerzen (2018), inter-cluster alliances are a “nascent research field”. The traditional view of inter-clustering reflects the implicit postulate of the cluster literature, according to which such relations create value for clusters (Schüßler, Decker, & Lerch, 2013).

A great number of investigations have been made about cluster connectivity concentrated on organizational-based linkages (Lorenzen & Mudambi, 2013), but little attention has been paid to the person-based relationships that result from trans-regional entrepreneurs-managers promoting the transfer of knowledge from one cluster to another (Saxenian, 2006). Few studies on inter-cluster relations have investigated their influence in terms of knowledge creation and sharing (Bathelt, Malmberg, & Maskell, 2004) and on learning processes.

Therefore, from a perspective of inter-organizational networks (Hamel, Doz, & Prahalad, 1989), this study of an exploratory nature intends to contribute to improving knowledge about the relationship between clusters, namely regarding the share of knowledge (share of wisdom, experiences, activities, initiatives, ...) and learning. More precisely, the aim is to assess top management's perception in six Portuguese clusters located in the same or a nearby geographical area, distinguished by the ECEI (European Cluster Excellence Initiative) as Gold Label.

The following questions were also defined for the purpose of this study:

Q1: How do inter-clustering linkages permit the knowledge-sharing and learning processes?

Q2: What are the challenges for inter-clustering representing a competitive advantage at the individual (person-based) and trans-regional levels?

Q3: How does inter-clustering promote regional development and competitiveness?

Therefore, our contributions are twofold. First, inter-cluster relations offer a new framework. We show inter-clustering as people-based relationships across clusters (Saxenian, 2006). These types of networks are designed by and systematically involve cluster-level actors. Second, we discuss how these networks can be seen as an instrument to share knowledge and a learning process, as well as showing the motivation for forming inter-cluster networks. Finally, we believe that this study constitutes an interesting and innovative line of research, especially when we look into knowledge transfer and learning in relations among close clusters. Our paper also highlights the importance of inter-cluster cooperation to promote regional development and competitiveness.

We proceed as follows. First, we outline the theory of clusters and the inter-cluster phenomenon. Second, we show how inter-cluster networks can be a way to share knowledge and learning. Thirdly, we present our research methodology and based on our findings, we specify and compare six Portuguese clusters. Finally, we outline the main conclusions and the implications of our results.

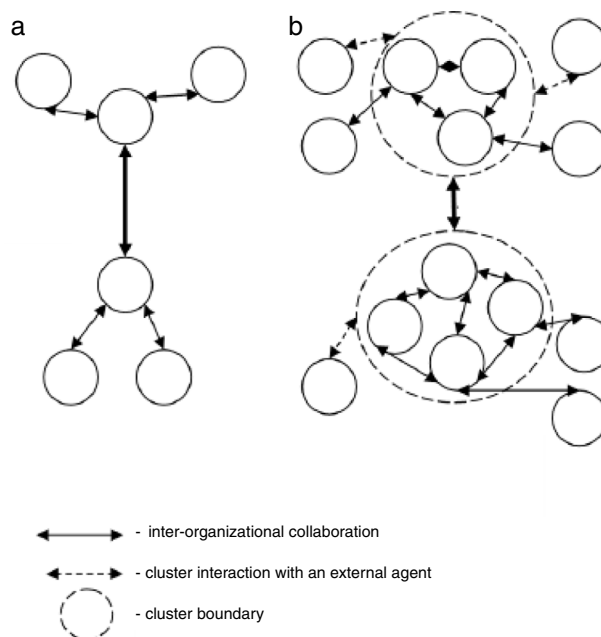


Fig. 1. Cooperation in innovation

Note: (a) Inter-organizational collaboration; (b) inter-cluster interaction. Source: Adapted from Omelyanenko (2014).

Literature review

Clusters

Clusters have attracted researchers' interest for decades (e.g., Hoover, 1937; Marshall, 1890; Scott, 2002). Indeed, many of the studies made on business were built on the first theories of Marshall, in 1920, related to agglomeration/cluster economies (Parr, Hewings, Sohn, & Nazara, 2002). Nevertheless, according to Felzensztein, Stringer, Benson-Rea, and Freeman (2014), researchers do not have a single definition of cluster. For Porter (1998), although clusters are formed on any geographical scale, they are mainly localized and related organizations. Porter (1998, 2008) states that clusters are geographical concentrations of firms and institutions interlinked in a given area or specific sector of activity, including industries and other essential entities for competitiveness.

Industrial districts differ from industrial clusters by the nature of the inter-relations (Porter, 1998; Takeda, Kajikawa, Sakata, & Matsushima, 2008). Clusters are characterized as cooperation and collaboration networks that provide significant opportunities to stimulate economic development and strengthen competitiveness (Porter, 1998).

According to Zvyagina (2014), the cluster typology can also be complemented by the effects of inter-cluster interaction. This effect is shown in the fact that clusters, as a whole or individually (organizations and firms), can interact with other types of clusters. This interaction can lead to the creation of new competitive products, fundamentally due to the synergetic effect (Fig. 1). The greatest potential of inter-cluster interaction is associated with educational and infrastructural clusters, to a certain extent, with the capacity to carry out functions of interest to any type of cluster.

Clusters are therefore considered to include firms, and other institutions such as universities, research centers, commercial associations, standardizing organizations, technical laboratories and other institutions and suppliers that support the sector's activities; also benefiting from public assets in the surrounding community (Porter, 1998; Porter & Kramer, 2011; Sohn, 2015).

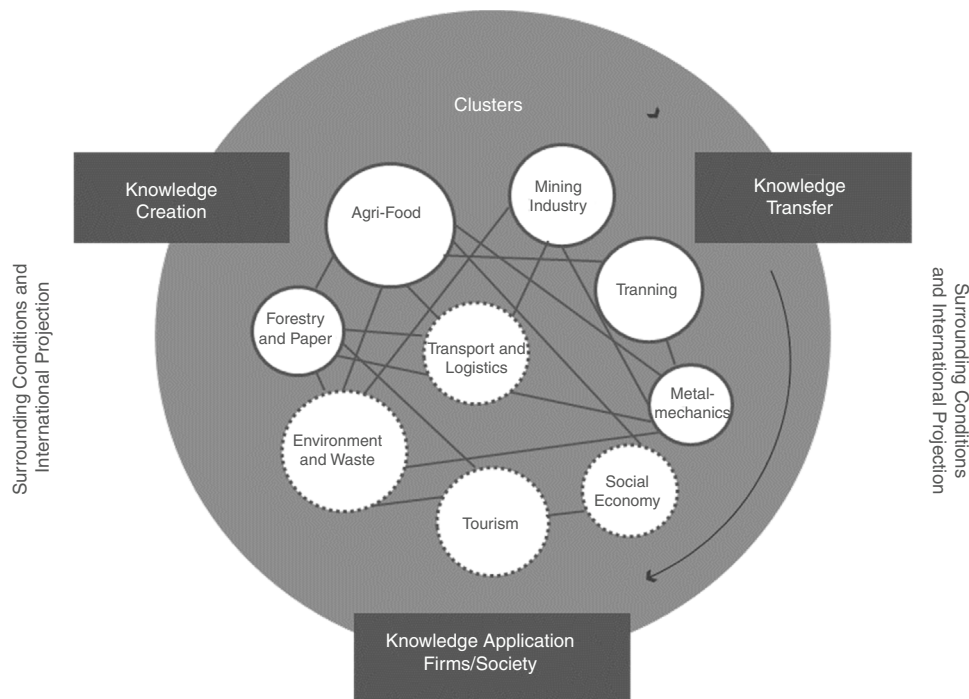


Fig. 2. Inter-clustering.

Source: Portuguese Innovation Society – 20 years (2016).

According to Anatoliyovych, in a knowledge-based economy, clusters of innovative firms emerge close to sources of knowledge. They are based on sophisticated infrastructure, where knowledge is created, developed, shared and exchanged. Clusters are characterized by highly concentrated and effective links between business-people, investors and researchers.

Clusters can take on a variety of forms, depending on their main technological and commercial areas of specialization. In most cases, they operate in localized geographical areas and interact in larger innovation systems at the regional, national and international level. With globalization, clusters have become more dynamic and are key factors in a country's capacity to attract international investment, which generates new technological knowledge (Kay et al., 2016). Clusters are of interest to investors in innovation (risk capital, etc.) and benefit from the international mobility of qualified staff.

According to the information available from the Institute to Support Small and Medium-Sized Enterprises and Innovation (IAP-MEI) and Ruling no. 2909/2015, a cluster of competitiveness is an aggregating platform of knowledge and competences, formed of partnerships and networks that include firms, business associations, public bodies and relevant supporting institutions, namely non-business entities of the Research and Innovation System (SII), which share a common strategic vision, through cooperation and obtaining agglomeration economies, to reach higher levels of competitive capacity (DR no. 57, 2015). This legal document also mentions that strategic initiatives of collective efficiency existing or emerging in the business sector and directed toward substantial reinforcement of levels of competitiveness, promoting innovation and stimulating the internationalization of the Portuguese economy, opening a new cycle of public policy to support the dynamics of business clustering, are instruments to fulfill the strategic objectives of "Competitiveness and Internationalization of Portugal 2020". It is also considered essential to create extended and improved conditions for innovation in the intra and inter-firm domains, to allow the insertion in international markets of ranges of differentiated products and services with greater added value.

Regional clusters have been defined as "geographical concentrations of inter-related firms, specialized suppliers, service providers, firms in related industries and associated industries, in a specific field in which they compete, but also cooperate" (Porter, 1998), and have attracted the interest of researchers for many decades (Hoover, 1937; Marshall, 1890; Scott, 2002). As an engine for economic growth, regional clusters have been regarded as a vital source of competitiveness in most industries (Delgado, Porter, & Stern, 2016).

One of the main objectives of competitiveness clusters is to "Promote the cluster's internationalization through participation in international networks, triggering or developing inter-cluster initiatives, as well as collective international promotion of the goods and services produced in the respective branches (Porter, 1998)". Clusters enable the emergence of local relational assets leading to technological spillovers, for example, which are central to the process of learning, innovation, and economic growth (Beugelsdijk & Mudambi, 2013).

Inter-clustering

In order to specify better the functioning of the greatly contested cluster concept (Martin & Sunley, 2003), research has paid attention to the real networks that are formed within (Visser & Boschma, 2004; Visser, 2009) and also between different clusters (Asheim & Isaksen, 2002; Boschma, 2005; Lorenzen & Mudambi, 2013; Schübler et al., 2013) (Fig. 2).

Clusters cooperate for a specific cluster-related purpose, such as enhancing participants' innovative abilities, attracting public funding or strengthening regional economic development. They are frequently supported by national or regional policies (Dohse, 2007). Actors participating in cluster networks are network partners residing in different clusters that, in turn, are embedded in networks among clusters (Schübler et al., 2013).

From the perspective of Competence Theory (Penrose, 1959; Richardson, 1972), linkages established across firms can be explained by firms' need to access external competences and

abilities, which may or may not be found in their closest neighbors. This perspective is useful to explain recent dynamics of clusters especially with respect to innovation (Parrili & Sacchetti, 2008). In these cases, local firms created bridges of cooperation with leading firms located outside the cluster in order to incorporate new competitive advantages (Rabellotti, 2004). In this connection, according to Morrison and Rabellotti (2009) and Kay et al. (2016), knowledge is distributed unequally in clusters, and knowledge and information networks differ greatly in their structure. The authors found that knowledge flows in a given sector are restricted to a strongly related local economy (e.g., the Italian wine sector), differing in terms of knowledge assets, innovation behavior and economic performance, in relation to the other cluster firms. Boschma (2005) mentions that too much clustering or network closure can harm the dynamics of local learning and that larger, more successful producers in the local sphere are not interested in forming internal knowledge links with local, small and medium-sized enterprises (SME). Regarding network formation, larger firms are found to prefer to remain on the periphery of the knowledge network and strengthen their links to sources of knowledge outside the cluster, whereas smaller firms are closely inter-linked and communicate with external sources of knowledge.

Although external links are recognized as crucial for the development and maintenance of cluster innovation, few studies have examined the idiosyncratic and extremely variable aspects that are established between the elements (Engel & del-Palacio, 2011). This analysis is necessary to understand how the administrative organs of the cluster or other organizations, between them, support the development of shared, institutionalized mechanisms for solving problems, access to markets and sources of finance or knowledge transfer in the complex network of centralized and decentralized, strong and weak organizations, based on people who characterize the links between groupings (Schüßler et al., 2013).

Inter-clustering as a Knowledge and Learning Network

The emergence of knowledge within and over the different ontological levels can be stimulated through interaction communities (or contexts). Accordingly, a team, organization or inter-organizational network represents contexts (or communities) of interaction favoring the creation of support platforms for their members for the articulation, share and amplification of individual perspectives and ideas, as well as to build shared understanding, i.e., to create, develop and expand knowledge (Boschma and Ter Wal, 2007; Inkpen & Tsang, 2005). Inasmuch as these communities can involve (formal and/or informal) interactions at the inter-organizational level (i.e., links with clients, suppliers, distributors, competitors . . .), it is important that each organization is able to capture and integrate the emerging knowledge that is appropriate (or more beneficial) for their strategic development.

As an organizational resource, knowledge differs from others due to some particular attributes, namely: (i) it is inexhaustible; (ii) it grows and increases through its share and use; and (iii) it needs continuous stimulation to avoid becoming obsolete (Cardoso & Gomes, 2011; Cardoso, Meireles, & Peralta, 2012; Passerini, 2007). From the results and/or objectives it leads to, knowledge represents an entry and exit resource. Knowledge is therefore defined as the main determinant of organizations' functioning, sustainable value and performance (Pais & dos Santos, 2015).

Regarding the perspective of knowledge as an input and output resource, this originates in the resource-based theory of the firm (Wernerfelt, 1984). This theory is traditionally centered on organizations' internal resources (i.e., all types of assets, processes, knowledge, organizational capacities) identified as unique and fundamental determinants able to contribute and lead to achieving and increasing competitive advantages (Bridoux, 2004;

Dyer & Singh, 1998; Kinra & Antai, 2010). Through efficient and effective management of a set of specific and strategic resources, as well as their respective returns, organizations have the potential to create strategic and competitive differentiation. The resource-based theory of the firm, subsequently extended through knowledge-based theory (Nonaka & VonKrogh, 2009), identifies and emphasizes knowledge as potentially the most strategic and significant resource. According to these authors, knowledge can be a special source of competitive advantage, in and for organizations (Halawi, Aronson, & McCarthy, 2005). At the center of this theory lies the premise that due to the inherent difficulty to imitate, being of a socially complex origin and nature, knowledge is a resource able to differentiate (or heterogenize) organizations' performance and success (Kogut & Zander, 1992).

In this context, and according to Balestrin and Verschoore (2010), inter-cluster networks have the capacity to facilitate joint actions and resource transaction to achieve organizational objectives. This type of network can be defined as a set of repeated transactions supported by relational and structural forms, having dynamic frontiers and interconnected elements (Todorova & Durisin, 2007). Inter-cluster networks are therefore a phenomenon in organizational theory, and have consequently been much studied from different theoretical viewpoints. This inter-disciplinary nature of contributions was also shown by Oliver and Ebers (1998) and Gnyawali and Madhavan (2001) when presenting the main theoretical streams used in research about cooperation networks between organizations, highlighting: industrial economy, resource-dependence approach, social network theory, critical theories, institutional theory, transaction cost theory and the organizational strategies approach.

When two or more clusters have common and complementary characteristics and areas (e.g., knowledge bases; resources; language; objectives; understandings; representations; meanings), the emergence and continuity of cooperative links between them is more likely to occur (Broekel & Boschma, 2012; Das & Teng, 2003). In this context, it is underlined that although competitive interdependence may be dominant (or is potentially more probable) between clusters operating in the same sector of activity, relationships of cooperative interdependence can exist between clusters of the same or different sectors of activity, involving or not organizations that compete with each other.

Still in the scope of knowledge network functioning, Morrison and Rabellotti (2009) mention that in contexts such as industrial "districts", clusters and local production systems, informal relationships are key channels for spreading knowledge. According to the authors, local and personal knowledge (i.e., tacit) is mainly exchanged by people who are involved in its creation, or by those who are part of the same local community. In this context, access to information and non-intentional knowledge is facilitated by geographical proximity and because the different actors in the cluster have common cultural values, communication codes and behavioral norms (Cusin & Loubarette, 2018). So informal contacts allow knowledge and learning to be shared by the members of a group, while those excluded, or not part of the local community, are not privy to this type of knowledge (Morrison & Rabellotti, 2009). According to Stuck, Broekel, and Diez (2015), the literature on knowledge networks shows that indirect relations are crucial for the spread of knowledge and innovation. Given the relevance of indirect relations, the structural characteristics of a complete system of relationships (i.e., the network) are also extremely important.

Knowledge and learning in clusters is related through various forms of local inter-organizational collaborative interaction (Malmberg & Power, 2005). According to Sohn (2015), informal contacts are relevant and effective channels for sharing

information and knowledge in clusters. However, few empirical studies provide detailed and convincing evidence about this matter.

Research methodology

Type of study

To answer the research questions defined for this study, research of a qualitative nature was undertaken. According to Gil (1999), qualitative research should be understood as a formal, systematic process with the fundamental aim of discovering answers to problems by using scientific procedures that allow new knowledge to be obtained. For Merriam (1988), in qualitative methodologies, those involved in the research are not reduced to isolated variables, but are seen as a whole in their natural context. Observation of social phenomena implies the researcher's participation in the universe where the chosen phenomenon occurs, and research methods can be applied aiming to confirm the meaning of something in its natural environment (Patton, 1990).

Within this qualitative research, the case study method was chosen. Since our knowledge about inter-clustering is limited, we have chosen a multiple-case design that allows us to uncover different facets of this phenomenon (Yin, 2015). This author states that case studies are a basis of knowledge, giving direction to future studies, an interactive and flexible project, taking a holistic approach to study real life events and using multiple data-collecting sources and techniques. The case study is a methodology characterized by deep and exhaustive study of one or a few objects, to provide wide-ranging and detailed knowledge about this (Gil, 1999; Yin, 2015). According to Bonoma (1985), the case study method, like other qualitative methods, is useful whenever the subject of study is wide and complex, the existing body of knowledge is insufficient to allow the proposition of causal questions, and when a phenomenon cannot be studied outside the context in which it naturally occurs (Bonoma, 1985).

Based on the knowledge acquired from one case, it is possible to identify and analyze, in others, the existence of certain behavior patterns that explain the elements of homogeneity and heterogeneity characterizing the subject of study (Yin, 2015). Qualitative methodology is not concerned with generalization. What characterizes this type of method is in-depth study, seeking the valid explanation for the case studied, but recognizing that observations are always partial. What makes these studies valid is the rigor of the bonds formed between the theoretical bases and the empirical research (Yin, 2015).

Selection of cases

The selection of cases is determined according to the study's needs. From the qualitative research approach, the intention is to analyze the results arising from individual cases, which generate more detailed, richer and more useful information for the phenomenon observed (Patton, 1990).

The recommended number of cases depends on how many are necessary to discover what must be known (Kvale, 1996). In this study, a case corresponds to a cluster. Case selection, following Patton (1990), was intentional and for research convenience. The criterion for cluster (case) selection was based on recognition by the European Cluster Excellence Initiative (ECEI) as Gold Label, i.e., recognized at the European level with "Cluster Management Excellence Label GOLD". This recognition results from the ECEI applying a framework with 31 measures of management performance, where cluster organizations show highly sophisticated management and strong commitment to improving organizational structures and routines, with a view to improving performance. We select and

Table 1
Identification of the clusters studied.

Cluster designation (case)	Sector of activity
E&T – Engineering and Tooling (Case 1) (Group E&T = AFR Moulds + E&T Plastics)	Moulds
TICE.PT (Case 2) (Centre of Information, Communication and Electronic Technology)	Information and communication technology
InovCluster (Case 3) (Agro-industrial Cluster Association of the Centre)	Agri-food production
PRODUTECH (Case 4) (Centre for Production Technology)	Production technology
Sustainable Habitat (Case 5) (Platform Association for Sustainable Construction)	Habitat
Portugal Foods (Case 6) (Integral Association)	Agri-food

Source: Elaboration based on information available online on 19-04-2017.

analyze six empirical cases of cluster cooperation varying in size, regional scope and industry to understand what objectives are defined to ensure knowledge transfer and learning process at the inter-cluster level. The Portuguese clusters with this recognition and studied here, and their area of activity, are presented in Table 1.

Data collection

In carrying out research it is necessary to use techniques and instruments to gather and obtain information. According to Deshaies (1992), the construction of data-gathering instruments is considered very important in research work, since on it depends the collection of pertinent information, considering the subject of study.

Qualitative research does not try to numerate or measure events. Its aim is to obtain descriptive data, through the researcher's direct and interactive contact with the situation studied. The researcher tries to understand the phenomenon, from the perspective of the participants in the situation studied, and from this, interpret the phenomena studied (Patton, 1990; Yin, 2015).

According to Yin (2015), possible sources of evidence for use in a case study are: (a) interviews, (b) observations, (c) documents and records, (d) physical artifacts and (e) surveys. These sources allow a great amount of information to be collected in great detail and in-depth analysis, when dealing with one, or a small number of case studies.

In this exploratory study, besides documentary analysis (e.g., consulting the sites of the selected clusters) semi-structured interviews (primary sources) were used as this seemed the most appropriate choice in the context, giving the researcher more certainty. According to Patton (1990), semi-structured interviews have the advantage of the certainty of obtaining data that is comparable among the various subjects.

As qualitative data collection works best in natural environments at respondents' place of work (Gelo, Braakmann, & Benetka, 2009), four face-to-face interviews took place on-site with the executive directors of the selected clusters (Table 2). Given their strategic role/involvement in the clusters and their comprehensive knowledge about knowledge transfer and learning, the interviewees selected were most likely to provide the information needed, being considered key informants (Kumar, Stern, & Anderson, 1993). The interviews were held in June and July 2017 and lasted 55 min on average. The interviews were guided by open questions, and answered in a free and moderately directed way. The script was elaborated based on the study's aim and was in two parts: brief characterization of the respondent (gender, age and academic qualifications), the cluster (location, sector of operation and number

Table 2
Characterization of interviewees.

Designation of the interviewee	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
	RT	VL	CS	PR	VF	AS
Position	Executive director	Executive director	Executive director	Executive director	Executive director	Executive director
Gender	Male	Male	Female	Male	Male	Male
Age	50	66	40	42	56	46
Academic Qual.	Master in International Economy	MS in Telecommunications (U. of Essex)	Master	Degree in Economics	Ph.D.	Diploma

of members) and a number of questions associated with inter-clustering and knowledge networks.

Analysis of the information revealed that the executive directors are aged between 40 and 66. All are male, except for the director of Inovcluster (Case 3), the only woman to occupy this post and the youngest of the interviewees. The interviewees' academic qualifications are diverse, with one holding a Ph.D., three a master degree, one a first degree and one a diploma.

Analysis and interpretation of the information

According to Bertaux, quoted by Lalanda (1998), the researcher should not only focus on the content of one interview, but focus on various types of messages or reports from several interviews. In this way, the intention was to improve understanding of the communication resulting from the interview.

The information collected/generated in the interviews was also checked, complemented and contrasted with analysis of documents and materials, such as the sites of the selected clusters. The purpose of this documentary analysis was data triangulation (Blaikie, 2000), meaning greater external validity of the results (Yin, 2015; Eisenhardt, 1989). This involved crossing information from the interviews with secondary sources. Summarizing, data interpretation was based on the interviewees' opinions/perceptions (first order interpretation) and subsequent validation (second order interpretation) to confirm the coherence of all the information gathered. Lastly, a theoretical meaning (third order interpretation) was attributed to complete the case evidence (Neuman, 2010). Finally, the results obtained were treated, the information it was intended to obtain being highlighted, so as to develop interpretations, conclusions, limitations and expectations regarding the topic studied.

Table 3
Characterization of the clusters.

Year of creation	Case 1 2009	Case 2 2008	Case 3 2010	Case 4 2009	Case 5 2009	Case 6 2009
Managing Entity	POOL NET Portuguese Tooling & Plastics Network	Centre of Information, Communication and Electronic Technology	Agro-Industrial Cluster of the Centre Association	Association for Sustainable Production Technology	Platform for Sustainable Construction Association	Integral Association
Legal status	Non-profit-making Private Association	Non-profit-making Private Association	Non-profit-making Private Association	Non-profit-making Private Association	Non-profit-making Private Association	Non-profit-making Private Association
Location	Marinha Grande/Central Region	Aveiro/Central Region	Castelo Branco/Central Region	Porto/North Region	Aveiro/Central Region	Maia/North Region
Sector of activity	Moulds, Special Tools and Plastics	Information, Communication and Electronic Technology	Agri-industrial	Production Technology	Construction materials and buildings	Agri-food
No. of members	92	90	180	109	157	170
Site	toolingportugal.com	tice.pt	inovcluster.com	produtech.org	centrohabitat.net/pt	www.portugalfoods.org

Case results and discussion

To achieve the goals defined in this qualitative research, six cases/clusters were considered. With this type of qualitative and exploratory research, the aim was to understand the relationship between *Gold Label* clusters and whether inter-clustering is, or could come to be, a competitive advantage at the regional and national level and have an impact on the internal and external economy.

Description of the six cases is organized based on the objectives of each cluster, and the network functioning, restrictions, benefits and potential of inter-clustering, themes identified in the literature review. Finally, based on the empirical evidence found from the six case studies, a comparative analysis was made. This type of procedure aimed for better understanding of the results obtained.

Characterization of the clusters

The following tables present a brief characterization of the six clusters/cases selected and their sphere of activity and objectives (Table 3).

All the clusters come under the legal status of non-profit-making private associations and all emerged between 2008 and 2010, following approval of the legal ruling foreseeing the formation of clusters in Portugal. This ruling emerges through the cluster policy gaining greater significance with the QREN 2007–2013, this being the main basis of the current policy to support clustering and a fundamental instrument in operational integration of strategic priorities related to strengthening cooperation, consolidating innovation and R&D, and increased international projection (Moreira, 2014).

Among the cases studied, it is of note that three carry out activities associated with production technology (plastic molds – Case

Table 4
Objectives of the clusters.

	Objective of the cluster
Case 1	Focuses its firms' activity on engineering, development, production and export of injection molds for the plastics industry and also on trials of molds and production of plastic parts, in extremely diversified sectors and markets.
Case 2	Focuses activity on the whole value chain in the area of ICET. Aims to stimulate and enhance network strategies for the sector, between the firms and R&D centers, in order to stimulate active renewal in the national economy, produce effects on the national supply made possible by innovation and knowledge, and thereby create export capacity and value creation in national products.
Case 3	Contribute to increased competitiveness in local and regional production systems and promoting the Central Region of Portugal nationally and internationally. To do so, it establishes a unifying platform for the main actors in this sector, and supports firms in innovation processes, R&DT, knowledge transfer, training, development of new products, services and processes, marketing and internationalization.
Case 4	Brings dynamics to the production technology sector, including firms that develop and commercialize products and services able to respond to the challenges and requirements of competitiveness and sustainability in the national and international manufacturing industry, with innovative, flexible, integrated and competitive solutions.
Case 5	Create synergies between cluster entities in order to develop new products, technology and construction systems, and a new way of conceiving spaces and surroundings, inducing an innovative attitude through a sustainable built environment which aims to generate factors of added competitiveness.
Case 6	Production and share of knowledge as a support for innovation and competitiveness, being identified as a "space" where companies and entities form win-win relationships. The PortugalFoods brand is an umbrella brand of the Portuguese Food-Producing Sector promoted by the Centre of Competitiveness and Food-Producing Technology. This image should be unique and one of excellence, promoting Portugal, its products, its brands and its companies in a modern, appropriate way in international markets.

1; developing products for innovative industries – Case 4; sustainable construction – Case 5), information, communication and electronics (Case 2), one with activity associated with the agro-industrial sector (Case 3) and the other with agro-food (Case 6). This last one has the major objective of promoting the country through spreading the "PortugalFoods" brand and image with an impact on publicizing national products in the agro-food branch (Table 4).

Also regarding characterization of the clusters, it is noted that four are situated in the central region of the country and the other two in the north. All the clusters operate in distinct sectors of activity, but with a potential transversal effect in their activity. Inovcluster (Case 3) has the largest number of members and TICE.PT (Case 2) the smallest, with activity in the agro-industry and information, communication and electronic technology sectors, respectively.

Inter-clustering as the sharing of knowledge and learning

When the interviewees were asked if there was already a network of collaboration and knowledge-sharing among clusters and how this was formed, all of them said that the inter-connection of the clusters, as a network of collaboration and sharing of knowledge and experience/learning, was indeed the case, but no formal mechanism led to its formation. "The complementarity between entities and identification of joint opportunities (VL, Case 2 and CS, Case 3), the need for firms to promote their competitiveness (PR, Case 4) and the very nature of a cluster creating the capacity to take the initiative and form thematic or institutional networks in order to benefit its own members" (VF, Case 5), were what determined network functioning. This situation corroborates the argument that networks involve

interactions between their actors, both formally and informally, as shown by various authors (Boschma and Ter Wal, 2007; Inkpen & Tsang, 2005).

Also according to the previous interviewee, "the cluster itself is a network of sub-networks when it is formed by associations from different sectors, technological centers and other R&D institutions that themselves have solid relationships with firms and other entities". So it seems possible to state that clusters, by their very nature and function, develop an endogenous process of establishing a collaborative network, "involving national, regional and local entities, Entities of the National Scientific Council, with a common objective to create cooperation and sharing networks to give firms more capacity and support their development", as stated by AS (Case 6). For this, it was essential for the cluster to be recognized as an Entity of Collective Efficiency (EEC), in the form of Centers of Competitiveness and Clusters. This perception is reflected in the conclusion by Morrison and Rabelotti (2009), as in the context of industrial clusters, relationships and informal collaboration play a crucial role in knowledge-sharing.

As stated by the executive director of the E&T-Engineering & Tooling cluster (RT, Case 1), "there's always a story/motivation behind its development, resulting above all from the capital of trust that's developed between peers, as the success of clusters is in the people who form it and stimulate it". This statement alone shows the importance of the actors involved in clusters.

When cluster managers were asked how clusters can form networks for managing learning, the answers obtained are associated with concepts like cooperation, strategy, sharing, complementarity, competitiveness, opportunities and extending the value chain. In a systematic way, and connecting the opinions of the different interviewees, the executive director of the E&T-Engineering & Tooling cluster (RT, Case 1) says that "it will be possible to establish a network to manage learning if the clusters – identify clusters that, within their areas of intervention and operating markets, show a potential for the expansion of their value chain, expansion of the supply and the development of knowledge and competences". In this way, it will be possible to cooperate with clusters in mutually competitive areas, aiming to increase the effective scale or with complementary clusters where it is necessary to achieve common goals. So inter-cluster cooperation, even if with "competitors", will allow continuous learning, benchmarking and developing opportunities with mutual advantages.

The interviewee also states that "it is necessary to develop analyses of strategic mapping, surveillance activities, and promote actions to mobilize partnerships (events, joint projects, B2B, training, work groups, etc.) that potentialize this inter-cluster cooperation for which effective inter-peer commitment is very important". However, according to the executive director of the PRODUTECH cluster (Case 4), "a learning management network finds its potential . . . quite limited, if there is no policy of clustering the economy that promotes: expanding, deepening and increasing the intensity of the relationships established". As the cases studied are considered innovative, the importance of shared learning (cooperation) is noted, as mentioned by Balestrine and Verschoore (2012) in relation to cooperation networks.

In an attempt to understand better how cluster managers/executive directors could act as agents promoting change, they were asked how cluster managers could promote effective inter-cluster cooperation, and through this, obtain competitive advantages. The answers obtained underline that people/managers are indispensable in the whole process and determine the involvement and degree of commitment, their profile and relational competences to promote active and systematic dynamics, so as to obtain results with mutual advantages. Also in the opinion stated by RT (Case 1) "mapping the areas of opportunities and critical points/weaknesses are at the origin of any cooperation movement. However, clusters have to show a development strategy that is

accepted and shared by its stakeholders, so as to potentialize a waterfall effect on the results pursued". For this, VL (Case 2), "it is essential to know the objectives and mission of each cluster in order to complement or strengthen the activities developed".

Also regarding inter-sector cooperation as a key to success and stimulating new projects, CS (Case 3) gives some examples of initiatives to follow up, such as: *organization of joint events, participation in common projects, determining the needs of a given sector where the possible response lies in another sector, sharing sector trends so as to direct and affect innovation in a complementary sector*. She also emphasizes the importance of the inter-cluster communication process, indicating that for effective cooperation and achievement of win-win results, it is essential to *draw up a joint communication strategy*.

Another piece of information referred to by the interviewees concerns People, with PR (Case 4) highlighting that "cluster managers are in an ideal position to promote inter-cluster collaboration, solving failures in coordination and promoting measures (e.g. joint initiatives) to promote demonstration of the synergies of this type of relationship, thereby promoting a contagion effect on the economy as a whole". Managers' attitude is also mentioned by CF (Case 5) pointing out what has already been done by establishing the Portugal Clusters partnership, which "in a voluntary and pro-active way has contributed to inter-cluster cooperation and obtaining competitive advantages". Indeed, the periodic meeting of clusters is an opportunity to exchange experiences, but also to undertake joint initiatives of different kinds. Internationally, CF pointed out clusters' participation in B2B networks or events (meetings on a given topic), which aim to publicize activities and promote inter-cluster cooperation.

Concerning the importance of clusters' access to tools, means and programs to support their initiatives, in terms of innovation and development and/or internationalization, for AS (Case 6), "cluster managers should accept in the definition of their strategies that cooperation and networking is the basis for companies to be able to develop", and consequently, that clusters reinforce their position in the country's economic context.

From the above, it seems evident that the existence of effective and efficient cooperation can provide the firms involved with a competitive advantage, as mentioned by Porter (1998).

Restrictions and benefits of inter-clustering

Regarding the principal limitations of inter-clustering, the interviewees (C1–C6) mention the lack of motivation and mutual commitment, the non-existence of an environment of trust, respect and transparency, the lack of tools and policies for operational management of inter-clustering, the diversity of functions they take on and the lack of training in relational capital. Consequently, these factors could imply there is no "structured alignment of all stakeholders" (case1), and that cluster managers are not leaders with relational competences, as stated by interviewee RT, meaning that network cooperation is jeopardized, and so it is important to make an analysis from a perspective of solving these restrictions, as mentioned by Engel and del-Palácio (2011). Furthermore, cooperation in clusters is closely linked to the characteristics of their actors (e.g. Schüßler et al., 2013) and is a means to create and transfer knowledge.

As for the benefits of inter-cluster networks, the managers of the clusters studied mentioned additional innovative opportunities and research projects, the sharing of competences and the synergetic effect obtained at the micro and macro level. These benefits are obvious, as "inter-cluster cooperation can also – stimulate the capacity for joint supply of integrated and more robust solutions which, separately, would not be possible and/or an option in supplying products/services" (case2), where "the main benefit is the increased

innovation potential for firms in the cluster through cooperating with clusters from different value chains" (case 5), and "taking advantage of synergies and rational use of existing resources, avoiding redundancy of initiatives and projects, thereby stimulating networking" (Case 6). This question is closely related to knowledge networks and their functioning, as stated by Morrison and Rabellotti (2009). This means that within the network there can be competition between the actors involved, and simultaneously cooperation (e.g., Broekel & Boschma, 2012) – cooptation.

Network size and future expectations

Although cluster networks are understood to contribute to regional development (Sohn, 2015), the size of the network is not relevant, as what matters is the corporate links formed between their actors and their interactions (Molina-Morales et al., 2015). These considerations are visible in the answers obtained from the interviewees when asked about the relevance of cluster size, where "I consider that what really matters is the size of the capacity to cooperate between those involved (degree of commitment), says the executive director of case 1, but "size in terms of human resources, that is in fact a limiting criterion." (Case 3). Summarizing, the six managers (cases 1 to 6) do not consider cluster size to be significant for its success and that of its cooperation network.

Finally, when managers were asked about their expectations for the future of inter-clustering, it is understood that the organizations' future and success includes concentrating on this inter-organizational relationship nationally and internationally, as a way to raise economic development (e.g., DR 57/2015). All the evidence obtained refers to very positive expectations, since "national clusters have developed well-structured relational capital of mutual trust, based on respect, sharing and people who have known each other for several years and ... a potential to develop joint actions promoting innovation hubs" (Case 1). According to VL and CS, innovation arises from the development of "sectors that cross" or "crossed fertilization", respectively, the last manager quoted referring to the importance of being recognized by local, regional and central government bodies. This is corroborated by Quandt (2004) when stating that positive externalities occur associated with the proximity between firms, these being potentialized by the agglomeration – clusters – and how interactions and inter-dependences contribute to spreading information and knowledge. According to Jimenez and Junquera (2010), agglomeration in a cluster, and potentially its inter-relationships, promotes access to specialized resources at a lower cost, improved human capital, and flexibility, the creation of new business and promotion of innovation.

For PR (Case 4), "the dynamics of inter-clustering have been a key element of European policies and initiatives, despite the limited clustering policy in Portugal (particularly in terms of the instruments available/made available to clusters, and their suitability to promote truly structuring initiatives". According to the manager in Case 5, inter-clustering is an unavoidable path even without support, as was proved by the Portugal Clusters partnership in a period such as 2014–2016, and the head of cluster 6 is peremptory in stating this "is taken for granted and there is no going back. The results achieved and recognized by the firms functioning in a network and inserted in clusters demonstrate the bonus obtained by operating in a cluster." This opinion corresponds to the definition of cluster adopted by Portuguese entities (IAPMEI) and the priority shown in the document "Competitiveness and Internationalization in Portugal 2020", where knowledge networks have and will have an intangible asset, knowledge, that can be shared (Cardoso et al., 2012; Passerini, 2007) and which provides their actors with added and collective value (Pais & Santos, 2010).

Conclusions and implications

From a network perspective, this study aimed to understand the relationship between clusters and how this type of network is seen as a mechanism for the share of knowledge and learning. To this end, we analyzed six types of cluster positioned in different fields and located in the same or a nearby territory.

The results presented allowed assessment of the cluster managers' perception of the process of sharing and managing knowledge in the network context, which emerges as a factor of competitive advantage. Therefore, responding to the research questions defined, it is concluded that this process has a crucial role in inter-clustering (Question 1), as it allows the spread of knowledge and learning, and benefiting from synergies through establishing informal cooperation networks.

Furthermore, a competitive advantage is no longer only understood as a tangible asset, which means that the intangible nature of resources is a vehicle to attain a competitive position in the market, in the context of cluster location (regional level) and also in terms of the actors, as individuals, by absorbing new and differentiating competences (person-based) in beneficial relationships (Question 2). Finally, inter-clustering promotes regional development, as it is a way to attract local investment and involve people with an open, entrepreneurial and innovative spirit, aspects that are important for regional competitiveness and promote positive externalities not only at the regional level, but also nationally and internationally, aspects mentioned by the different clusters studied (Question 3). Moreover, we identify several categories of inter-clustering challenges: (1) inter-clustering as the sharing of knowledge and learning, (2) restrictions and benefits of inter-clustering and (3) size of the inter-cluster network and future expectations.

This study also presents some implications for theory and practice in this area. It applied the inter-organizational network perspective to the study of clusters and inter-cluster linkages. The new approach applied allowed identification of categories/variables related to inter-cluster formation. Our findings add to our limited knowledge of the effectiveness of inter-clustering cooperation. In addition, while inter-clustering corresponds to a specific case of inter-organizational relations, its competitiveness and regional development has rarely been investigated. Here, we examine inter-cluster relationships from the person-based perspective and in line with the literature on inter-organizational relations. Inter-clustering linkages offer a new framework in which to analyze knowledge and learning practices. We believe it constitutes an interesting line of research, especially when we look into knowledge sources and management, as well as learning networks. The exploratory character of our research enabled us to comprehend the particular effects that certain factors exert on inter-clustering networks. Nevertheless, there is still the need for further analysis to refine and adapt the outcomes of our multiple case studies.

At the managerial level, one of our contributions is to help cluster facilitators to know when it is productive to cooperate and how to operate in practice, taking existing challenges into account. In this case, there still seems to be a need for government policy on clustering, particularly regarding the definition of effective support instruments which are stable over time and will allow better definition and strategic operation of inter-clustering. This requires more effective commitment by those involved, both public and private bodies. In addition, relational capital such as personal linkages and contacts is extremely important and mutual trust and commitments are an overruling condition for successful inter-cluster cooperation. Also recommended are public policies to encourage the aggregation and share of knowledge arising from the greater intensity of inter-cluster relations. It is suggested that those in

charge of this type of inter-clustering should establish and maintain both personal and professional relationship networks, being part of and leading inter(trans)disciplinary teams in the search for reciprocal/cooperative actions oriented to results.

The study has certain limitations, firstly, as only Portuguese clusters were studied. This naturally led us to investigate clusters organized according to national and regional public policies. In this respect, we agree with Peng and Bourne (2009) who recommend investigating the contingency factors that simultaneously influence cooperation/inter-clustering. In addition, the fact of selecting only six clusters classified as "Cluster Management Excellence Label GOLD" is a major limitation regarding generalization of our findings at the international level. Consequently, our research could benefit from a study of relations between Portuguese and foreign clusters within the same domain in order to neutralize the effects of public intervention at the national or regional level.

Proposals for future research could include exploring the connection between cluster network functioning and knowledge-sharing and learning management between clusters. Broadening the study of nationally recognized inter-clustering and carrying out a study according to area or sector of activity could be another aspect to explore in the future.

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