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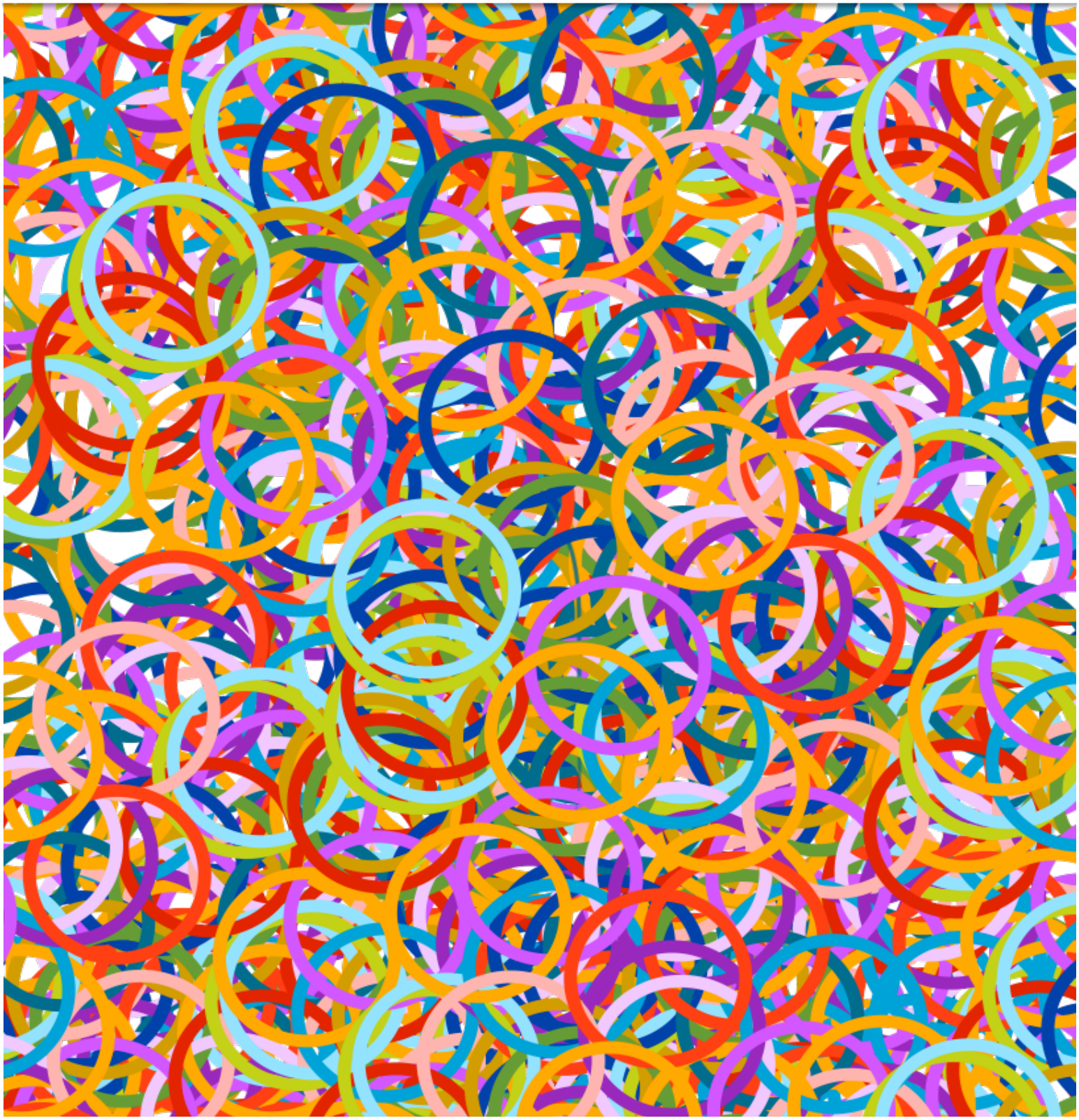

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Phrasing the giant: on the importance of rigour in literature search process

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> *Literature is the noblest of all the arts. Music dies on the air, or at best exists only in memory; oratory ceases with the effort; the painter's colors fade and the canvas rots; the marble is dragged from its pedestal and is broken into fragments.*
>
> Elbert Hubbard

At a very early age, we start to develop a sense of playfulness. We touch things, we build things, we break them apart. Soon after we begin to utter words. We babble, we squeal, we try to imitate. Music begins to inform our bodily movements. What develops last and continues to develop throughout our waking lives is connections of words. The essential and characteristic features of words used to describe things within and around us are the hardest to grapple with. The same word can be expressed in different ways and could mean different things in different contexts. Literature, being the written expression of words in its various forms, has progressively shaped our world view.

Liberal news outlets around the world have been stressing recurrently that words matter, as the imagination of some politicians' is set loose and boundaries to what one may say seem not to exist. However, despite this current societal struggle to adhere to facts, namely amid the current pandemic, science has remained irreducible in its systematic approach supported by the scientific method where facts and doubt do co-exist as a process towards the discovery and construction of new knowledge.

As the years go by, time flies, and suddenly, as a grownup doing research, one needs to select keywords in order to find the right information to extend our world view. We have all been there:

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sitting in front of our digital devices and rapidly searching for information using keywords, say "COVID-19. First, you keep it simple with just one keyword, but soon realise that the results return some relevant articles. So, you extend the search terms, say "COVID-19 Europe", but still the results are wide and varied. So, you limit the search further "COVID-19 Europe Statistics". Now you have some relevant information. You randomly pick few articles (perhaps those with catchy titles), consult them, and be happy that in some arbitrary way you added value to your knowledge store. This is fine for everyday searches but is not what is preferred or generally accepted when it comes to literature search composing one's research paper or thesis. Those papers should indeed be the right ones, as the objective is to write a paper or thesis. Get the wrong papers, or have essential papers missing and trouble is just around the corner! So, we need the right keywords, "As any good library or information worker knows the accurate and consistent application of keywords can serve to enhance the content representation and retrieval of literature." (Grant, 2010, p.173). Reviewing the literature represents an "essential first step and foundation when undertaking a research project" (Baker, 2000, p. 219). It is well established that literature search seeks to reveal relevant information on a topic and make a contribution towards scientific rigour (Baker, 2000; Cooper, 1998; Garfield, 1977). Rigour is achieved when the search process effectively avoids the investigation and already well researched topic and allows for composition of extant knowledge base.

Still looking at words, scientific literature can be analysed using several techniques. These may help us "understand global research trends or see links and patterns amongst scientific documents" (Isenberg et. al., 2016), and examples of these techniques are co-citation analysis, co-word analysis, co-author analysis, word frequency analysis. The new digital sources have enabled researchers to count words based on proximity of their appearance in a text (e.g. Nicholson, 2012; Guldi, 2012), visualise the results using Ngrams or word clouds (e.g. Holmes, 2016) and even depict the strength of disciplinary networks or the extend of a topic (e.g. Randhawa, Wilden & Hohberger, 2016). However, will a novice researcher have to cope with these techniques to start his/her research? Surely not! So, how should we do it?

Setting the Scene

The following paragraphs outline an iterative method that may be used by both the novice and the seasoned researcher in the process of finding the keywords that best fit the search for the information they want.

For the sake of this illustration, let us start by defining a scenario:

- We do not know exactly which keywords to use.
- It is our first time looking up information in this knowledge domain, and, as a result, we just have a feeling about the broad keywords.
- We want to be able to explore; we want to try alternative paths and do it efficiently.
- We would like to have an easy way to cope with the overwhelming amount of information available.

For the sake of this scenario, let us pretend we want to look into the literature in the area of business, entrepreneurship, and innovation.

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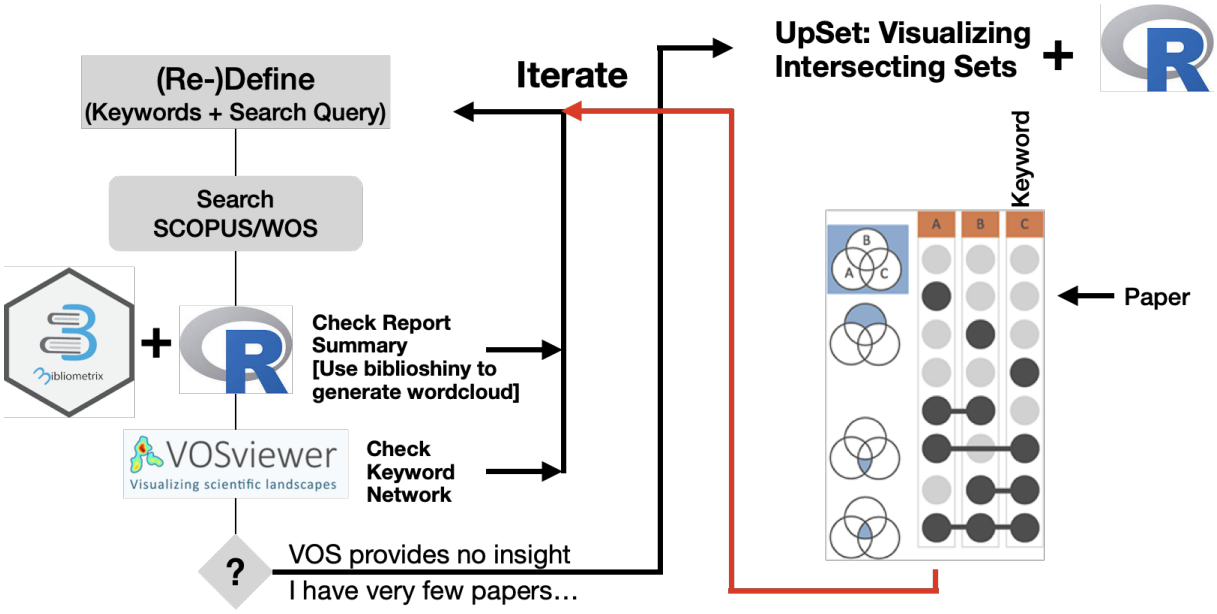

Fig. 1. The keyword exploration process (uses logos for the different tools and the picture extracted from the UPSet website that was adapted to explain the intersecting sets of keyword / paper)

The Approach

When we are looking for literature in a database such as SCOPUS or WoS, we define the keywords, we define the search query which is a specific combination of keywords to be used in the search and, as results, the databases will provide us with a list of hundreds or even thousands of records. So, what do you do? Typically, one would output the data to a Microsoft Excel worksheet and have a look at the records, one at a time. This is very slow and time consuming and the question one may ask is, are there tools out there that could help us with this job?

A natural way of thinking about this issue is, it would be great if we could visualize it! Can we do it? If so, how?

The first thought was to look for tools used to support research in the area of bibliometrics. This search revealed two most interesting and powerful tools: Bibliometrix (Aria & Cuccurullo, 2017) and VOSviewer - Visualization of Similarity (Van Eck & Waltman 2007). Another tool was added latter, the so-called "UpSet: Visualizing Intersecting Sets" (Lex et.al. 2014).

Fig. 1 outlines the iterative process to be detailed in the next section. The objective is to start with a search query, visualize the outputs of that query and decide if it represents what we are looking for or, if not, pick up new keywords that may be worth exploring. The process starts all over again, until we reach a point where we feel that we got what we want.

The tools used are the following:

- R is a free software environment for statistical computing and graphics. R is a very powerful in handling huge amounts of data.

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- Bibliometrix is a wonderful tool for handling and processing massive amounts of data. Bibliometrix is a R Package. This means the user may build on other R functions, Packages and scripting possibilities to enhance functionalities and automate frequent tasks. It's fast and easy to export whatever we like to VOSviewer.
- VOSviewer is a wonderful tool for visualization. VOS imports bibligraphic data (in this process, we use data that we from R), and enables different types of analysis, involving for example, keywords (e.g.: co-occurrence) and references (e.g.: co-citation/bibliographic coupling). Graphics are easy to generate, and navigate.
- UpSet: Visualizing Intersecting Sets is an R Package. This means that we may visualize data available in R, we just have to transform this data into the correct format for generating the graphics. This tool plots a graphic built from a sparse matrix where in each line has a "1" if the keyword (column) occurs for that paper corresponding to that line.

The full process, Step-by-Step

This sequence of steps builds on the assumption that Bibliometrix and UpSet are installed in the R platform. Also install VOSviewer in the computer.

Step 1. Load the libraries

library(bibliometrix)

library(UpSetR)

Step 2. Do the search in SCOPUS or WOS. In this example we did the search in SCOPUS using the following query:

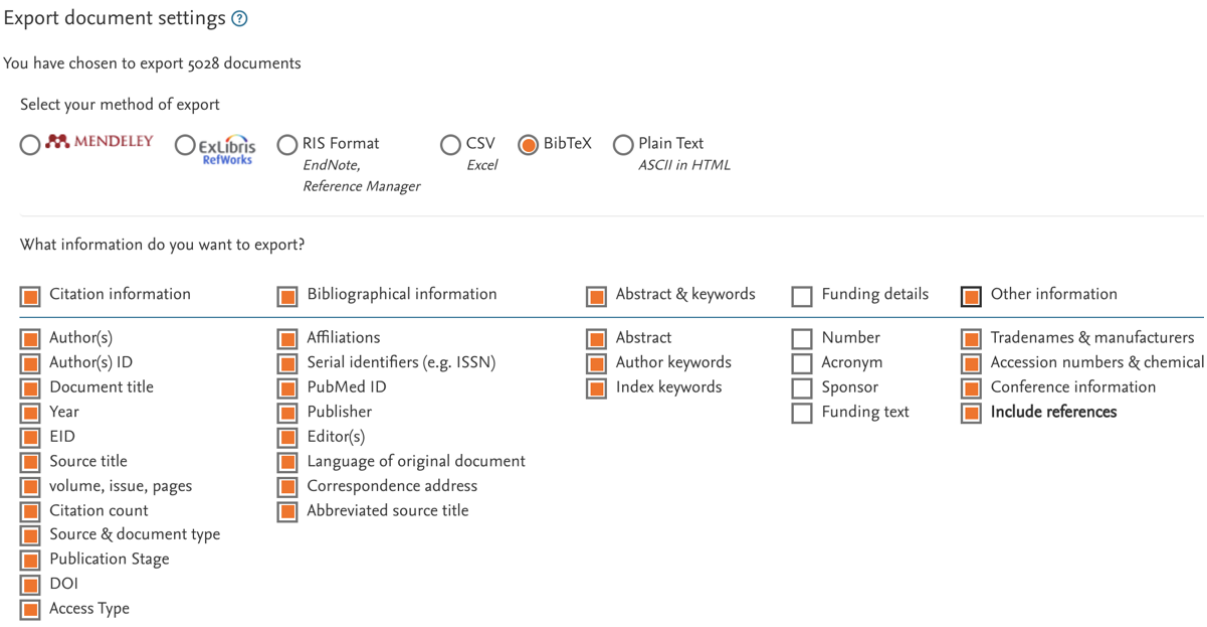

Fig. 2. SCOPUS Export method.

KEY (business AND entrepreneur* AND innovation)

The results were then exported in the BibTeX format as illustrated in Fig. 2. The file was saved as “scopus.bib”.

Step 3. Import all records to R using the Bibliometrix functions and convert the imported data structure to a dataframe. The result is saved in the vaiable M_SCOPUS0.

D_scopus0 <- readFiles("scopus.bib")

M_SCOPUS0 <- convert2df(D_scopus0, dbsource="scopus",format="bibtex")

Remark: if we import records from both SCOPUS and VOS, Bibliometrix provides the function mergeDbSources that merges the dataframes from the two sources by removing duplicates.

Step 4. Have a first glimpse into the contents by using the function biblioAnalysis. The actual results may then be checked using the summary function. One may also plot to picture the numeric results.

results <- biblioAnalysis(M_SCOPUS0)

summary(results, k=10, pause=F, width=130)

plot(x=results, k=10, pause=F)

The summary provides interesting information, namely the number of papers by “Document type” (Article, Book Chapter, ...), the “Annual Scientific Production”, the “Most Productive Authors”, the “Top manuscripts per citations”, the “Most Relevant Sources”, and the “Most Relevant Keywords”.

Step 5. We would now like to visualize what we have in the database. Our proposal is to use VOSviewer. The easy way to do it is to just export the dataframe to a Comma Separated Values (CSV) file as a text document using the function write.csv:

write.csv(M_SCOPUS0,"for_VOS.txt", na="")

Note: na="" replaces the not available (NA) contents to null char.

Step 6. In the application VOSviewer, the file "for_VOS.txt" should be opened as a bibliographic bibliographic data. Then we may choose to generate a map of co-occorrence of “All keywords”,”Author keywords” or “KeyWords Plus”. For the sake of this example, we will focus on “Author keywords”.

Fig. 3 illustrates the resulting keyword co-occurrence map. In the process, the user has to select the threshold for the minimum number of occurrences of a keyword.

This map gives an interesting perspective of the knowledge stores in the database. It also shows that authors’ used in some cases the keyword “business model” and in other cases “business models”.

Step 7. Let us now suppose we want to dig deeper and explore the word business model. We could repeat the whole process with the new search query which returned 30 documents:

KEY (business and entrepreneur* and innovation AND "business model")

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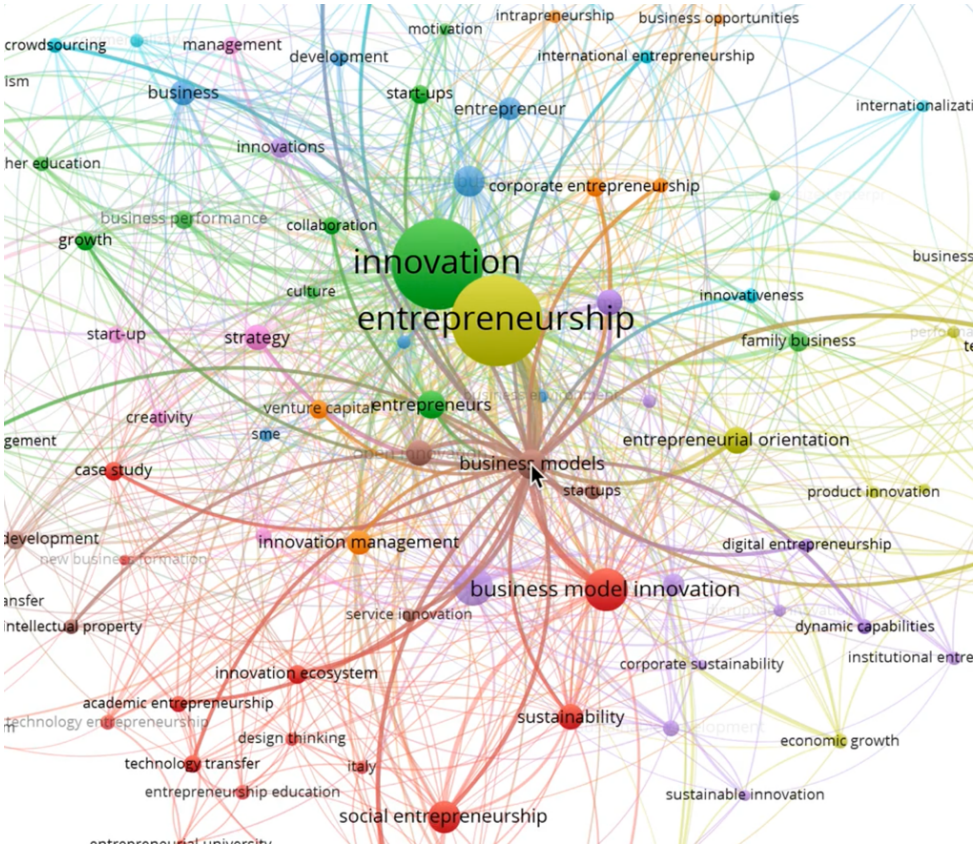

Fig. 3. Keyword co-occurrence map. The selection of one node highlights the node connections for easier visualization.

An alternative would have been to use an R command to create a new dataframe from the original M_SCOPUS0 by just selecting the records that matched the keyword "business model". This means that, with some practice, one is able to load a big databased into R and manipulate and generate new ones by selecting records matching a specific condition. This accelerates the process and saves us regular visits to SCOPUS and WOS.

Fig. 5 illustrates to new keyword map and it seems clear not useful information may be extracted regarding the contents of the selected papers. So, we go to step 8.

Step 8. This step is about getting further detail from the papers we have in the database. To this end we will use the R package UpSet: Visualizing Intersecting Sets and also a bibliometrics function cocMatrix that generates the Co-occurrence matrix. The command below generates the Co-occurrence matrix for the Field "DE" that corresponds to the Author Keywords. The second command converts the matrix to a dataframe and the third, removes the line labels (paper reference).

```
co_de <- cocMatrix(M_SCOPUS0, Field = "DE", type = "matrix", sep = ";", binary = TRUE)

co_de.df <- as.data.frame(co_de)
```

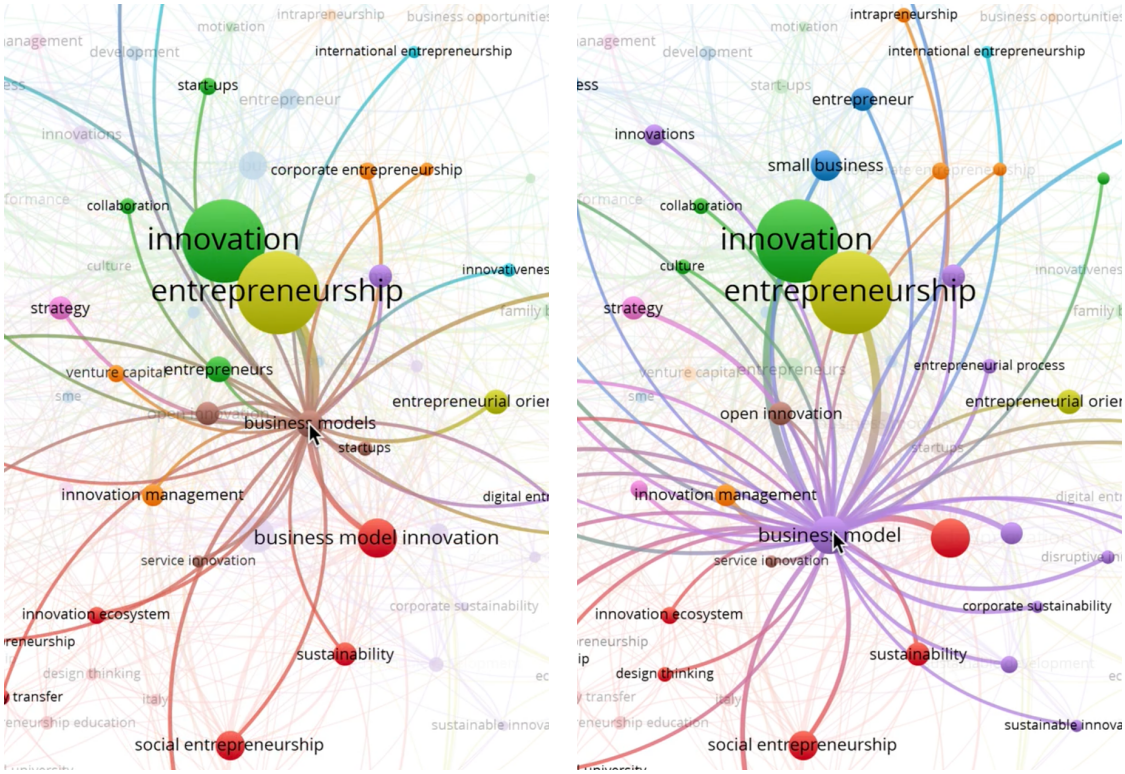

Fig. 4. Showing the keywords "business model" and "business models"

row.names(co_de.df) <- NULL

All is now set to run the UpSet command and generate the visualization of the intersecting sets:

upset(co_de.df, nsets = 40, nintersects = 60, mb.ratio = c(0.3, 0.7), order.by = c("degree","freq"), decreasing = c(TRUE,FALSE), show.numbers = TRUE)

This visualization provides an interesting insight into what one has in the selected papers. Remember that we are exploring what we have, and we may realize that the keyword "social franchise" seems to be interesting and we see that appears together with the other keywords highlighted in the red circles in one paper. In R, using the RStudio (ref) interface it is quite easy to define a filter with the keyword "social franchise". In less than a minute have all the information about the paper we need, and we can retrieve it from google scholar (provided you are within a VPN that grants the needed permission).

Conclusion

The process herein described, may be used to find the adequate keywords to start any research. This a possible approach that may be used to handle the overwhelming amount of information one gets whenever looking for any bibliographic material. The process allows exploration of the

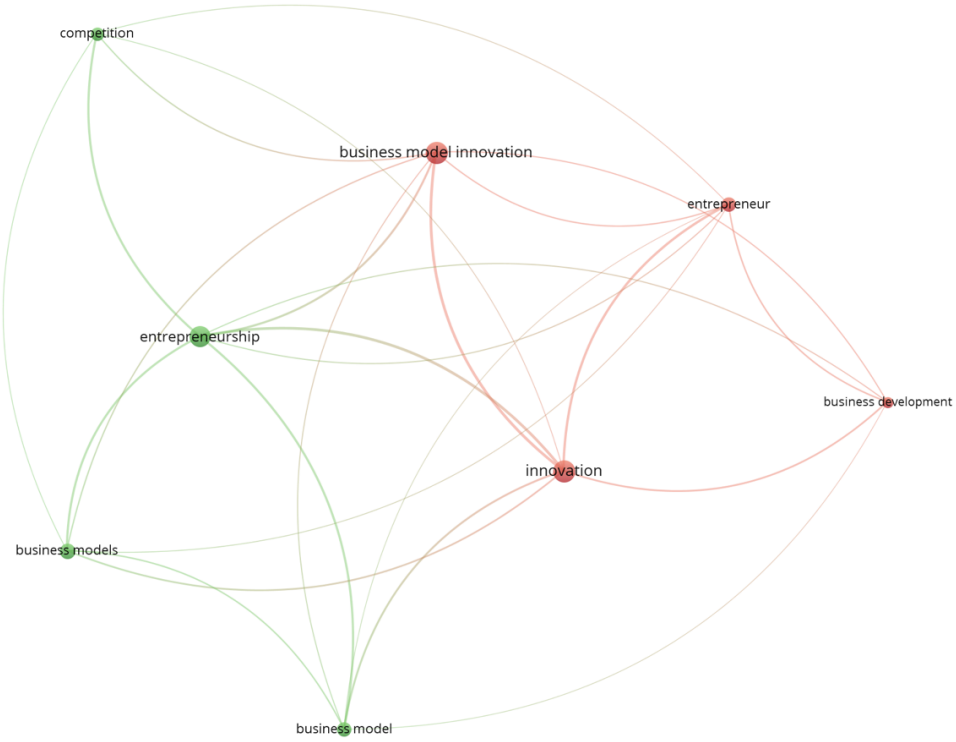

Fig. 5. The new map of keywords

keyword space and use successive zoom's into areas that may seem interesting, exploring them fast, and getting back up if what we find does not seem promising.

The above tools, both VOSviewer and Bibliometrix provide other great functionalities such as co-citation and bibliographic coupling analysis (Boyack & Klavans, 2010). For a novice researcher, as soon as the right keywords are found, the co-citation analysis will provide them with the most co-cited papers by the documents stored in the database.

Remark: This co-citation analysis may not be fully correct, in the sense that, in order to do it properly, one would need to make sure that cited papers referring to the same document have exactly the same text. The issue is that, different papers may refer to the same cited paper using a slightly different text, and the system will look at them and consider that these papers are not the same.

It seems to be quite useful to have a systematic approach that enables the exploration of the papers extracted from a repository, even before reading any of them. This exploration should unfold, keeping in mind the actual final goal. The researcher will want to know which way to go! Is research he/she is thinking about needed? Should one read the articles in full? Considerations of relevance and significance of the phenomenon should always remain central to the process. These will eventually guide the decision on whether to proceed with the research.

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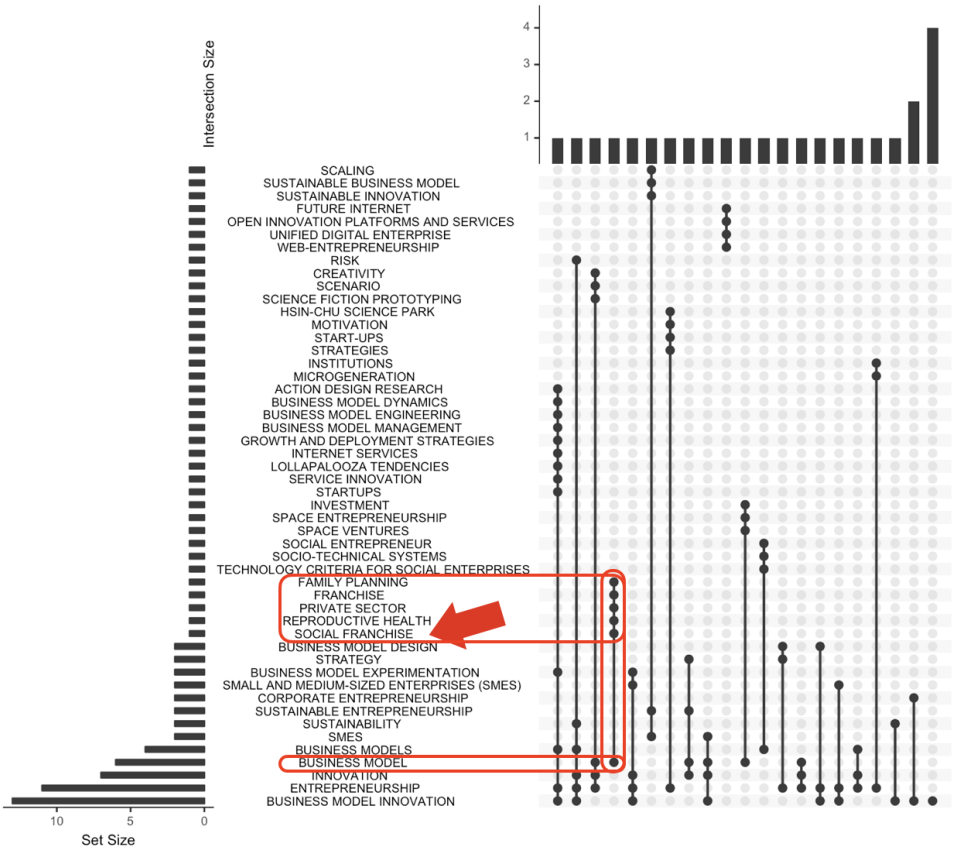

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Review article

Franchising of health services in low-income countries

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DrPH Candidate, University of California at Berkeley, USA

Grouping existing providers under a franchised brand, supported by training, advertising and supplies, is a potentially important way of improving access to and assuring quality of some types of clinical medical services. While franchising has great potential to increase service delivery points and method acceptability, a number of challenges are inherent to the delivery model: controlling the quality of services provided by independent practitioners is difficult, positioning branded services to compete on either price or quality requires trade-offs between social goals and provider satisfaction, and understanding the motivations of clients may lead to organizational choices which do not maximize quality or minimize costs. This paper describes the structure and operation of existing franchises and presents a model of social franchise activities that will afford a context for analyzing choices in the design and implementation of health-related social franchises in developing countries.

Key words: franchise, social franchise, family planning, business model, private sector, reproductive health

Fig. 6. Visualizing intersecting sets (sets of keywords appearing together in papers) (above); The selected papers and the keywords found in the intersecting sets (below)

Wishing you a great experience in exploring the literature in the search for the best words,

Innovatively yours,

The Editors.

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Successful Aging in Small Enterprises: Entrepreneurship, Job Demands-Resources, and Health

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Letter from Academia

Abstract. Successful aging at work is an important topic which is pertinent to everyone who works to make a living because getting older is unavoidable. The objective of this paper is to draw on Job Demands-Resources (JD-R) model to explore successful aging in the field of entrepreneurship. A conceptual approach was used to examine the successful aging in the field of entrepreneurship. Building on JD-R model, older workers who pursue entrepreneurship may have improved mental and physical health and obtain successful aging at work. The current study developed a theoretical foundation to explore successful aging in the field of entrepreneurship and offered suggestions for future research.

Keywords. Entrepreneurship; Successful Aging.

Cite paper as: Miao, C., Qian, S., Humphrey, R., (2020). Successful Aging in Small Enterprises: Entrepreneurship, Job Demands-Resources, and Health - Letter from Academia, *Journal of Innovation Management*, www.open-jim.org, 8(2), 11-15.

1 Introduction

The research regarding successful aging at work is a critical topic for everyone who works to earn a living in that getting older is inevitable (Kooij, Zacher, Wang, & Heckhausen, 2020). Recently, a comprehensive process model was proposed to explain the antecedents and mechanisms which lead to successful aging at work (Kooij et al., 2020). In spite of the comprehensiveness of their process model, one important missing piece is regarding the successful aging in the field of entrepreneurship. We believe this missing piece deserves attention for two reasons.

First, senior entrepreneurship has become a critical topic due to the aging workforce (Stypinska, Franke, & Myrczik, 2019). For example, it is predicted that the population of the people aged 65 and older will be more than that of the people aged 18 and younger by 2035 in the U.S. (McLennan, 2018). Second, one assumption of the successful aging at work discussed in Kooij et al. (2020) is that older workers have to handle age-related losses (e.g., physical health) and that the factors which will help older workers to properly deal with these age-related losses may contribute to successful aging at work. Recently, some entrepreneurship studies indicated that pursuing entrepreneurship may allow one to acquire job resources and to improve health and well-being (e.g., Nikolova, 2019), which may result in successful aging at work.

In the following sections, we will draw on the Job Demands-Resources (JD-R) model to explain how entrepreneurial activities may lead to increased job resources and to improve health and well-being to enable older workers to continue working.

2 JD-R Model

The JD-R model suggests that every occupation has its own risk factors related to job stress and these factors can be categorized into two types: job demands and job resources (Bakker & Demerouti, 2007). Job demands will result in psychological and/or physiological costs because job demands require sustained psychological and/or physical efforts whereas job resources will help to reduce job demands, foster personal growth, development, and learning, and facilitate the accomplishment of work goals (Bakker & Demerouti, 2007). Prior research demonstrated that preserving job resources will help one to achieve work goals and will lead to positive attitudinal and health-related outcomes (e.g., Crawford, LePine, & Rich, 2010; Miao, Humphrey, & Qian, 2017).

3 Entrepreneurship, Job Resources, and Health

Although entrepreneurship research typically focuses on firm-level outcomes (e.g., firm performance), there is a growing body of research which aims at well-being and fulfillment because idiosyncratic and personal reasons explain why individuals engage in entrepreneurship (Wiklund et al., 2019).

Research has shown that pursuing entrepreneurship (a type of "active jobs") may lead to improved mental health and physical health because one may enjoy greater autonomy, flexibility, and

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being their own boss, learn and develop new skills to better him/herself, and develop a feeling of mastery (Nikolova, 2019). Hence, these acquired benefits as a result of self-employment (i.e., job resources) may stimulate older workers who pursue entrepreneurship to develop self-regulation behaviors and self-initiate changes in the job to improve person-job fit, thus leading to successful aging at work (Kooij et al., 2020). Therefore, older workers who pursue entrepreneurship may not only enjoy improved mental and physical health but also achieve successful aging at work.

4 Recommendations for Future Research

We encourage future research to apply Kooij et al.'s (2020) process model of successful aging at work to the field of entrepreneurship in order to develop a better understanding of senior entrepreneurship. This cross-disciplinary investigation will bring mutual benefits. For the field of industrial and organizational psychology (I/O psychology), I/O psychologists may test the process model of successful aging at work in a unique context and may examine whether the major theoretical propositions in the process model will still work in entrepreneur samples. This may also open avenues for I/O researchers to revise and improve the process model to enhance its external validity. From practical standpoints, I/O psychologists can also serve as mentors and/or consultants for senior entrepreneurs to help them better navigate their work life and devise their career plan to increase their chances of successful aging at work.

There are incessant calls for more research to examine entrepreneurial well-being (Wiklund et al., 2019). For the field of entrepreneurship, entrepreneurship researchers may apply the process model of successful aging at work to better comprehend how senior entrepreneurs can develop better well-being through the factors and mechanisms as discussed in the process model. We also argue that this line of investigation may enhance the current understanding of social entrepreneurship because senior entrepreneurs typically have more socially oriented goals to operate their enterprises (Stypinska et al., 2019). In terms of practical implications, policy makers may follow the evidence-based advices provided by entrepreneurship researchers to create favorable environments and frameworks to promote entrepreneurship among older workers.

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Biographies

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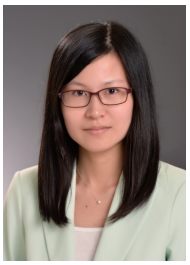

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On the structural barriers to public innovation support for SMEs and the opportunity COVID-19 can offer to overcome these barriers

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Letter from Academia

Abstract. COVID-19 pandemic-related direct public support mechanisms have received more attention than previously and budgets for SME subsidies have skyrocketed around the globe. Currently, most support measures focus on short-term liquidity needs. However, policy makers have already started thinking about which role subsidies should play in the renewal of the economic structure once the pandemic dust has settled. The pandemic offers a good opportunity to restructure a company support system taking into account the structural barriers that innovation support systems have been subject to over the last decade. The aim of the analysis in this letter is threefold: (1) to map the barriers to innovation support, (2) to offer policy makers and SME support agencies a set of solutions to overcome these barriers and (3) to re-interpret these results against the background of the COVID-19 pandemic that started to unravel shortly after finalising the set of research interviews.

Keywords. Innovation Policy; Public Support; R&D Subsidies; Structural Barriers; Small and Medium-sized Enterprises; SME; COVID-19.

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1 Introduction

Since the outbreak of the pandemic, direct public support mechanisms have received more attention than previously and budgets for SME subsidies have skyrocketed around the globe (e.g. VNK, 2020; OECD, 2020). Currently, most support measures focus on short-term liquidity needs. However, policy makers have already started thinking about which role subsidies should play in the renewal of the economic structure once the pandemic dust has settled (e.g. EIT, 2020). Given the hasty launch to firms of a number of brand new support instruments that were badly designed and poorly implemented, in certain countries a debate has already started on the clear need to restructure the company subsidy system. Eventually, budgetary constraints will become tighter and calls for restructuring company support systems around the world will grow more pronounced.

When restructuring the support system for firms, primary attention should be paid to innovative firms as they can set the stage for entirely new industries and spur the renewal of existing industries, ultimately driving long-term economic growth. Moreover, the latest evidence on the impact of different innovation support instruments should offer solid guidance when designing a balanced policy mix for innovation policy that has the greatest impact (Bloom et al. 2019).

Innovation policy makers and innovation support agencies have been facing a set of structural barriers that prevent them from making more impact. The pandemic offers a good opportunity to restructure the company support system taking into account the structural barriers that innovation support systems have been subject to over the last decade.

This letter is based on a policy brief document that was published in May 2020 as Deliverable 5.5 in the H2020 SMEthod project (project number 777491). The analysis is based on semi-structured interviews with 16 representatives of 11 EU and UK innovation support agencies and policy makers. The interviews were conducted during the last quarter of 2019. In this discussion paper we depart from the results of the policy brief document and re-interpret them against the background of the ongoing pandemic. The aim of the analysis is threefold: (1) to map the barriers to innovation support, (2) to offer a set of solutions to policy makers and SME support agencies to overcome these barriers and (3) to re-interpret these results against the background of the COVID-19 pandemic that started to unravel shortly after finalising the set of interviews.

This letter contributes to the literature on innovation barriers by focusing on the barriers that are faced by public support actors in offering innovation support to innovative firms. Most evidence in the literature on innovation barriers is based on micro-level survey evidence from firms. Examining the barriers that are faced by support agencies has the advantage that their complementary evidence is situated on the macro-level as it bundles information from a wide range of firms over time. Most importantly, the identified barriers are complemented with recommendations on how to solve them and their validity has been checked against the background of the unravelling pandemic.

The discussion paper first presents the identified barriers (Chapter 2) after which potential solutions (Chapter 3) and the effects of COVID-19 on the barriers (Chapter 4) are discussed. The letter concludes with a discussion on the way forward (Chapter 5).

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2 Structural barriers to innovation support

The most severe and long-term challenges faced by public organisations supporting SME innovation are situated at the SME end – in other words – on the demand side of support. It is access to talent that sets the stage for which kind of SMEs can be developed and which kind of growth path can be attained (Kerr, 2020). Concerning the access to talent that SME teams have, the support agencies and policy makers that were interviewed identified three main barriers: (1) SME teams are not ambitious enough; (2) SME teams are not diverse enough and; (3) valuable innovation activities are concentrated into increasingly fewer firms and these rising innovation disparities are associated with rising inequality.

As well as the three concerns noted by innovation support actors about their SME customers, the analysis identified seven barriers on the supply side of support. At the meso level, the innovation support organisations themselves need resources to continuously renew their capabilities in a fast-changing world, as well as additional funds for the implementation of new policies and instruments. At the macro level, policies and instruments need to be stable and predictable. However, new instruments can be introduced if they are able to cover new or existing support gaps and are suitable for tackling the grand challenges faced by EU countries. Cooperation between support actors from the public and private sector can be encouraged by new instruments and cooperation structures for raising matched funding, and the overall public support system would benefit from a user-friendly simplification (e.g. Veugelers, 2009).

3 Solutions to overcome the barriers

The following sub-chapters briefly present our recommendations to overcome the structural barriers to innovation support that we identified.

Foster motivation and attitudes to boost the ambition of SME teams

To encourage economic growth, the ambition level of SME teams should be more explicitly acknowledged by policies. One way to achieve this is to promote ambition as one of the key criteria for SME support in all EU countries. Another way of addressing ambition is to give innovation and growth opportunities to both innovative and non-innovative SMEs.

Forge new SME teams to rectify the lack of diversity and talent

Policy instruments should focus on building capabilities, forging strong teams and accessing both EU and non-EU talent (e.g. Coad et al., 2020). Moreover, developing an innovation system that focuses on long-term capability building will help companies be prepared for shocks. A collaborative long-term model that focuses on capability development is exactly the kind of shock-absorbing model that could accommodate today's turbulent times. In order to know precisely which programmes and instruments should be developed, a roadmap for capability development should be created that analyses the various set of skills that will be needed in the future. In turn, stronger teams can be built by creating larger national and international pools of diverse human resources using digital matching platforms. To access foreign talent, new programmes can be developed that target specific sets of skills in specific countries, such as the 'Talent Boost'

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programme in Finland. While typical talent attraction models aim to attract people, the main aim is to have virtual access to talent – and this does not necessarily require people to move or travel. However, talent access via virtual teams may only be viable for larger SMEs and SMEs that are lead users in digitalisation practices.

Focus on both innovation leaders and followers in order to limit the disparities inherent to innovation

All instruments for innovation support should acknowledge the heterogeneity of a firm's capabilities and its sectoral and regional specificities. The focus on regions with less known innovative SMEs should be on establishing new firms and stimulating the development of new innovative firms. Regional characteristics could become increasingly important SME segmentation criteria, while keeping in mind that the selection pool for public funding should be of sufficient size to maintain an optimal level of competition. As the tension between innovation policy and regional policy is omnipresent, it is important to be transparent about where and why the precise border between policy areas is drawn.

Monitor and close all important gaps in SME development support

The policy focus should continue to be on innovation ecosystem development and on how large firms can help small and young firms to scale-up (cf. Knockaert et al., 2019). This also means that innovation support organisations should acknowledge the innovation ecosystem dimension as a relevant segmentation dimension in their innovation support models (e.g. Kreutzer, 2018). This is certainly not the case yet in all EU countries.

Reduce the complexity of the support system with client-orientated approaches

The support service system should be truly designed with the client and implemented for the client. Firstly, this requires a simple interface for SMEs that is characterised by unification of the service processes. Secondly, this requires CRM systems that minimize the need for data inputs and maximize data sharing based on optimal permits. Thirdly, this requires intelligent service offerings, based on client needs information and AI solutions. Fourthly, this requires a simplification of business support by fostering complementarities between different support services instead of competition between service providers.

Match public funding with sufficient private funding

Public-private partnerships to fund SMEs transitioning from the start-up phase to the scale-up phase should be further promoted. Using funds of funds could be one viable way of implementing public-private joint investment activities.

Ensure the stability of policy and instruments

The predictability of policy and instruments should be safeguarded in order to build trust in the long-term funding environment for innovation investments. This does not mean that changes should be abandoned altogether but rather that changes in policies and instruments are made in a predictable and transparent manner. Finding the balance between stability and agility is important because they are both important cornerstones conditional for the resilience of an innovation system.

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Reserve sufficient resources for policy implementation

For implementation, sufficient resources must be set aside in terms of a budget for personnel and cooperation with other agencies. In the case of the implementation of new innovation policy in particular, the development of operational procedures requires cooperation between different agencies. The design of new policies and instruments should take this additional budgeting into account and such an approach will also benefit the predictability of policies.

Have a concrete plan on how to support the grand challenges

All innovation support agencies must have clarity on how they are going to contribute to solving the grand challenges and how they are going to monitor their progress in this respect. New data will need to be collected and new methodologies and ways of thinking will need to be developed. The segmentation of SMEs should consider the impact the SMEs are seeking by paying consistent attention to the grand challenges that the firms are addressing via their innovations.

There is a need for R&D funding for the United Nations Sustainable Development Goals (UN SDGs) and market creation (via programmes) and public-private partnerships. The downside is that policy makers may earmark money for new programmes, which could lead to quick spending.

Invest in skills development in support ecosystem

Firm development requires knowledge about private investors and their networks. To enable this, face-to-face contacts with the entrepreneurial teams that run the firms would be crucial. The automation of funding decisions typically misses the outliers and it is exactly those firms that can turn out to be very valuable. However, the automation of decision-making could be a promising avenue for smaller grants thus freeing resources for the skills that require support tasks.

4 Discussion on how COVID-19 will affect the structural barriers to innovation support

Our expectations on how the identified barriers to innovation support for SMEs will be affected are summarized in Table 1. The identified barriers offer a useful framework for considering what opportunities and what threats the pandemic could represent to innovation support and the innovation system. We see a further increase in the relevance of most of the identified barriers during the crisis but believe that restructuring the public support landscape also offers bright opportunities. Restructuring the support system could be more robust if the identified barriers to innovation support are considered.

As the economic headwinds triggered by the pandemic are picking up, the teams in charge of SMEs will need to be more ambitious in order to survive and grow. This suggests that a lack of ambition could be a greater barrier than before the current crisis. As lower activity levels in SMEs may constitute a real threat to the depreciation of human capital and motivation, at both entrepreneur level and employee level, it is important that sufficient investments are made in capability building. This is the perfect opportunity to invest in digital skills or to experiment

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Table 1. Expected effects of COVID-19 on the identified barriers to public innovation support for SMEs

Barriers	**Expected impact of COVID-19**
Demand side of public innovation support	
1 Lack of ambition	Need for ambition will increase
2 Lack of diverse teams	Need for diversity will increase
3 Rising disparities in innovation	Inequalities will increase
Supply side of public innovation support	
4 Gaps in support	Resources will be more constrained
5 Complexity of the support system	Good opportunity to simplify
6 Lack of matching private funding	Need for cooperation will increase
7 Lack of stability in policies	Leadership needed
8 Lack of resources for policy implementation	Currently highly relevant
9 Supporting grand challenges	Affects many of the United Nations Sustainable Development Goals
10 Lagging skills development in the support ecosystem	Take a leap forward in digital skills

with completely new ideas. This capability building in SMEs should now be one of the key focus areas of the public support system.

The need for diverse teams will become more important as diverse teams can foster performance (cf. Korn Ferry, 2018). However, it is not clear how the crisis will affect the mobility of people who could be restricted by country-specific limitations for a long time to come. Once borders have started to reopen, the regions that have recovered faster from the Covid-19 shock will be more likely to succeed in talent attraction. However, it can be expected that in the short to mid-term, the mobility of people will be lower and the challenge to increase diversity will become greater.

The main concern regarding the current crisis lies in its power to raise inequality and there are now signs that the pandemic has led to a series of inequality shocks (Adams-Prassl et al., 2020a/2020b). While there was already evidence of innovation disparities before the crisis (OECD, 2019), we can expect this trend to pick up during and after the crisis with the danger that the image of innovation will become increasingly negative as more regions start to lose out. In this respect, it is crucial to keep on searching for the balance and keep on believing in the power of innovation as a way of increasing prosperity in society.

The landscape of innovation agencies would benefit from a simplification and the crisis offers a good opportunity to plan and implement a restructuring. However, a restructuring should not be driven by short-term cost cutting or emergency actions. Instead, it should be used to make the system truly stronger and better. Restructuring should also address how important support gaps will be covered as it can be expected that there will be more financing gaps. Restructuring

should also consider a reserve budget for the implementation of changes and new instruments. This may become one of the critical bottlenecks.

While the crisis can be an opportunity to restructure and make the system better, this cannot be achieved without real leadership that ensures a sufficient level of policy stability as this is often a condition for private R&D investments to be approved. There is a threat that instability in policies may increase due to the rapid introduction of new policies and instruments to manage the emergency. Given the challenges that lie ahead, the need for cooperation between the public and private sector will increase and it is crucial that both public and private funds work together in forging a way out of the crisis. The main aim of public sector support is to encourage the private sector to survive and start to invest again, eventually.

Grand challenges remain but the speed at which they are tackled decrease. The COVID-19 crisis has directly or indirectly been affected by several Sustainable Development Goals of the United Nations (UN SDGs) and it can be expected that more concrete actions will be needed to tackle these. A clear uncertainty resulting from the pandemic is that competition between the goals has been rising and that climate change actions, for example, have been affected by concerns about the pandemic. Regaining the balance here will be important if economic recovery is to happen.

Finally, yet importantly, the pandemic offers an opportunity to upgrade the capabilities of the innovation support actors. Taking into account the latest developments in fintech and digitalisation, support agencies can completely reinvent themselves and, for public players, now is the perfect time to invest in this infrastructure.

5 Conclusions

We see the COVID-19 crisis as a strong opportunity to tackle the 10 structural barriers to public innovation support we identified as it is investments in innovation that will need to put our societies back on track. This will require a well functioning innovation system with the right balance of instruments.

We would like to conclude this discussion paper by highlighting one key threat – that does not necessarily have to materialize – and one key opportunity, that hopefully will not be wasted.

One major threat is that the pandemic will be bad for innovation and will negatively impact private and public R&D investments. This is a profound threat as it is precisely innovation that drives long-term economic growth. Private investments could suffer because negative demand shocks typically slow down turnover, profits and R&D investments for firms that switch to survival mode.

Public investments could suffer because with crumbling budgets the focus of policy makers typically turns to short-term solutions and not to long-term counter-cyclical investments. However, there are a number of examples of counter-cyclical investments during crises, for example, how Germany picked up investments during the Great Recession. These brave decisions require leadership. In fact, the best way out of this crisis is to have a solid counter-cyclical investment plan for R&D.

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One key opportunity is to use the crisis to restructure the innovation system and its public support pillar. The aim of such a reform should ultimately be to raise the capacity of the innovation system to absorb shocks. This requires optimal use of resources in order to build and foster the right kind of capabilities throughout the innovation system. Better access to capabilities will offer firms the best chances to succeed. While for many companies the demand is already too low, now is the best time for them to experiment and learn new capabilities. Restructuring the system should rebalance and simplify the policy mix with the ultimate aim of serving the client. Moreover, public support actors should update their knowledge of the latest developments and opportunities in terms of finance and digitalisation (e.g. Block et al. 2020).

To conclude, we underline four key trends that will drive the innovation policy and direct the innovation support agenda in the coming years – and that will all be affected by the crisis: (1) Solving grand challenges related to the United Nations Sustainable Development Goals is becoming mainstream (cf. Mazzucato, 2018). However, some of the key goals may unfortunately have to be put on hold due to the pandemic. (2) The borders of innovation policy will continue to become less clear due to the rising interaction with competition policy, industrial policy and regional policy. We foresee difficult times ahead for innovation policy with the borders between policy areas becoming even more blurred. (3) Smart specialisation will be important, although the focus has jumped from the poorer regions to the more powerful cities. The crisis will accelerate this divide and stimulate regions to become more self-sufficient (4) With shrinking budgets, the competition for innovation support will increase and it is important to ensure that the right segments of firms will receive the support they deserve for the revival of European society and the economy. This trend will magnify the need to segment the hugely heterogeneous group of SMEs more carefully in order to ensure that the right firms get the right level of support.

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The Practice of Open Innovation by SMEs in the Food Industry

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Abstract. This paper examines the practice of open innovation by Small and Medium-sized Enterprises (SMEs) in the food industry. We adopted a multiple case study approach and conducted in-depth semi-structured interviews with four food SMEs in the Flanders region of Belgium. The results of the analysis show that food SMEs practice open innovation mostly through inbound open innovation activities rather than outbound, mainly due to lack of sufficient resources. Food SMEs typically lack sufficient financial capital, technology, and human capital. Within inbound open innovation activities, collaboration with organizations is found to be a key element for food SMEs' internal development and innovation of new products.

Keywords. Open Innovation Practice; Food industry; SMEs; Inbound; Outbound; Collaboration.

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1 Introduction

Small and Medium-sized Enterprises (SMEs) play a vital role in national economies by generating employment opportunities and are important contributors to value creation as well as innovation (Organization for Economic Co-operation and Development [OECD], 2017). To achieve and sustain competitive advantage in the market, many SMEs depend on their ability to be innovative (Parida, Westerberg, & Frishammar, 2012). However, innovation as a tool for development is usually challenging for SMEs compared to large firms. For instance, SMEs are subject to limited resources and innovation capabilities that larger firms acquire more easily (Lee, Park, Yoon, & Park, 2010). Therefore, these limitations may hamper their ability to compete and survive in the current competitive business environment. Studies related to innovation proposed opening the innovation process in order to overcome these limitations for SMEs (Parida et al., 2012). This means a shift from a closed innovation model to an open innovation model (Chesbrough, 2003; Gassmann, 2006).

Adequate studies on the adoption or practice of open innovation by SMEs are lacking in the extant literature because they have predominantly focused on large or multinational firms (e.g., Parida et al., 2012; Hutter, Hautz, Repke, & Matzler, 2013; Bogers et al., 2017). Acknowledging this gap, Bigliardi & Galati (2013) suggested that much attention should be given on the practice of open innovation in the food industry by academia. Additionally, after reviewing the existing literature, we found that open innovation by SMEs in the food industry has still received less attention. Moreover, it is important to focus on the food industry because SMEs in this industry experience more complex challenges such as high regulations and high local and international competition (Saguy & Sirotinskaya, 2016). This is due to various reasons, such as the nature of food production, involving several actors and the various, and inconsistent requirements that must be met by the food firms (see Section 2). Therefore, this study attempts to provide further understanding of how food SMEs practice open innovation.

More specifically, this study focuses on food SMEs in the Flanders region of Belgium. This is due to several reasons. In the first instance, in terms of geographical distribution, more than half of SMEs in Belgium are located in the Flanders region (de Best, 2019). Furthermore, in Belgium, as in the rest of the EU member countries, SMEs are the backbone of the economy. For example, in 2013 SMEs constituted 99.9% of all firms in Belgium (OECD, 2016). This is due to the fact that in terms of firm size, all firms with 1-249 employees are considered an SME (OECD, 2015). According to the Federation of the Belgium Food Industry (FEVIA)[1], the Belgian food industry is an actual SME sector because the vast majority (96%) of employers have less than 100 employees (FEVIA, 2017-2018). With the main focus on food SMEs in the Flanders region of Belgium, this study tries to answer the question of: *How do food SMEs practice open innovation?*

[1] FEVIA is the federation of food industry in Belgium and represents 700 innovative food and/or beverage companies (for more details visit https://www.fevia.be/nl).

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2 Literature Review

2.1 Open Innovation

The concept of open innovation was first introduced by Henry Chesbrough in 2003 (Chesbrough, 2003). This concept is defined as, "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, Vanhaverbeke, & West, 2006, p. 1). Since its introduction, this concept has gained importance among academics and practitioners (Usman, Roijakkers, Vanhaverbeke, & Frattini, 2018). Although Chesbrough (2003) described the differences between open and closed innovation models (see Appendix A), the concept of open innovation has been criticized. For example, a study by Trott and Hartmann (2009) indicates no real paradigm shift from closed to open innovation approaches. This is because they argued that firms have always practiced open innovation and no firms at any time have followed closed innovation in their innovation procedure. In addition, Duarte and Sarkar (2011) argued that the concept of open innovation is not entirely new, because collaboration among firms or organizations has been taking place for many years. In 2014, Chesbrough and Bogers responded to the critics on the concept and development of open innovation in the literature (Chesbrough & Bogers, 2014). The concept of open innovation covers more research areas than how it was studied in the past (Muller, Hutchins, & Pinto 2012). For example, the application of open innovation, at first mainly started in the high-tech sector. However, later it spread into different sectors, including food, machinery, and architecture (Gassmann, Enkel, & Chesbrough, 2010).

2.2 Open Innovation and SMEs

SMEs face several challenges with innovation in contrast to the large enterprises or firms. These challenges include lack of resources, smallness, commodity pressure (Dahlander & Gann, 2010; Rahman & Ramos, 2010), and inability to perform all their Research & Development (R&D) activities internally (Gassmann, 2006). Van de Vrande, Jong, Vanhaverbeke, & De Rochemont (2009) pointed out that these challenges can be resolved, if or when the SMEs practice open innovation effectively. However, the success of practicing open innovation effectively depends on various factors. Durst and Ståhle (2013) identified success factors of open innovation and grouped them into nine dimensions: relational issues, people, governance, facilitators, resources, strategy and leadership, culture and open innovation process. Among them, the three key success factors are relational issues (e.g., trust and partner compatibility), governance (e.g., coordination and control, mechanism and structures) and people, such as individuals' education, skills, capacities, commitment, among others (Durst & Ståhle, 2013). In terms of processes or activities, open innovation is commonly categorized into two types: inbound and outbound open innovation (e.g., Huizingh, 2011; Parida et al., 2012). The inbound open innovation cited as the "internal use of external knowledge, while outbound open innovation refers to external exploitation of internal knowledge" (Huizingh, 2011, p.4). Dahlander and Gann (2010) further classified inbound and outbound open innovation activities into sub-categories, which are illustrated in Table 1 below.

Table 1. Classification of open innovation

Perspective	Inbound open innovation	Outbound open innovation
Controlled/formal	**Acquiring** How do firms acquire or in-license input to the innovation process through the marketplace?	**Selling** How do firms commercialize their internally-developed technologies or inventions via out-licensing or selling?
Libre/informal	**Sourcing** How do firms use external sources for internal innovation or development?	**Revealing** How are the internal resources revealed to the external environment by a firm without immediate financial reward?

Source: Adapted from Dahlander & Gann, 2010; Virlee et al., 2015

The types of open innovation have their own advantages and disadvantages, which can be seen from the above table. For instance, the benefits of outbound innovation of a firm or SME can be both strategic and monetary (Lichtenthaler & Ernst, 2007). However, it can also be risky due to the possibility of revealing internal resources or knowledge, which in turn can better position or strengthen the competitors of the firm in the market (Dahlander & Gann, 2010). A firm can acquire external resources or knowledge through inbound open innovation activities (Chesbrough & Crowther, 2006). Nonetheless, to do so, a firm requires money, time, and the ability to take advantage effectively from the acquired resources or knowledge to the innovation process (Bapuji, Loree, & Crossan, 2011). The inbound (acquiring and sourcing) and outbound (selling and revealing) open innovation can be practiced through different sub-activities. A firm can carry out the task of acquiring knowledge through formal networking, cooperation or collaboration, in-licensing, and outsourcing R&D. On the other hand, the task of sourcing the knowledge by a firm can be carried out through activities such as customer participation and informal networking. Activities of selling the inventions and technology include venturing and out-licensing to other enterprises (Virlee et al., 2015). Unlike selling, a firm can carry out the revealing task through any activities without receiving financial rewards in the short term (Dahlander & Gann, 2010).

The above Table indicates that resources are crucial for SMEs to carry out their inbound and outbound open innovation activities. Firms contain resources such as: assets, organizational processes, capabilities, knowledge, attribute and information, so on (Daft, 1983 as cited in Barney, 1991). According to Ray, Barney, & Muhanna (2004), resources are used by firms "to develop and implement their strategies" (p. 24).The management of a firm's strategic resources is central in order to achieve sustained competitive advantage and performance, which is called Resource Based Theory (e.g., Barney, 1991; Barney, Ketchen, & Wright, 2011). In order to gain sustained competitive advantages, a firm resource must be: valuable, rare, inimitable, and non-substitutable (Barney, 1991). Open innovation is one of the strategies embraced by firms to survive and have sustainable competitive advantage in the fast-changing business environment (Lee & Yoo, 2019). Taking a dynamic capability perspective, Lee & Yoo (2019) identified that the success of open innovation can be accomplished by merging three aspects. These are: (1)

sensing capability (firms collecting information on changes in the market to promptly respond to a competitive environment); (2) seizing capability (firms acquiring knowledge to benefit product innovation and its success); and (3) transforming capability (firms rearranging available resources to accomplish the cited activities successfully).

2.3 Open Innovation and SMEs in the Food Industry

Traditionally, the food processing industry develops relatively slow with a much lower level of R&D investment compared to industries in other sectors (Costa & Jongen, 2006). It is also considered relatively conservative when it comes to the introduction of the types of innovations to the market (Costa & Jongen, 2006). However, with recent significant changes in the demand and supply of food, the growing level of domestic and international business competition have driven innovation to be a necessary business activity in the industry (Sarkar & Costa, 2008). The need to respond to these changes have forced the food processing firms to adopt or practice innovative technological solutions and new business strategies for the mutual benefit of all firms (Bigliardi & Galati, 2013). Nonetheless, food production is complicated as it involves a number of actors and the various, and inconsistent requirements of the intermediate customers, legislators and end-users (Mikkelsen, Kristensen, & Nielsen, 2005; Costa & Jongen, 2006). Furthermore, the actors in the food processing industry must enter into agreements with other individuals or firms to have new food technologies that are developed externally and to establish a close business relationship (Maula, Keil, & Salmenkaita, 2006). This can improve the acceptance of those food technologies in the public and the success of the products in the business market (Costa & Jongen, 2006).

The above considerations show that innovation in the food industry relies largely upon the activities and decisions of other actors involved in the innovation system. Therefore, firms in the food industry should open themselves to adopt open innovation strategies or models. This will help them to gain access to external knowledge, ideas, and skills in open innovation process. The existing literature shows that there are several models adopted by firms for open innovation in the food industry (Galanakis, 2016). Based on the purpose of this study, we will only describe the Sharing is Winning (SiW) and the Want, Find, Get, Manage (WFGM) models. Bigliardi and Galati (2013) indicated that these models could also be adopted by SMEs.

Sharing is Winning (SiW): This model was initially proposed by Traitler and Saguy (2009) in the food industry. According to Traitler, Watzke, & Saguy (2011), the SiW model "extends the definition of OI, namely, a new avenue for collaboration in all areas of discovery and development with external partners who bring competence, commitment, and speed to the relationship, and also share the risk of innovation" (pp.63-64). This model consists of three levels of partnership for co-development: in universities, including research centers and institutes; in start-up firms and inventors; and through a particular number of important suppliers (Traitler & Saguy, 2009). The aims of this model include: trust building, respect, and cooperative feelings with an emphasis on partners (Bigliardi & Galati, 2013). The implementation of this model requires: selection of partner/s; co-creation of Intellectual Properties (IPs); a team to jointly and creatively solve the problems; best practices implementation; constant and maintainable activities affecting the people, culture, education, mindset, and metrics (Traitler & Saguy, 2009). The implementation

of the SiW model requires a paradigm shift. Thus, the leadership of the firms must not only accept or welcome the shift but also must take the risk of failure. The shift demands, for example, developing a clear vision, sustaining co-innovation, and cultural change (Traitler et al., 2011).

Want, Find, Get, Manage (WFGM): This model was introduced by Slowinski (2004). As the name indicates, it has four steps: Want, Find, Get, and Manage. The first step (WANT) refers to what knowledge a firm wants to achieve its growth objective/s. The second step is FIND, which refers to finding actors or partners who have the knowledge to fulfill the wants. The third stage is GET, which refers to acquiring of the knowledge or external sources through collaborative relationships. In the final step (MANAGE) the ongoing collaboration relationship must be managed by the firm to succeed (Slowinski & Sagal, 2010). According to Garcia (2011), the WFGM is a widely adopted model by firms as a guide in their transition from closed to open innovation. In the implementation of the WFGM model, a cross functional team seeks, gains and manages the external non-physical assets, which in turn makes the open innovation process efficient (Bigliardi & Galati, 2013). Furthermore, Garcia (2011) indicated that the extensive use of the WFGM model by firms could positively impact the success rate of new food products.

These models display that firms applying open innovation risk exposure of knowledge sharing. However, applying or using of these models are relevant in the context of open innovation by (food) SMEs if certain conditions are met, which include: improving their networking capability in order to overcome the challenges related to organizational and cultural issues, and/or to adopting different Intellectual Property (IP) strategies (see Table 2) or trust partners (see Section 4). Allen (2003) pointed out that firms use the IP or intellectual property rights (IPRs) not only to safeguard their competitive position in the market, but also to earn income from the innovations they create.

Table 2. Key characteristics of the SiW and WFGM models

Models	Benefits	Obstacles	IP protection
SiW	- Major effectiveness and speeding up of the innovation process - Collaboration with highly motivated and skilled experts - Minimization of risks for financial vows	- Further embraces open culture - Risk-taking activities - Different value chain perceived by the food actors	-Confidentiality agreements - Master joint agreements for development - Patenting
WFGM	- Faster, better and more innovative capacity - Increasing the number of collaborative contracts	- Difficulty in managing the several relationships - Different focus of the different involved actors	- Non-disclosure agreements -Intensive arrangements for collaboration

Source: Adapted from Bigliardi & Galati, 2013.

3 Methodology

To answer the research question stipulated in Section 1, a qualitative research method was adopted, and a multiple case study approach was used. This approach not only decreases the probability of randomness, but also facilitates the researcher to "identify and study patterns across multiple cases" (Virlee et al., 2015, p. 113). To obtain rich data, multiple data sources were used such as a review of the available literature (journal papers and reports) and in-depth semi-structured interviews. Notably, with the help from UNIZO[2] and web search, approximately 200 food SMEs were contacted to be interviewed. During the recruitment, the aim and criteria for the interview were explained. One of the main criteria in selecting an SME to be interviewed was that they were already engaged in the practice of open innovation. Consequently, only four food SMEs showed willingness to participate and thus four interviews (one interview per SME) were conducted in the Flanders region, Belgium. Four cases were sufficient, as usually in multiple case studies, no more than four or five cases are chosen by researchers (Creswell, 2012). Reasons that the remaining SMEs did not participate were various: such as the unwillingness to participate in research interviews, privacy concerns, busy schedules, or because they were not yet engaged in practicing open innovation. The interview questions were open-ended, which are listed in Appendix B.

As illustrated in Table 3 below, the staff headcount for each SME was less than 10. These SMEs were established in different years. All of the (four) respondents were males and on average they were almost 46 years old. Each SME had an annual turnover of less than 2 million Euros. The interviews were conducted in person in the office of each interviewee in English. The interviews were conducted by the first author[3] between December 2017 and February 2018 with the senior staff of each SME, such as the CEO or Director, or founder. These participants were thought to be the most knowledgeable persons regarding the innovation strategy and practicing open innovation in their firms. The average duration of the interviews was approximately 96 minutes. Prior to the interviews, the participants were informed about the purpose of the research and consented to be interviewed and recorded on the iPhone 5S.

Once completed, the interview audio files were transcribed verbatim, and then thematically coded in NVivo software in order to be analyzed. For the purpose of trustworthiness (see Lincoln & Guba, 1985), the interview data was shared with the interviewees before and after the analytical process. As suggested by Yin (2009), first within-case and then cross-case analysis was conducted. This enables the researchers to discern the similarities and differences in cases (Rothkopf, 2009). Since generalizability with a case study approach is challenging (Virlee et al., 2015), the generalization of the results beyond the cases under research in this study was avoided. However, suggestions are provided for further research on the subject beyond the Flanders region, Belgium (see Section 6).

[2] It is "the largest organization for independent entrepreneurs, SMEs and the liberal professions" (for more details visit https://www.unizo.be/antwerpen).

[3] The primary data was collected by the first author as part of his master thesis.

Table 3. Brief overview of interviewees and SMEs

SME	Interviewee position	Year of establishment	Staff headcount
SME 1	CEO	1970s	7
SME 2	Managing Director	2015	7
SME 3	CEO	2012	9
SME 4	Founder	1920s	6

4 Case Studies

This section describes the four cases from the interviews. The descriptions are based on inbound and outbound open innovation processes or activities, which are discussed in Section 2. Each case in this section mainly includes: (1) brief introduction; (2) the activities through which the SME has practiced open innovation; and (3) the views and experiences of the interviewees on IP protection and management.

4.1 SME 1

This firm is a family owned business that was founded in the 1970s. This firm has seven employees and produces spices, stocks, flavors, and fragrances to the market in and outside Belgium.

When interviewed, the CEO of this firm explained that the flavor sector is a bit new and it is facing challenges in terms of finding the right professionals. Therefore, this firm has been involved in practicing open innovation from the very beginning, but this practice was accelerated since 2014. The interviewee specified that "our customers are the main source of our internal product development." According to the interviewee, his firm works with the customers, suppliers distributors, and a flavor consultant. Customers do not actually produce the flavors, but they use the flavors. Thus, based on the ideas and information received from the customers, the external consultant integrates the ideas into the new product development process of SME 1. Additionally, the interviewee pointed out that they are using external innovative research labs and their collaboration with the FEVIA as a source of internal product and process development. This allows them to have certified water based on HACCP (Hazard Analysis and Critical Control Points) rules.

Through collaboration and networking with its customers, this firm is engaged and benefiting from practicing open innovation. The interviewee sees this as an important approach for his business and believes that ignoring the customers' ideas will strengthen his competitors in the market. He stated:

If we lock ourselves under the roof of our company then we will lose all the opportunities and possibilities, which are available outside of our firm. [...] through collaboration with our customers, we can learn a lot because customers have talent, knowledge, and most importantly expertise.

In addition to its customers, the interviewee explained that they have collaborated and established networks with several private and public organizations. For example, they have established a networking relationship with the FEVIA, the Flanders' Chamber of Commerce and Industry (VOKA), and with the Belgian Flavor Association (AROMA)[4]. According to the interviewee, collaboration is a fast way of getting and sharing information. Moreover, it is essential to their business survival in the current competitive business environment. As a result of obtaining external ideas and knowledge and mixing them with the internal knowledge, this firm has innovated several products such as: Natural Chicken Flavor and Spray dried Chardonnay Wine Vinegar. These products are available with different flavors and tastes based on the demand of their customers. When asked about outbound open innovation activities (e.g., selling and revealing), the interviewee mentioned that they are not engaged in such kind of activities because they do not have sufficient resources (e.g., financial capital, technology, and human capital).

Regarding the IP protection and management, the interviewee described that it is difficult to secure and manage IP during collaboration with partners in the food industry, especially in the business of flavors which can be copied easily. Therefore, they have trust on their employees and partner/s that they will not copy their ideas and technology without their permission or agreement.

4.2 SME 2

This firm started operation in 2015 with the aim to produce fish in a sustainable way based on scientific research. Seven people are employed in this firm and it produces ecologically high and fast-growing fish species called Jade Perch (omega-perch) to the restaurants and supermarkets in Belgium and the Netherlands.

When asked about the practice of open innovation, the interviewee explained that they are engaged in practicing open innovation. He added that they get technical and professional knowledge from two public universities in Belgium and also from the Flanders Research Institute for Agriculture, Fisheries and Food (ILVO) for internal development and innovation. The interviewee said that "practicing open innovation has helped and optimized our infiltration processes, feeding the fishes, which are plant-based and also it has helped and improved our product quality."

In addition to collaborating with the universities and ILVO, this firm also collaborates with suppliers, supermarkets, clients, sometimes with SME 3, and even with some of its competitors. Interestingly, it has a win-win collaboration with one of its suppliers called Tomato Masters. This means that the water from this firm (SME 2), which is filtered, purified, and enriched, is used as a fertilizer for the cultivation of fresh tomatoes in the greenhouses of Tomato Masters. In return, the Tomato Masters supplies this firm (SME 2) with its surplus electricity to heat the water tanks to maintain the right temperature for the fish survival, especially during the winter season. According to the interviewee, they have outsourced their R&D to PCG - a test center for vegetable growing, which is the leader in greenhouse crop and herb research.

[4] AROMA is a member of the European Flavor Fragrance Association (EFFA). It has close communication with the European Food Safety Authority (EFSA), which is a member of the International Organization of the Flavor Industry (IOFI).

Furthermore, this firm maintains networks with various public and private agencies. The interviewee stated that "networking with external bodies can save our time and money in obtaining external knowledge." He mentioned that their main networks linked to various institutions, including the Flanders Cleantech Association (FCA), the Traditional Food Network to Improve the Transfer of Knowledge for Innovation, and the ILVO. The interviewee explained that as a result of obtaining external knowledge, importantly, through collaboration, he has innovated, for instance, the water recirculation system and a formula to feed the fish only from plant-based materials.

Regarding the outbound open innovation activities, the interviewee mentioned that they have not yet engaged in these activities due to lack of necessary resources. However, they have a plan to do so in the future. When asked about the IP protection and management system, the interviewee mentioned that the IP protection is a valuable asset and his firm has its own trademark that nobody can copy or use without their agreement.

4.3 SME 3

This firm started operation in 2012. It has nine employees and mainly produces protein isolate, BSF lipids, and chitins with the help of larvae produced by black soldier fly (Hermetia illucens). The aim is to turn Belgium's waste into a resource in an environmentally friendly, sustainable and profitable manner.

When asked about the practice of open innovation, the interviewee explained that running this kind of business is impossible without practicing open innovation. He mentioned that they adopted open innovation at the time when they established this firm. According to the interviewee, there are three main reasons that they are engaged in practicing open innovation. First, for this business, they must develop three different technologies for breeding, rearing, and processing of insects, which requires an enormous amount of money that they never had. Therefore, they included several other firms, research institutions and universities from and outside Belgium. Second, this firm could not achieve these tasks alone. Third, the federal government in the Flanders supports firms if they work together for their internal development.

The interviewee pointed out that they are deeply motivated to practice open innovation and his firm is now one of the most successful firms in Belgium. To gain external knowledge and technology, this firm (SME 3) collaborates and networks with different organizations. For example, with the Agency for Innovation by Science and Technology (IWT), the VOKA, Flanders Innovation and Entrepreneurship (VLAIO), Belgian Insect Industry Federation (BIIF), and with the Food and Environment Research Agency (FERA) in the UK, and with the above-mentioned firm (SME 2). In addition, this firm has collaboration and networking with some universities in Flanders, the Wageningen University in the Netherlands, and the University of Parma in Italy. As a result of networking and collaboration, this firm has innovated larvae from black soldier fly and produces protein isolate, BSF lipids, and chitins.

Unlike the other SMEs in this study, SME 3 has out-licensed its technology. This is one of the sub-activities of outbound open innovation (see Section 2). The interviewee said that "we sold our technology to some international projects for the purpose of generating revenue and

survival as a firm." Due to confidentiality issues, the interviewee avoided naming the projects or the firms. When asked about the process of out-licensing, the interviewee stated that "it's very complicated to explain." In addition, regarding the IP protection and management the interviewee stated:

In general, we must be careful about our firm's IP. Nonetheless, in the region of Flanders in Belgium, most of the firms rigorously follow their core business. So, they do not copy ideas or steal technological assets [...]. This culture has made open innovation possible in this region.

4.4 SME 4

This firm started operation in the early 1920s and has six employees now. Initially, it was producing only pasta, then later it expanded its food production to dehydrated soups (e.g., asparagus, carrot soup), broth sauces and stocks (e.g., chicken and fish).The aim of this firm is to support central kitchens, catering companies, food service, and food processing companies, particularly in Belgium.

On the topic of the practice of open innovation, the founder of SME 4 explained that his firm was involved in practicing open innovation right at the start of its business. For its internal development, this firm always listens to its customers, suppliers and distributors and then combines their ideas and knowledge with its own nearly one century in-house experience and knowledge.

In addition, the interviewee pointed out that due to lack of sophisticated technologies and high cost, they have outsourced the analysis of water and salt in their products to two private research laboratories. He mentioned that they have collaboration with different universities and government agencies in Belgium. For instance, they collaborate with Alimento. According to the interviewee, Alimento offers educational and professional classes for food firms to enhance their knowledge of the food industry. The cost of the classes is paid by the Flanders government. Furthermore, the interviewee mentioned that they have networks with a number of organizations, including Culinaria[5], the FEVIA, the VOKA, University College Ghent, some schools, and the nursing homes.

As a result of networking and significantly through collaboration activities with different partners, SME 4 has innovated several products such as: (1) Silver Line Bouillons, a high - quality line of broths made up of beef, chicken and vegetables; and (2) new soup flavors. On the topic of the outbound open innovation activities, the interviewee mentioned that they are not engaged in outbound activities because they do not have sufficient resources. When asked about securing and management of the IP, the interviewee said that "it is difficult to protect our IP in the food and beverage industry, especially in small businesses, but we have confidence in our partners."

[5] Culinaria is an association of producers and importers of soups, broths, and sauces.

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5 Discussion

5.1 Inbound Open Innovation

As explained in Section 2, inbound open innovation can be carried out by firms through two activities: acquiring and sourcing. More specifically, firms can acquire external knowledge or resources for its innovation process through formal networking, cooperation or collaboration, in-licensing, and outsourcing R&D. In addition, external knowledge can be obtained through sourcing, which includes customer participation and informal networking activities (Virlee et al., 2015). The four SME cases in this study showed that they have obtained the external knowledge and ideas through both acquiring and sourcing activities. While fulfilling acquiring activities, it was found that collaboration, networking, and outsourcing were used by the SMEs in this study. Among them, collaboration with public and private firms and organizations is found to be a key activity to acquire external knowledge and ideas for internal development and innovating products. Interestingly, SME 2 had collaboration with some of its competitors and also had a win-win collaboration with one of its suppliers. This shows that this SME has the willingness to expand know-how through collaboration with its partners and a well-managed partner. Partner management in a reliable environment is an advantage for firms to form and improve relationships for win-win collaboration (Manceau, Moatti, Fabbri, Kaltenbach, & Bagger-Hansen, 2011).

Despite the advantages of collaboration, Saguy & Sirotinskaya (2014) indicated that collaboration "could lead to information leaks" (p. 141). However, in practice the SMEs in this study did not have any examples to show that information leakage occurred as a result of collaboration with their partners. This is mainly because they have trust in their partners and also some agreements (see Section 4). In addition to acquiring, sourcing was used to obtain ideas and knowledge. We found that two (SME 1 and SME 4) of the four SMEs in this study partly obtained knowledge from its customers for the purpose of product development. This is due to the nature of their business strategy, which is more customer oriented. This result is in line with the findings by Garavelli, Petruzzelli, Natalicchio, & Vanhaverbeke (2013).

Overall, the findings from the practice of inbound open innovation activities show that the SMEs in this study are mostly involved in acquiring rather than sourcing activities. This is due to the fact that sourcing is an informal inbound activity to obtain ideas and knowledge. The task of acquiring is preferred by these food SMEs due to the complex nature of food production, which involves several actors and the various, and inconsistent requirements must be met by the food firms (see Section 2).

5.2 Outbound Open Innovation

Looking at outbound open innovation activities, within the four cases we found evidence that SME 3 is the only firm in our sample that has out-licensed its innovation or technology to generate revenue and maintain its business. However, the out-licensing process for SME 3 was complicated. Certainly, this type of activity necessitates significant management of resources and complex coordination (Bianchi, Campodall'Orto, Frattini & Verseci, 2010).

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Synthesizing the inbound and outbound activities of open innovation, this study showed that food SMEs practice open innovation mostly through inbound open innovation activities rather than outbound. Previous studies also reached the same result, including food SMEs (e.g., Van de Vrande et al, 2009) and non-food SMEs, for instance, in the service sector (Parida et al, 2012; Virlee et al., 2015). This study found that the preference for inbound open innovation is largely a result of SMEs lacking sufficient resources (e.g., financial capital, technology, and human capital). This supports the findings of the previous studies that SMEs need more resources to practice outbound activities (e.g., Van de Vrande et al., 2009; Parida et al, 2012; Virlee et al., 2015). Notably, by looking at SME 1 and SME 4, it could be argued that food SMEs were engaged in practicing inbound open innovation a long time before the introduction of the concept of open innovation by the Chesbrough in 2003. This finding supports, for example, the study by Duarte and Sarkar (2011), who argued that the concept of open innovation is not entirely new.

The products developed or innovated by these four food SMEs as a result of inbound open innovation activities highlight the rapid innovation efforts of SMEs in the food industry. This finding can be in line with the findings reported by Fryer and Versteeg (2008). However, it contradicts the study by Hou and Mohnen (2013), who considered innovation efforts to be slow in the food industry and other traditional industries. Our findings also indicate that the food SMEs in the current study have knowledge of open innovation. Having knowledge of open innovation is among one of the indispensable factors contributing to the successful practice of open innovation by SMEs (Van de Vrande et al., 2009). However, there are SMEs that have little or no adequate knowledge about open innovation, which was one of the reasons that some of the food SMEs contacted about this research declined to participate.

As explained in section 2.3, the SiW and WFGM models can be relevant for the adoption of open innovation for SMEs. While this research has found some similarities between them, the SiW model has been more relevant within the scope of this study. In applying the models to the cases investigated in this study, it could be argued that the SiW model is more applicable in the context of practicing open innovation by the food SMEs. For example, the SMEs in this study were engaged in open innovation at the beginning of their business. Moreover, they have networking and collaboration with different partners (see Section 4). The SiW model is found as a crucial part of open innovation and it can enhance collaboration among partners (Saguy & Sirotinskaya, 2014). Moreover, SiW is identified as a sustainable model for firms because "the risk of making financial commitments too early in the project(s) is kept low" (Traitler et al, 2011, p. 64). The WFGM model is used more as a guide when SMEs are in transition from closed to open innovation (see Section 2). Bigliardi and Galati (2013) viewed that the WFGM model is the most used when adopting open innovation by food SMEs or firms. However, they pointed out that its implementation is difficult, for instance, when compared to the SiW model. This is because the WFGM model requires a firm to change its whole organizational structure, including the organizational culture (Bigliardi & Galati, 2013).

6 Conclusions and Recommendations

The purpose of this paper was to examine how food SMEs practice open innovation with a focus in

the Flanders region, Belgium. We found that SMEs in the food industry practice open innovation mostly through inbound open innovation activities rather than outbound. This is largely because food SMEs typically lack financial capital, technology, and human capital – a problem which likely does not exist in large firms. Within inbound open innovation activities, collaboration with organizations was found to be a key element for food SMEs' internal development and innovation of new products compared to networking, in-licensing, and outsourcing R&D. The practice of open innovation, mainly through collaboration by some SMEs, shows that open innovation is not an entirely new concept developed by Henry Chesbrough in 2003.

Based on the findings and discussions in this study, we provide the following recommendations, which will be beneficial for SMEs or firms in the food industry.

- Practicing open innovation is important for food SMEs to survive in the current competitive business environment. Therefore, SMEs that practice open innovation should maintain and expand their networks and collaboration with trustworthy agencies and partners. SMEs that have not yet practiced open innovation should start. Otherwise, they will miss out on benefitting from the wide range of external resources and technologies available. For collaboration, SMEs should have agreements with their partners and/or proper IP protection and management system to avoid pitfalls and unnecessary misunderstandings during the implementation process.
- Managers or the CEOs of SMEs should approach collaboration with open minds with food firms who have a different culture than their own. This can be an important initiative in encouraging successful collaborative efforts, which can lead SMEs to internal development and profitability.
- The food industry plays a vital role in the economic development of many countries (e.g., see McKay, 2007; Food & Drink Europe, 2018). Therefore, the Belgian government should expand their support towards tackling the financial, human capital and technological related barriers for food SMEs. This is possible through different approaches, such as providing grants or loans, needs-based free training, and enhancing support in collaborative work among the interested SMEs. Among others, the practice of these actions will help to encourage SMEs managers to accelerate, improve and enhance their innovation processes.
- The government in coordination with the (federation of) food industry should pay special attention in supporting food enterprises to participate in international food exhibitions in different countries. This will help food SMEs to be further aware of the current food trends, challenges and innovations in the industry. Additionally, it can be beneficial for SMEs to find new partners for collaborations, networks, and attracting new customers.

6.1 Limitations and Further Research

This study can contribute to the literature on the practice of open innovation by SMEs in the food industry with a focus in the Flanders region, Belgium. However, some limitations and recommendations for further research can be acknowledged. First, the findings in this study cannot be generalizable as it has only used four cases from the SMEs in the food sector, while many other SMEs refused to participate (see Section 3). Therefore, there is a need for further

research to broaden the amount of cases with the focus in more than one region in Belgium as well as beyond Belgium to achieve results that can be more widely applicable. Second, due to limited time, this study only focused on the food industry, but further research should be conducted to compare how open innovation is practiced outside of the food industry such as hospitality, sport and services industries. Third, as a qualitative research method is used in this study, the analysis can be subjective; therefore, a quantitative research or mixed methods is suggested for the future research to increase the precision of the study. Fourth, since the focus on IP protection and management of SMEs was beyond the scope of this study, it may be interesting for future studies to focus in detail on how SMEs can secure and manage IP while practicing open innovation. Fifth, this study found that trust between partners is an important factor for SMEs in practicing open innovation. Thus, further studies should be conducted on the relationship between interpersonal trust and trust between firms in the context of open innovation. Sixth, a specific study should be conducted on the motivations and challenges related to the practice of open innovation by food SMEs and on the role of government funds in encouraging the practice of open innovation in SMEs in the food industry.

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Appendixes

Appendix A:

Table A.1. Open innovation versus closed innovation principles

Open innovation	Closed innovation
"Not all of the smart people work for us, so we must find and tap into the knowledge and expertise of bright individuals outside our company"	"Most of the smart people in our field work for us"
"External R&D can create significant value; internal R&D is needed to claim some portion of that value"	"To profit from R&D, we must discover, develop and ship it ourselves"
"We don't have to originate the research in order to profit from it"	"If we discover it ourselves, we will get it to market first"
"Building a better business model is better than getting to market first"	"If we are the first to commercialize an innovation, we will win"
"If we make the best use of internal and external ideas, we will win"	"If we create the most and best ideas in the industry, we will win"
"We should profit from others' use of our IP, and we should buy others' IP whenever it advances our own business model"	"We should control our intellectual property (IP) so that our competitors don't profit from our ideas"

Source: Retrieved from Chesbrough (2003, p. xxvi)

Appendix B:

Interview questions[6]

1. **Introductory questions**
2. **Open innovation practice**

   What is your main motivation for adopting or practicing Open Innovation in your business?

   When did you move from Closed to Open Innovation? How? When? Why?

   Did the practice of Open Innovation create any competitive edge to your business?

   Do you have collaboration partnerships with external parties such as market based sources (e.g., suppliers, distributors, customers, competitors, firms from other industries, etc.), science based sources (e.g., universities, technical colleges, research etc.), government agencies, SMEs and start-ups and designers? If yes, *with whom? Which entity? Why?* Please elaborate.

[6] Several questions were elaborated for the interviewees during the interviews and follow up questions were asked.

How do you select these organizations or partners for collaboration? Are there any specific criteria for partner's selection that you want to mention?

What are the main advantages and disadvantages of collaboration? Did collaboration help your business?

Which kind of knowledge, idea, technology and information do you get and share with these external partners?

How do you maintain your collaboration with the organizations or partners?

How are you managing intellectual property (IP) protection mechanisms (patents, copyrights, trademarks and secrets, NDA) while collaborating with external partners?

Do you have any networking relationship with government and private agencies? Which agencies and How?

Have you ever utilized or acquired outside/external resources, ideas, knowledge and technologies through in-licensing, formal networking, cooperation or collaboration and outsourcing R&D? Please elaborate.

How did the external knowledge sources help your SME in terms of innovation?

How often do you get feedback from your customers/consumers, suppliers, intellectual property rights experts, universities, laboratories and network partners in the evaluation and testing of new products and development?

Have you ever been forced by the feedback of the customers to interact with external environment in order to meet their demand?

Have you ever commercialized your innovation, resources, knowledge and technology through selling or out-licensing it to the external environment? If yes, how? If no, why?

Do you have any suggestions or would you like to add any information, which is important but I have not asked you.

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Why Open Innovation is Easier Said Than Done: An Organizational Identity Perspective

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Abstract. In this article, we explore and interpret organizational identity transformation associated with the open innovation strategy of the largest telecommunication company in Italy, Telecom Italia (TIM). When TIM established eight joint laboratories within five major Italian universities to benefit from opening its business model, it transferred some R&D employees to the new laboratories to work with the university scientists. This organizational transformation imposed challenging conditions for R&D employees engaged in the open innovation activities of the firm. We conducted an interpretative phenomenological analysis (IPA) to answer the question of "how do R&D employees experience the implementation of an open innovation strategy from an organizational identity perspective?" Our analysis is based on the interpretation of the lived experiences of 14 employees. Studying the phenomenon of open innovation implementation using the lens of organizational identity suggests the following: (1) The process of open innovation through mobility of skilled R&D employees triggers organizational identity ambiguity and change, (2) Organizational identity ambiguity phase in the process of open innovation can be shortened by the support of parent company and managerial skills highlighting sensemaking mechanisms, (3) Constructing a shared organizational identity with university members involved in this process is an undeniable element of OI success. We contribute to the literature by establishing linkages among organizational identity and open innovation and building on recent works on the role of individuals within open innovation ecosystems. Our qualitative analysis draws on a conceptual framework for open innovation and organizational identity transformation.

Keywords. Open Innovation; Organizational Identity; University−Industry Collaboration; Joint Laboratories.

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1 Introduction

In this article, we conduct an interpretative phenomenological analysis (IPA) to answer the question of "how do R&D employees experience the implementation of an open innovation strategy from an organizational identity perspective?" In order to address this question, we explore and interpret the phenomenon of open innovation strategy implemented through the mobility of high skilled employees, applying the theoretical lens of organizational identity. Our study sheds light on the underexplored conditions that organizational identity transformations generate in the process of an organizational change, related to a specific mode of implementing the open innovation strategy, i.e. the collaboration between university and industry.

Chesbrough and Bogers (2014) provided the most recent definition of open innovation describing it as knowledge flows across organizational boundaries using mechanisms in line with the organization's business model. Open innovation scholars have studied this paradigm across different level of analysis, but the individual level received limited attention (e.g., Salter et al. 2015). Bogers et al. (2016) called for more research on how individuals within an organization cope with the new challenges of open innovation strategies. In their research, there is a specific invitation for organizational behavior and identity scholars, to address the question of how R&D employees experience change when they start involving more in the activities outside the organizational boundaries.

In the last decade, innovation studies gave significant attention to the sources of knowledge external to the firm. Chesbrough (2006) noted that firms employ 'open innovation' strategies to tap into external R&D, share uncertainties and risks and leveraging on a distributed inter-organizational network. Following this trend, universities became an interesting source of external knowledge for companies that look for opening up strategies. Firms usually choose to build up collaborative networks with universities, especially when the aim is to acquire tacit and uncodified knowledge (Yusuf, 2008). However, Perkmann & Walsh (2007) noted that according to the concept of open, in networked or interactive innovation, the actual ties between university and industry play a stronger role rather than the symbolic links in generating innovation. According to him, in the 'open innovation' context, the links with high relational engagements are beneficial for partners, as they enable building and maintenance of inter-organizational relationships over time. An example of these links is the mobility of staff/researchers as, for example, the cases of academics deciding to manage their own research spin-off, or temporary or industrial scientists moving to laboratories where they can closely work with university scientists. In these cases, the organization goes through a process of subtractive change (e.g. spin-offs, de-merges, elimination of units, against the additive changes related to, e.g., merges, new unit creation, assimilation). The subtractive change questions members' understanding of organizational identity (Corley and Gioia, 2004). Indeed, the establishment of university-industry joint laboratories – outside of the firm's boundaries and within university's ones – can configure as a subtractive change to the firm. In this context, companies' employees that move to work within the laboratories become outsiders to their own organization and go through an identity change over the process of implementation of the open innovation strategy. Corley and Gioia (2004) pointed out the lack of understanding around identity change dynamics in this context.

While open innovation is indeed well researched, the role of individuals and human resources

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within a collaborative innovation process – especially in the form of separate research entities – is still not fully understood. Feller (2005) and Nelson (2004) raised the necessity of exploring what institutional and organizational conditions can and should be reconfigured to make university-industry collaboration work more efficiently, while West et al. (2014) emphasized the role of human resources in open innovation processes as a specific research gap. Furthermore, the research on open innovation has not clearly investigated changes and challenges that result from adopting open innovation, particularly at the individual level of analysis. The research has been focusing more on the organizational level of exploration both for open innovation and organizational identity, neglecting the analysis at the individual level (Reissner, 2019). Therefore, the challenges that managers of collaborative processes might face need further investigations. Organizational identity of R&D employees might, indeed, be affected by the implementation of an open innovation strategy by the parent firm, especially when stable employees turn to be mobile and enter new organizational setting.

In this article we address these underexplored issues by focusing on employees who went through this transformation and joined cooperative research centers between university and industry. Our interpretative phenomenological analysis (IPA) sheds light on the literature on open innovation and organizational identity theories. We base our analysis on interpreting lived experiences of 14 employees.

Our study contributes to the literature in three ways. First, by establishing linkages among organizational identity and open innovation, we shed light on how elements of the organizational identity change are triggered in the implementation of an open innovation strategy, particularly through the mobility of skilled R&D employees (Chesbrough, 2006). Second, building on recent works on the role of individuals within open innovation ecosystem (Bogers et al., 2016), we emphasize the importance of human resources in open innovation research. Finally, our paper adds to organizational identity theory not only by bringing open innovation into the discourse and conceptualizing it, but also employing IPA in addressing organizational identity change (Gioia et al., 2013). Our qualitative analysis draws on a conceptual framework for open innovation and organizational identity transformation. The following sections include a brief review of organizational identity and the process of change/transformation. We continue by introducing the methodology applied, followed by our results and concluding remarks.

2 Literature background

2.1 The changes related to open innovation strategy implementation

Firms' open innovation implementation covers a wide range of practices, such as in-/out-licensing (van de Vrande et al., 2009), involvement of different stakeholders in the open innovation ecosystem (van de Vrande et al., 2009), participation in public technology transfer programs (Dodgson et al., 2006). Open innovation practices also include research contracts and ventures with universities (Perkmann and Walsh, 2007). Regardless of the type of activity chosen, organizations still face a variety of challenges in practicing open innovation. Scholars highlighted two categories of challenges: internal and external, according to whether they arise within or beyond organi-

zational boundaries (De Marco, 2017). While the external challenges of open innovation result more impactful for SMEs (De Marco et al. 2020), the internal ones appear more severe for large organizations, as they are related to the organizational and cultural changes needed to favor the successful implementation of the open innovation strategy.

Addressing these challenges to deploy different practices within the open innovation paradigm requires not only knowledge and resources, but also expertise. According to Chesbrough (2006), the increasing attention toward opening R&D procedures requires new organizational choices for R&D. In this paradigm, universities have been treated as important external actors in facilitating access to new scientific knowledge (Klevorick et al., 1995; Belderbos et al., 2004). Collaboration with universities is perceived as a productive mean for partnerships at the technology/knowledge development level (Chesbrough, 2003; Harwing, 2004; Blau, 2007). Establishing joint laboratories with universities has not been excluded from this trend as shown, for example, in the case of Deutsche Telekom creating an open innovation ecosystem with universities by establishing T-Labs (Rohrebeck et al. 2009). Providing a separate organizational structure for academics and R&D personnel allows overcoming many barriers associated with university-industry collaborations (Rohrbeck and Arnold, 2006; Mahdad et al., 2018). Indeed, even the practice of establishing separate organizational structures for open university/industry collaboration is not free from challenges. The organizational and cultural (internal) challenges of such structure can emerge when industry collaborates with academia in *ad hoc* created laboratories and scholars showed how applying structural properties of adaptive capacity can trigger positive effects and help in handling these challenges (Mahdad et al, 2019)

2.2 The mobility of high-skill workers

Literature recognized the role of labor mobility, particularly of high-skilled workers, as the most effective mean enabling the transfer of knowledge and skills (Arrow, 1962; Gilson, 1999). Since knowledge is embedded in individuals, their movements across firms and organizations generate involuntary spillovers of tacit knowledge transfer. A strong body of literature focused on the importance of labor mobility and its positive impact on regional culture, including on non-hierarchal business culture and socio/cultural learning features (Saxenian, 1994; Florida, 2000). Scholars also highlighted the importance of factors and attitudes that can facilitate mobility impacts, such as the willingness to experiment and take risks, informality of work styles, and high occupational mobility (Saxenian, 1994). Despite the definition of open innovation is based on the flows of knowledge and, as mentioned, workers mobility is a major mean to make knowledge flow, not many studies focused on the impact of workers' mobility within open innovation. However, in the specific practice of open innovation in which industry collaborates with academia, scholars identified the transfer of human resources, i.e. movements of the staff between the two types of organizations, as a learning mechanism and knowledge transfer mean (Perkmann and Walsh 2007; De Fuentes and Dutrénit, 2012). Literature showed that the interorganizational mobility of employees implies the dissemination of cognitive resources derived from the organization of origin, even influencing innovation capabilities (Herstad et al., 2015).

While the phenomenon of knowledge transfer and collaboration between university and industry have been widely explored at the organizational level, literature still lacks clear understanding

of the dynamics at the individual level (Bogers et al. 2016, Perkmann et al. 2013). Perkmann et al. (2013) argue that a good understanding of the individual behavior in the collaboration between academia and industry would benefit the overall organizational performance. Moreover, shedding light on how individuals adapt to the rules of their work contexts and how they react to different institutional logics, would contribute to the understanding of the open innovation phenomenon in its university-industry collaboration form.

2.3 Open Innovation and organizational identity

According to Petroni et al. (2012), open innovation influences R&D personnel for their role in inter-organizational innovation activities. When open innovation comes into the debate, the dynamics of organizational and individual collaboration merge and need to be managed with a human-centric approach, rather than an organizational-centered one, as individuals deal with the uncertainty of the '*give-and-take*' of the collaboration that generates innovation (Salampasis and Mention, 2017; Webb 2017). This 'give-and-take' is the source of innovation as it comes from the above-mentioned knowledge flows. Nonetheless, grasping external knowledge is very different from generating internal innovation. When we talk about open innovation adoption and its process, the attention should also move toward actors within this paradigm. R&D employees are directly involved in the process of innovation, weather it is closed or open. Changing the organizational structure might have various influences on the organization itself and its members, including a change in organizational identity (Gioia and Thomas, 1996). Organizational identity is considered crucial for organization development since it affects actions, interpretation, and decision making of the members and management. Indeed, in open innovation, employees coming from different organizations keep representing their parent one, but still identify with the new organization established for the collaboration, incurring in identity shifts that might affect joint innovation activities (Webb 2017). For these reasons, scholars suggested the combination of managerial actions that can drive the dynamics related to the 'dual allegiance' of R&D employees involved in the exchange of knowledge during collaborative projects: a good governance of the balance between disclosure and protection of knowledge would allow success of collaboration (Husted and Michailova, 2010).

The concept of organizational identity was initially introduced by Albert and Whetten (1985) as a set of features that should be central, enduring and distinctive. Hatch and Schultz (2002), complemented this concept as a 'reflective dialogue between the organization and social context'. Whetten (2006) referred to the features of organizational identity that conceptualize self-referencing and help members to construct a collective sense of self that satisfies organizational and individual needs for continuity, coherence and distinctiveness.

Albert and Whetten (1985) proposed three definitional elements of organizational identity:

- What is taken by organization members as being *central* within an organization and the organization's work, such as beliefs and norms, that cannot be changed without redefining the organization itself.
- How organization members *distinct* their organization from other similar ones, e.g. from competitors (Ravasi & Phillips, 2011).

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- How organization members *endure* or link the past, present and presumably future of the organization activities to each other.

Other scholars evolved and redefined the definition of organizational identity after Albert and Whetten's work. Gioia (1998) defined organizational identity as a 'shared answer to the question of "who we are as an organization?"; later, Navis & Glynn (2010) built upon this definition by including "what do we do?". Many scholars noted that organizational identity refers to the collective level where members define themselves relating to the organization (Ashforth and Mael, 1989; Corley and Gioia, 2004; Corley et al., 2006). In contrast, Polos et al. (2002), defined organizational identity as a concept of the organization held by outsiders rather than its members. Scholars have been investigating the organizational identity theory within different context. The static perspective of organizational identity has been recently changed to a more fluid one, considering a process view of organizational identity (Hatch and Schultz, 2002). From another perspective, Scott & Lane (2000) believe that organizational identity is neither static nor fluid, but it is rather 'sticky', meaning that organization members tend to preserve the old identity and resist the change.

Although there have been complementary definitions of organizational identity in the field of organization studies, Albert and Whetten's definition (1985) seems to be the backbone of this literature. Therefore, we also build our research on their 'three pillars' definition of organizational identity. However, we use this definition more in a dynamic than a static setting, to see how the main features of identity might change during an open innovation process.

The important role of 'enduring' features of organizational identity comes into the debate when a change or transformation occurs to the members of an organization. The debate over the 'continuity' element of organizational identity can rely on a strong body of research confirming that identity can change over time (Corley and Gioia, 2004; Dutton and Dukerich, 1991; Fiol, 2002). Organizational identity received significant attention in studies on different transformational phenomena, particularly acquisition (Melewar and Harrold, 2000; Reade, 2001; Vaara et al. 2003; Ullrich et al. 2005; Bartels et al. 2006; Van Dick et al. 2006), and post-acquisition integration (Van Knippenberg and Van Leeuwen, 2001). Corley and Gioia (2004) highlighted temporal identity discrepancy and change in social referent as triggers of organizational identity transformation, while the importance of managing image and identity during a radical change has been studied by Fiol (2002). According to Vieru and Rivard (2012), challenges of organizational identity change appear not only with members' attempts to answer the question "Who are we?", but also with the question of "Who do others think we are?".

In accordance with this, an open innovation practice can be very challenging for R&D employees who join a new organization with new institutional settings. Scholars highlighted how organizational identity elements can generate employees' resistance to technological changes and innovation perceived as going against their organization identity (Tripsas 2009). Nonetheless, supporting the dynamic view of identity, Lifshitz-Assaf (2018) recently connected the literature on open innovation to the one on organization identity, showing how professionals' identity is crucial to avoid resistance to change and innovation.

Three decades of research on organizational identity topics built a rich body of literature; even though, scholars still call for more research on the relevance of organizational identity for the

inter-organizational phenomenon, i.e. open innovation (Randawa et al. 2016; Bogers et al., 2017), and the conceptualization of the field, e.g. learning, strategy, innovation, etc. (Gioia et al., 2013). Trying to answer these calls, our research's goal is to address the question of 'how do R&D employees experience the implementation of an open innovation strategy from an organizational identity perspective?'. In doing so, we aim at enriching the literature on organizational identity and open innovation by providing empirical evidence of the relation between open innovation practices and organizational identity change. In addition, this research contributes to the recent literature of open innovation and the importance of R&D employees as a unit of analysis. We use the term organizational identity transformation when R&D employees change their organization as a part of the parent company's decision of opening its business model.

3 Method

We chose a qualitative research design because it gives importance to interpretation, descriptions, characteristics and meaning (Kvale, 1996).

Denzin & Lincoln (2004) established the relevance of qualitative research in the field of human behavior. In addition, we chose qualitative approach to understand the true value of the employees' behaviors beyond numbers and measure. Exploring the phenomenon based on participants' experiences was the main aim of this research. Willig (2001) noted that qualitative research is able to connect the researcher to the experience of the individuals' context. Qualitative methodologies in organization studies include different methods of interpreting and exploring participants' experiences.

For this research, we chose interpretative phenomenological analysis (IPA) over other qualitative methods because of our focus on the phenomenon of experiencing organizational change in the process of open innovation implementation. We aim to enrich the theory rather than generating new ones. According to Gill (2014), phenomenological methodologies enable researchers to adopts a more dynamic and process view of organizational identity in their research contexts. Gill claims that the supporters of this perspective (e.g. Corley et al., 2006) believe that organizational identity is truly phenomenological, which means that it is something experienced as a phenomenon by organizational members. In our study, because of its focus on how employees interpret and make sense of a particular experience, namely change, Smith's IPA (1996) offers a suitable methodology to address our understanding of organizational identity in the context of open innovation.

IPA's distinctive element is its high emphasis on interpretative and idiographic account rather than seeking subordinate themes that emerge through data codification (Gill, 2015). The ideal situation is to have rich data from few informants rather than having enough numbers of participants. IPA is an established methodology mostly in the field of psychology (Smith, 1996). Using semi-structured interviews with a small set of participants, normally from two to ten in IPA, gives researchers a taste of participants' experiences through an interpretative analysis. IPA methodology does not test hypotheses and is neither inductive or abductive. It is a pure interpretation of researchers aiming to understand the participants' lived experiences without imposing the constraints of prior theory. There is a lack in using any phenomenological methodologies within the

scope of organizational identity studies even though scholars refer to organizational identity as phenomenological and highly dependent on experiences of organizational members (Gill, 2014). Therefore, we chose IPA to understand employees' experience when the parent company decides to open its business model and how this organizational change influence how participant make sense of their current world and experience. Moreover, in our case, IPA provides an explanatory perspective that can complement other approaches in enriching existing theory.

3.1 The case of Telecom Italia

Telecom Italia (TIM) changed its innovation model to agile model of innovation, which enhances co-creation and co-development. Since 2012, TIM opened up eight joint laboratories within five major Italian universities as a strategy to take a step forward in the adoption of the open innovation paradigm. The Joint Open Laboratories (JOLs) are research and innovation laboratories set up within university centers, as a result of partnerships and agreements between TIM and the universities in specific fields of scientific and technological domains. The establishment of the JOLs aimed at overcoming barriers of collaboration between university and industry in practicing open innovation by transferring and mobilizing skilled R&D employees to the new organization structures within universities.

3.2 Participants

Participants of the study were initially R&D employees who moved from TIM or any branch of TIM to work in the new organizational setting of the JOLs. Eight employees moved voluntarily *(transferred employees)*, because of their field of interest or personal motivations. Preliminary results showed that the six employees directly employed *(newly hired employees)* by the JOLs could also provide valuable insights. Therefore, we included a total of 14 employees from both groups in our study.

3.2 Data collection

We performed semi-structured interviews that lasted between 45 minutes to 90 minutes. The topics of discussion with participants concerned the organization of the parent company and organization of JOLs; how do they perceive themselves as employees; what TIM and JOLs expects from them; how do they experience moving from TIM to JOL. These questions were open-ended and allowed participants to talk about the topic in a detailed way. The researcher remained for 2-5 days within each laboratory to further observe and collect data. This allowed researchers to enter participants lived experiences.

3.3 Data analysis

The interviews were recorded and then transcribed. We used Smith et al. (2009) method to initiate the data analysis process including thematic coding on single interview and identified

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table themes for the group followed by interpretation of meanings of participants' experiences. Nvivo software was used as a qualitative data management tool. We stored extracted themes in Nvivo and this allowed to manage and interpret qualitative data by eliminating the need for many of the manual tasks traditionally associated with qualitative analysis (Sorensen, 2008). As we mentioned, the aim of the IPA is to interpret rich data rather than coming up with a pattern in the themes and sub-themes.

4. Findings and discussion

The explanatory case design allows us to investigate the distinct phenomena of identity transformation when a company opens up by establishing research centers in collaboration with universities outside of the firm and undertakes labor mobility strategies to bring the knowledge generated from the labs inside the company. The initial basis of our findings emerged from the question 'how do you find yourself within the organization?'. The analysis is driven from the variety of subthemes emerged and can be categorized in three stages or three main themes.

We divide the process through which employees went into two stages: 1) shift from company's core identity to ambiguous identity and 2) construction of an open identity. We explain how TIM employees sustain the identity transformation and what are the mechanisms involved in different stages of identity transformation. The existence of core organizational identity (the identity that is related to parent company and employees who transferred from the parent company to the new venture) provided a firm baseline to start from.

4.1 First stage: From company's core identity to identity ambiguity

We started to explore individual's experience by interpreting their responses on how their core organizational identity changed (if changed) when entering to a new institutional context. TIM's paradigm shift - moving from closed to agile business model by implementing radical open innovation practice - enforced an institutional change on employees who had to move to a new venture, the JOLs established within the universities.

Central characteristic of the main company's organizational identity faces discontinuities. Employees that moved into JOLs had to maintain the organizational identity but being ready to also include some elements of the newly formed research center's identity. Features, beliefs and norms had to be transformed to the new ones due to the redefinition of a new institutional context. Based on our interpretation, we observe that in some cases the research center's director helped maintaining the *central identity* attributes of the organization. This was more visible in the JOLs that, in terms of physical distance, were closer to TIM.

"We have a contract with university but our rules and structure are still of the company, (even though) I have the feeling that in the company there is no idea of what is this innovation and who we are." (Transferred employee)

The theoretical explanation of the mechanisms that maintain centrality in the core organizational identity can be found in the "sensemaking" literature (Fiol, 1991, Corley and Gioia 2004).

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The centrality and firmness of norms and beliefs within an organization positively influence perceived organizational identity by employees and thus their performance. In our case, TIM risked the centrality of its organizational identity by creating a new institutional setting for those employees who were transferred from the central site to new locations. Different identities were formed when this institutional change occurred as a result of radically practicing open innovation and conflicting visions and beliefs emerged among employees who associated themselves to the new research center as central to their identity, with the ones who maintained the parent identity. Indeed, the few employees employed directly by the research centers tended to associate themselves with the parent company as their identity is stronger and well-structured.

The role of directors in creating a balanced view in the current ambiguous identity situation, was undeniable. Directors first reinforced central beliefs and, then, helped employees sustaining the vision shift. The important role of leaders becomes evident here. When asked whether they considered themselves as a member of the JOL or TIM, research centers' directors responded: 'Of course TIM'.

"*We are using the open innovation paradigm but we are new to this approach, everyone in the lab is aware of this approach but I am not sure if other departments of the company know about open innovation and that we are involved in this approach. We are TIM and we are not any kind of spin-off or an independent company."(JOL director/transferred)*

Identity endurance was challenged in the process of moving from stable identity to a more flexible one. In our interviews, employees projected an inconsistent identity especially in the initial phases of institutional transformation. The main unclear situation was when employees had doubt on whether to maintain the core identity of TIM or build a new identity shared with university representatives.

"What we do as company is really state of the art and innovative. We give a very good image of TIM to the outside of the company and I think we need to better understand the environment and where we belong to." (Transferred employee)

Identity alignment practices were found to be beneficial in overcoming ambiguous situation. The phase of ambiguity in identity endurance was facilitated by reinforcement practices such as directors' strategic actions for the vision alignment, and practices that were deployed by the company in order to involve mobile employees in the internal activities. Our interviewees argued that this was difficult to implement because employees should maintain consistent images of their existing identity over time, but the meanings linked to these images would change in order to suit new institutional settings (i.e. being in a joint laboratory). However, this has been a puzzled discussion in the field of organizational identity and change as well, especially when organizational identity issues arise during the implementation of structural changes in the organization.

To deal with *distinctiveness* feature of organizational identity, lab directors faced a twofold problem related to, on one side, the employees who had to make a distinction between the parent firm and other similar companies and, on the other side, the ones that had to be able to differentiate their research center from similar ones. In our dataset, managers who refined the identity overcame the identity ambiguity phase faster than the ones who solely enriched

the core TIM identity. Constant re-elaboration of identity attributes aimed at fitting changing organization's goals and missions helped employees redefining identity distinctiveness.

The first phase of the organizational identity change process has been discussed similarly in the literature. Some scholars noted organizational identity should be characterized by instability, thus the ability of members to adopt the change is not enduring (Gioia et al., 2000). Albert and Whetten (1985), on one hand, mentioned the multiplicity nature of organizational identity. Firms' success in organizational change is related to members' willingness to accept the change and form the transformed organizational identity.

"I really don't know the reality of TIM because I started to work in JOL and I never experienced working at TIM. JOLs are not independent but maybe something similar. Because most of them (JOLs) are not working on the core business of TIM." (Newly hired employee)

On the other hand, Gustafson & Reger (1995) claimed that identity in an organization is a multilayer construct with core parts and organizational change can, therefore, occur without meaningful change in the core identity. Although these views represent theoretical bases, our empirical case shows that success could be achieved in the first phase of transformation. Ideally, this would happen by making sense of new organizational identity with employees, while reinforcing core company's identity. These two are not mutually excluding. Managers who keep close contact with the core company, manage to overcome the early period of ambiguity faster. Younger members of the organizations, hired had hoc in the JOLs, are willing to be associated with the parent company: this might be because of TIM's reputation which lies in its brand rather than its laboratories. Our explanatory case shows that sensemaking practices should be included in the early phase of transformation. According to Weick et al. (2005), identity formulation represents a sensemaking process enabling employees to build new events on top of past experiences, and to meaningfully interpret and incorporate new information into a frame of explanatory reference. These practices include daily formal and informal collaborations with new colleagues in new institutions, trust building efforts, coordinated events with the core company and laboratories, and mission alignment with new colleagues from the merging laboratory.

4.2 Second stage: From identity ambiguity to construct an open identity

Being in a period of identity ambiguity requires organizations to react efficiently in order to overcome this period by deploying certain practices. The evolution of the identity over time and the emergence of new organizational images and values will need to pass through parallel processes of sensemaking. During this period, managers' sensemaking efforts help employees to overcome the ambiguity process and reconstruct the identity, which is needed to ensure a smooth functioning of the working environment and performance of the laboratories.

"JOL is not like a start-up, we are employee of TIM and there is a collaboration between university and the company. We are part of this collaboration which is regulated through a contract "(JOL director/Transferred)

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"We are like start-up. If we are not connected to different departments of TIM, then we are not very different from being a start-up." (Transferred employee)

We identified two sets of actions: 1) from vision shift and goal misalignment, to constructing an open identity, and 2) trust building and identity negotiation.

From vision shift and goal misalignment to construct an open identity:

Temporal divergences began to emerge when employees started to determine how the mission is differently perceived by the university representatives in the office. One debatable question for employees was why TIM established joint laboratories. The answer to this question was different from the perspective of different unit's representatives in the labs. It is clear that TIM members recognized and accepted the rationale for university-industry collaboration, and the reality that they were going to be partially independent from the mother company, but also responsible for TIM's core vision.

"I do not know very well the structure of my company (TIM), I am very interested on what I do in terms of technical world. I just need to know the structure of my team, like who is my boss and the boss of my boss, and that's it." (Newly hired employee)

Employees were totally aware of the fact that the existing organizational structure of TIM would influence their actions and interactions on one hand and, on the other hand, they had to produce income together with their new peers as a separate entity. That is supported by the definition of identity ambiguity. However, some practice of the management level of the JOLs led employees to take off from ambiguity phase and reconstruct identity.

"I moved from TIM environment and now I have the possibility to work with students and professor in a totally new environment. This needs a totally new mindset because we have different point of views. That is not easy, but it is possible." (Transferred employees)

Laboratory directors who took a proactive role in making sense of the new organization by giving meaning to new visions and how lab members should achieve those visions, were able to reconstruct a shared identity. A change in the vision requires a change in the organizational identity; hence, shared visionary environment like university-industry collaborative centers requires constructing a shared organizational identity by leaders. The conflict over mission and vision related to identity ambiguity is a twofold problem: a flexible mission should be formed for university members who join the laboratories, on the one side, while TIM employees should start understanding and making sense of university vision and change their company's one, on the other side. Our data showed that these conflicts decrease as interactions increases through events, formal and informal meetings. Making sense of the differences in the visions is considered beneficial in constructing a shared identity.

"I moved from T-lab (the company's research center) to the JOLs. I have to say the organizational perspectives are very different. We as an organization are trying to achieve our goals." (Transferred employee)

This process is an alternating process that should be led by lab directors to simultaneously reinforce the core company's identity and reconstruct the shared identity. Often, our respondents

called for more recognition from TIM, as they perceived themselves more as a TIM employee rather than a lab one.

Trust building and identity negotiation:

As Gioia et al. (2010, p. 4) indicated, "identity formation is likely to be a complex process subject to multiple influences and infused with ambiguity and one in which organizational identity is not defined solely by founders and leaders but negotiated by both insiders and outsiders." Our empirical data support this in the second phase of identity transformation in the university-industry joint laboratories. Reconstructing a shared identity could be the result of negotiation and sensemaking between stakeholders involved in the organization. In this context, trust between members from university or industry facilitate the process of negotiation for building a shared identity. The process of fostering trust within organizations is a result of effective communication organized and managed by leaders. Therefore, according to our empirical setting, the labs with effective communication techniques speeds up the process of trust formation and enter negotiation and identity construction. Different members from university and industry often define laboratory identity the same way, regardless of the connection to the parent company.

"I see myself not only the lab member. I would like to know also what happens in TIM. To better know the company's status and what they are heading to." (Newly hired employee)

They mutually shape norms and values for the laboratories and define themselves as a part of this organization. The laboratories that lack effective communication, leadership and interactions, on the contrary, experience ambiguity for a longer period. Langley et al. (2012) found that the boundary spanners and the employees negotiate different aspects of sameness and differences between the old and new identities. In our case, leaders facilitated the knowledge sharing processes, thus trust formation, when all the members of the new entity started to define and form an identity, which is newly distinct and central if compared to the previously existing one.

5 Identity Transformation Process in Open Innovation Initiatives

The main finding of this study is the analytical model for the process of identity transformation when a company opens its business model by establishing laboratories outside the firm boundaries, within the university. In our case, TIM established joint laboratories with major Italian universities within their sites. This happened through a change in the institutional and organizational settings. Figure 1 shows the process of employees' organizational identity transformation.

The identity of corporate employees that move to work in joint laboratories within universities reflects a growing sense of identity ambiguity among the members and how they construct a new shared identity. The figure represents the emergence of identity ambiguity and its increasing tension before and during the opening up period, which are followed by efforts to restore the shared identity. The activities of sensemaking are continuous throughout the process. The dynamics of identity transformation entail three stages: parent company's core identity, identity

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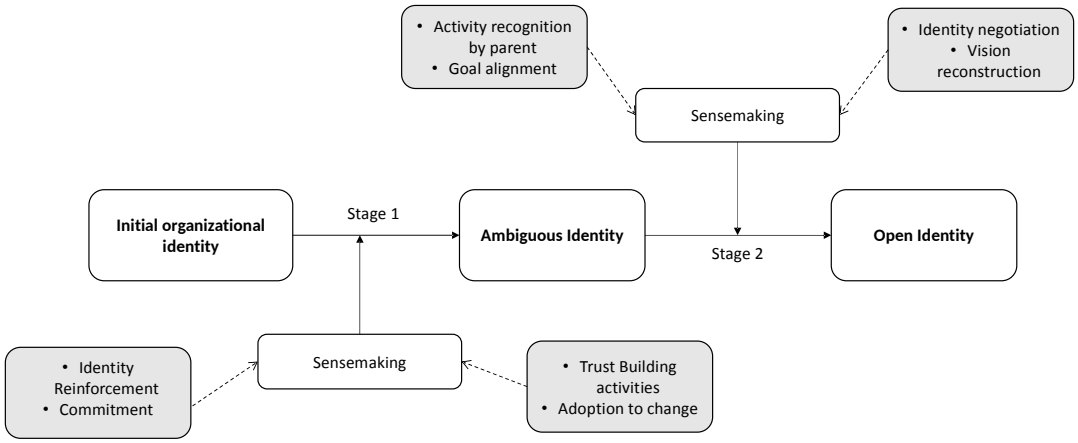

Fig. 1. The process of employees' organizational identity transformation

ambiguity, and restored shared identity. Furthermore, the effectiveness of leaders' sensemaking practices to move away from identity ambiguity phase results crucial.

6 Conclusions

Studying the phenomena of organizational identity change during the process of open innovation implementation suggests the followings:

1. The process of open innovation through the mobility of skilled R&D employees triggers organizational identity ambiguity and change;
2. The phase of organizational identity ambiguity in the process of open innovation can be shortened by the support of the parent company and the deployment of managerial skills;
3. Constructing a shared organizational identity with university members involved in the open innovation process is necessary and possible with leadership efforts.

This study contributes to the open innovation literature and offers implications for research on organizational identity change and transformation. Our findings support earlier research showing the complexity of conducting research in the areas related to processes of organizational identity (Whetten 2006). Although implementing open innovation through the mobility of skilled workers might bring external sources of knowledge, and therefore revenue, the organization and management of these approaches require accurate considerations in balancing identity issues of R&D professionals with the parent company and/or with the joint activities, as to manage the impacts on innovation and change acceptance (Lifshitz-Assaf, 2018). The results emerging from our case support earlier research on the importance of sensemaking and negotiation in the process of organizational identity, especially in the reconstruction phase (Hamalainen, 2007; Gioia et al. 2010). Based on our analyses, the formation of shared identity or co-existence of multiple identity, could be possible if – and only if – it adds value to the organization. This topic has been discussed admirably in the research related to organizational identity and mergers and acquisition (Bond

and Seneque, 2012). However, as our case showed, constructing a shared identity rather than coping with co-existence of multiple ones can be more beneficial because of the severe cultural differences. According to the research on organizational identity within an international joint venture (IJV) dual identification with the IJV and the parent company might lead to significant conflicts, especially at the management level, and more stress at the individual level (Li et al., 2002). We observed that younger employees tend to resist more to the organizational identity change. This might be due to the importance that the image and power of the parent company assume for them. Less experienced employees in our case reflect more heterogeneous perspective on their identity. The reason could be that they tried to build a non-collaborative identity, either professional or organizational, in order to achieve collaboration goals. However, Corley (2004) suggested that organization members should consciously consider the possibility that their perception of 'who the organization is' differs from the one of their colleagues, because of perceptual differences regarding the need for change in the organization. Clark et al. (2010) and Gioia and Thomas (1996) confirmed that strategic or transformational change are improbable to be done successfully without relative identity change. This is also confirmed by our study of open innovation phenomena underlying the importance of organizational identity change of mobile employees within the process of transformation.

In sum, our research offers a new perspective in the era of open innovation. Despite the limitations of our study, we shed light on the managerial practices of open innovation settings. Efforts in constructing a shared identity would help firms to avoid identity conflicts, thus benefiting efficiently from open innovation practices. We do not know yet how identity differentiation between laboratories and the parent company ultimately affects organizational and innovation performance. Nonetheless, the recognition and acceptance of its possibility within the organization is an important first step in diminishing negative consequences. The important role of leaders in the sensemaking process is an undeniable factor in overcoming identity ambiguity phase. In addition to our theoretical contributions, we can argue that firms could benefit from understanding the subsequent effects of adapting to open innovation paradigm particularly by taking advantage from the mobility of skilled employees in the generation of joint innovation.

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Organizational innovation in the context of family farms: lean diagnosis

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Abstract. Family farming has been on the agenda worldwide. Portugal is no exception. Act No. 64/2018, published in 2018, establishes the Family Farming Statute. Its preponderance in food and in the sustainability of families and territories has been reinforced by the sustainable development paradigm. However, competitiveness constraints assigned to the production system is often seen as an obstacle. Combining the theoretical frameworks of integrated agriculture and work organizations, we offer a lean sociological perspective on family farms producing lettuce. We concluded that their production system is characterized by a set of innovative practices very close to a lean approach. However, there is room for improvements in a production system that seems to maintain a family-based workforce and traditional know-how.

Keywords. Lean production; Family farming; Portugal; Integrated production; Agriculture.

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1 Introduction

Family farming is considered uncompetitive due to a multiplicity of constraints pointed out in literature. Among these, the farmers´ lack the technical and technological knowledge that would enable them to successfully plan the desired results and efficiently control production costs (Auerbach et al., 2013).

Worldwide, Lowder et al. (2014) report that of the 570 million farms, more than 500 million fall under the concept of family farming since their area is inferior to 2 hectares. They account for 90% of the world's farms and produce more than 70% of the food consumed, warranting the livelihoods of 40% of the families (Lowder*et al.*, 2014).

Also in Portugal, according to the 2009 Agricultural Census, more than 750 thousand people work in family farms. These represent more than 90% of the total agro-rural holdings, with a used agricultural area of more than 55% of the national area and are responsible for more than 50% of the country's production (INE, 2011).

The importance of family farming and the limitations of competitiveness imputed to its production system led us to question the work organization models on which production is based. The theoretical approach used for the analysis was that of lean production, based on continuous improvement and the minimization of waste. This methodology first appeared in the Japanese industrial world. It has been tested in the agricultural sector in some countries (namely, the United States and Brazil) and represents an organizational innovation with positive results on the competitiveness and long-term sustainability of this type of businesses (Hartman, 2015; Mancini et al.,2016).

In times and regions where economy is more prosperous and employment shortages are lower, as is the current situation in the north of Portugal, the lack of manpower available for agricultural activity is often a major obstacle for small farms. A key requirement of competitiveness for the farmer and family owner is the rational organization of work (GPP, 2017). Considering, just as Mention et al. (2019) that innovation is a transversal desire to all companies as it represents an improvement in their performance, a study was made about process innovation, mainly of an incremental (try to do better) more than radical type (do different). Spacek & Vacik (2016) in a case study in a diferente economic area show that efficiency creates value for the company.

We adopted an interdisciplinary approach that combines the theoretical and epistemological assumptions of agronomy, particularly of sustainable agriculture, and of the sociology of work and organizations with regard to work organization models and the premises of productive effectiveness and efficiency. Our main objective is to understand how can family farms become more competitive by adopting the principles of lean thinking in the organization of work without undermining a territorial model based on sustainable development. That is, ensuring economic efficiency without disrespecting natural and human resources, namely nature and workers. Using a qualitative methodology, we discuss the results of field observation in two family farms in the Portuguese coastal north. We wanted to know whether the work processes were close to, or distant from work rationalization techniques capable of promoting a more competitive agricultural production in family farms.

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The relevance of the study lies in the importance of family farming in terms of agricultural production, household income and its decisive contribution to the balance of the ecosystem, the preservation and enhancement of native species and the promotion of short production and consumption circuits. These are key aspects of environmental sustainability.

2 Family farming and production systems

According to FAO (2014), family farming has a key role in economic, environmental, social and cultural development.

Although the concept of family farming varies across countries (Suess-Reyes and Fuetsch, 2016), it is commonly accepted that it is a farming system based on small farms, mostly dependent on family labor and usually rooted in traditional practices. These small holdings (less than 2 ha) account for 12% of the world's agricultural area – about 30 to 40% in developing countries and 10% in developed countries (Lowderet al., 2016).

Recently, family farming has become a topic of public interest following the UN's recognition of its fundamental role in the sustainable development of territories and its declaration of 2014 as the International Year of Family Farming (FAO, 2014).

According to the FAO (2014), family and small-scale farming is closely linked to global food security, the preservation of traditional foods, a balanced diet, the preservation of agrobiodiversity and the sustainable use of natural resources. It offers an opportunity to stimulate local economies, especially when combined with specific policies designed to promote the social protection and well-being of communities.

More recently, in November 2017, the European Commission, in its communication to the European Parliament on the "Future of Food and Agriculture", stated that the evolution of agriculture aid includes “maintaining its market orientation and its support for the EU family farm model in all regions of the Union” (FAO, 2017).

Generally, family farming is linked to traditional production systems based on ancestral knowledge handed down from generation to generation and strong local roots. With the scientific and technological development occurred in the first half of the twentieth century, agriculture underwent great changes and began to use high quantities of production factors. In addition to machines, fertilizers and synthetic pesticides offer high rates of productivity and worldwide marketing. This strategy, known as industrial and / or conventional agriculture, is based on an intensive production system that has caused major environmental problems such as soil and water pollution, intoxication and loss of food quality. With the approaching 21st century and a growing ecological awareness and societal commitment, other production systems emerge that integrate new results of science, knowledge of other disciplinary areas and traditional ancestral knowledge. Sustainable agriculture can be seen as a development that meets current needs without compromising the ability of future generations to meet their own (WCED, 1987; Gold, 2007). The following sustainable production systems stand out: precision agriculture (Bongiovanni and Lowenberg-Deboer, 2004), integrated production (Freier and Boller, 2009), organic farming (IFOAM, 2020) and biodynamic agriculture (Biodynamics Association, 2020). In preci-

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sion agriculture, geographic positioning systems (GPS), geographic information systems (GIS), sensors and very sophisticated equipment are used in large and very large farms in extensive agriculture. In integrated production, natural resources are used to ensure long-term viable production. Any decision making is made after an evaluation of the action's indispensability and previously defined levels (thresholds). Chemical control is the last option (Stenberg, 2017). Organic farming is a way of producing high quality food and fiber using sustainable practices and rejecting synthetic pesticides and fertilizers. It is a type of agriculture that uses preventive and cultural methods such as crop rotation, intercropping and composting prioritizing soil care, pest and predator balance and recognizing the value of diversity and preservation of cultivars at risk. It is based on four principles: health, ecology, justice and precaution (IFOAM, 2020). Biodynamic agriculture integrates all the principles and requirements of organic farming and other traditional knowledge materialized in the use of preparations to improve soil and plants and a calendar of activities inspired by astrological information that provides indications of optimal dates and times for different operations respecting ecological and ethical principles (Paull, 2011).

The production system is at the farmer's discretion. The latter's choice is strongly determined by internal factors – personal beliefs, knowledge and routines –, as well as external factors – either the buyer's demands, the limitations of the activity itself or its location. For example, a small farm is unlikely to be able to acquire precision farming equipment or services and a farm located in a region where available irrigation water is contaminated with synthetic pesticides and fertilizers will not be able to adhere to organic or biodynamic agriculture.

In small-scale farms, as is the case of family farms, one way of making farming viable is to diversify supply and adopt the organic production system, thus being able to enter a market differentiated by quality.

In situations where the family farm does not adhere to organic production by option or impossibility, capitalization must be attained by another route. This is the case of horticultural farms located on the NW coast of Portugal between Esposende and Póvoa where, due to bad past agricultural practices, the aquifer supplying the whole area for irrigation is contaminated with high amounts of fertilizers and pesticides (Melo et al., 2012). This area where 100 years ago, in a time of food scarcity, human ingenuity built agricultural land on sandbanks is a place of intensive vegetable production all year round. Crops follow each other uninterruptedly occupying the entire available area and the cultural intensity requires fertilizers and pesticides in order to guarantee the desired productivity. As a result of growing ecological awareness, agricultural practices are changing and it is nowadays more common to opt for the so-called integrated production system (Aguiar, 2011). These farmers regularly conduct soil and water analyzes and use alternatives to chemical control such as biological control practices. The vegetables produced in this region are sold to the main supermarket chains competing directly with the large farms in the south of the country or in Spain (Silva, 2020). Our analysis focuses on these farms. It is based on the theoretical hypothesis that, in order to be competitive, the small family farmer common in this region must innovate in terms of work organization in an integrated production system. The lean approach is a path of organizational innovation.

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3 Organizational innovation

The word innovation became popular in the 1980s in Western countries. It was first used in industrial and technological policies (Guimarães, 1998) with instrumental objectives. In this line, it was allocated to knowledge production in economy and assumed an eminently technological feature. Scientific studies on innovation tend to show a strong trend to typifications according to different classification criteria: product and process innovation and more recently in distribution; incremental, radical and more recently disruptive innovation (eg. Nelson and Winter, 1982; Christensen, 1997). These two typologies, among others, have been revisited and remodelled in order to become heuristically effective to account for the evolution of socio-economic structures. The same can be said about the notion of change that is similar to that of innovation (Damanpour, 2017). The latter "follows both historically and theoretically the notion of change, widely developed within the classical issues of Industrial, Organizations and Work Sociology" (Parente, 2005). With regard to the Sociology of Work, organizational innovation, formerly called organizational change, refers to forms of work organization primarily associated with the socio-technical approach as alternatives to Taylorism and Fayolism (Ortsman, 1978) and, later, to toyotism and lean production (Coriat, 1993). As for management, it appears associated with the notion of organizational learning (Parente, 2008).

Whatever the discipline, technological innovation has been privileged in innovation studies (Damanpour and Aravind, 2012), insofar as, as Drucker (1985) stressed, innovation is primarily triggered by economic motivations. The sociology of work warns that there is no mechanical and deterministic relationship between technological innovation and productivity and growth. The refusal of technological determinism by sociologists since the 1970s, namely with the works of the so-called Critical Sociology, has only recently echoed in managent and business. Technological innovation alone represents a potential for productivity and growth that is all the more enhanced if associated with organizational innovation.

This explains why the analysis of other aspects of innovation, namely the organizational and social dimensions, is more recent (D' Iribarne, 1987). This was pointed out by the Green Paper on Innovation in 1995. It stated that one of the main weaknesses of European innovation systems was organizational innovation, "which does not allow the renewal of currently ineffective models" (Comissão Europeia, 1995).

The concept of innovation from a not only economic, but also socio-organizational perspective goes back to Schumpeter. For him, in 1934, to innovate was to revolutionize production routines benefiting from previously unknown possibilities (Schumpeter, 1996). Schumpeter's definition of innovation is broader and goes beyond technological innovation. According to Kanter (1983), "it allows thinking of innovation as 'the process of bringing and putting into use any form of problem solving'" (in Fonseca et al., 1996, p. 195). Innovation can be thought of as a "different way of doing things" (Fonseca et al., 1996, p. 194). As for its organizational dimension, the definition of innovation of the Oslo Manual "comprises three mains branches: (1) business practices (new methods for organizing routines and procedures); (2) workplace organization (new ways of distributing responsibilities involving employees); and (3) external relations (new ways of organizing relations with other firms or public institutions) (Alves et al., 2018).

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In line with the studies of the Sociology of Work, in this article, organizational innovation refers to routines and work organization processes associated with new forms of work organization. In this context, the Japanese models of organization (discussed in the following section) are often seen as an optimization of the classic proposals of the scientific organization of F. Taylor and H. Ford, even though they are still criticized for paying little attention to the equally impoverished work content and low worker empowerment.

4 Work organization: from classic industrial models to the transversal approaches of lean thinking

Work organization was first considered by industrial engineers. The first methodologies of work organization were formalized by xFrederick Taylor and Frank Gilbreth in the early twentieth century. Task fragmentation and the strict control of workers' movements were seen as beneficial. The study of work organization continued with Henry Ford who introduced a mechanical conveyor in the Taylor assembly chain making continuous and mass production possible. In the 1950s, Taiichi Ohno, an engineer born in China, sought to create competitive advantages through the optimization and improvement of work processes, developing this methodology with great success in the Toyota factory – the *Toyota Production System.*

However, it was in 1990 that the lean philosophy became known worldwide after the publication of the book "The Machine That Changed the World" written by James. P. Womack in partnership with Daniel T. Jones and Daniel Roos. The book presents a study of the Japanese automobile industry, especially Toyota, focused on the reduction of unproductive times and waste (Womack et al.,2007).

Lean production has evolved into a lean thinking philosophy with five basic principles.

Principle 1 – Define value. The value can only be defined from the customer perspective. This is the starting point of lean thinking. It identifies what customers want and what they are willing to pay for. It is no use doing anything technically perfect if the customer does not value it.

Principle 2 – Identify the value stream. Activities, from product design to delivery, must be identified, mapped and ranked according to the value they create. Whenever possible, this should include suppliers. Activities that do not add value to the customer are eliminated. Where this is not possible, they should be standardized and reduced to the necessary minimum.

Principle 3 – Make the value flow. The steps in a process must be interconnected and synchronized so that there is flow between them, minimizing waiting times and batch creation. By reducing activities that do not add value, the process must evolve in order to become as fluid as possible. It is the just-in-time (JIT), a system in which production and movement occur as needed.

Principle 4 – Implement pull based production. Pull based production (or pull flow) indicates that the (internal or external) customer's order is the trigger to start the value and production flow: right product at the right time and in the right amount. It is based on the JIT system and the leveling of production (known as *heijunka*), thus reducing stocks to a minimum.

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Principle 5 – Strive for perfection continuously. The strive for perfection is achieved through a continuous improvement culture where each person in the Value Stream must identify and propose improvements in the process for which s/he is responsible in order to reduce or eliminate waste. In accomplishing the four principles mentioned above, the company will be contributing to the continuous improvement that refers to the concept of k*aizen.*

Taiichi Ohno, in his professional experience and application of the Lean model, found three obstacles in the application of the Toyota Production System. He called them "The three MU: Muda, Mura e Muri."

The insufficiency of standardization and rationalization creates waste (Muda), inconsistency (Mura) and irrationality (Muri) in procedures and working hours that eventually lead to the production of defective products (Ohno, 1988).

There are several lean implementation tools of which we will retain only those that will be applied in this work:

- Value Stream Mapping (VSM) consists of identifying all tasks undertaken from order placement by the customer until delivery. It is essentially a planning tool to identify waste and devise solutions to eliminate it (Rother and Shook, 1999). It analyzes activity duration and corresponding costs takiing them into account in management optimization (Pinto, 2014);

- Kaizen - corresponds to continuous improvement efforts implemented by all parties. Its main focus is waste elimination (Imai, 1986);

- MUDA (refers to waste) - Anything that does not add value is waste, so it must be reduced or eliminated (Pinto, 2014);

- MURA (what is variable; it refers to irregularities or inconsistencies) - Variation in requests for a process or operation prevents the creation of a stable base (Pinto, 2014);

- MURI (What is irrational; manifests itself through excess or scarcity) - The standardization of work (ensures that everyone follows the same procedure; renders processes more predictable, stable and controllable) (Pinto, 2014);

- "5S" or more recently the "6S" refer to a set of practices that seek to reduce waste and improve the performance of processes and people through a simple approach aimed at achieving optimal conditions in the workplace (Zu et al.,2008).

The practices have designations beginning with the letter S: *Seiri*(sort); *Seiton*(set in order); *Seiso*(shine); *Seiketsu*(standardize); *Shitsuke*(sustain) and the most recent "S" for safety. This lean instrument motivates workers to order, organize and tidy up the workplace and facilitates the waste reduction effort. Worker involvement tends to be high and the return of its application very visible.

The lean philosophy has been implemented in several economic sectors, namely in services, where it seeks to reduce waste, improve efficiency and increase productivity, nonetheless always focusing on its main objective of identifying the value to the customer (Levitt, 1972; Suárez-Barraza et al., 2012). However, references to its application in the agricultural sector are scarce.

Hartman (2015) explains how he applied this methodology to his 4 ha farm in Indiana, United

States of America, where he produced vegetables. He believed that farmers worked hard and that it was possible to reduce wasted effort in tasks that did not add value to the final product, increase efficiency, maximize profit with less labor, and enjoy a more satisfying life. The author found two main types of waste on his farm: the necessary tasks, which do not add real value; and pure waste. The most controversial waste according to lean methodology is the first. For example, eliminating weeds does not add value but it is necessary.

Another study is that of Mancini *et al*(2016), who demonstrate the potential of this philosophy to improve small farm competitiveness. In this study, a small family producer whose main activity was lettuce production was chosen and exhaustively analyzed. They contacted this producer's main customer – a restaurant – to understand how the orders were placed and what represented value for the latter. They then visited the farm, followed the different phases of lettuce production and, after some information from the producer, elaborated the VSM. In this mapping, they identified the activities that added value, those which did not add value, but were necessary, and those that did not add value. After analyzing this tool and assuming that the producer should only produce what is requested by his/her client, a new VSM was elaborated eliminating pure waste (activities that did not add value) and suggesting some process changes to make it simpler and more continuous. They concluded that the use of lean philosophy in agriculture has great potential and offer competitive advantages to small farms (Mancini et al., 2016).

Motivated by these experiences and believing that family farms show potential for organizational innovations capable of improving their productivity, we have developed a diagnostic study to identify the extent to which work processes are close to or distant from lean approaches with the aim of offering recommendations for operational improvement.

5 Methodological strategy

In order to diagnose the work processes implemented in family farms based on the principles of lean thinking, we combined multiple case-studies in a cross-case analysis (Yin, 1994; Creswell, 1994) according to the qualitative paradigm (Denzin and Lincoln, 1994).

This is a multiple case-study of two similar cases in terms of lettuce culture. From the perspective of cross-case analysis, we resorted to a second case in order to ensure the validity of the analyzes carried out. These have been supported or rejected by a comparative and sequential approach. The fundamental choice lied in the culture to be studied, due either to the seasonal character of agricultural production or the farmers' willingness to demonstrate their operating modes during intensive labor times. Among the work processes observed on family farms, the lettuce crop was chosen for the following reasons: i) pre-existence of the Mancini et al.,(2016) study that allows us to share knowledge and experience; ii) it is grown almost all over the world and on all types of farm (family and industrial); iii) its strong presence in the region between Douro and Minho, where our study was conducted; iv) it can take place either during autumn-winter in greenhouses, or in the open air during spring-summer. These intentionally chosen characteristics facilitated the use of the indispensable observation protocols in a relatively unknown domain.

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Two family farms were randomly selected for the analysis of lettuce production. They are located in the area of Estela, Póvoa de Varzim, and produce vegetables. In both cases, the household revenue comes from agriculture and the workforce is predominantly composed of family members. Both adopted integrated production systems. On farm A, we observed the harvest of greenhouse lettuce during winter. On farm B, we observed the planting and harvest of lettuce produced outdoors during summer.

The main data collection techniques used were the systematic observation of work organization and verbal "why" and "how" protocols" (Bisseret et al.,1999) to question farmers about their activities. A check-list survey was also applied in order to understand: i) the farmers' sociodemographic characteristics and their relation to land and property; ii) the farm's characteristics (current parcels of the holding by numbers, areas, names; the presence of cover / greenhouse; current, previous, pre-previous, and pre- pre-previous crop to get information on culture rotation; people working in the farms); iii) agricultural practices related to crop protection – preventive and curative control methods including cultural, biological and chemical methods. The technical itinerary – "theoretical technical and technological models identifying the cultural operations, tasks and technologies to be used" (Amaro et al., 2000) – was also designed with the farmers. It identifies the orderly set of cultural operations and agricultural tasks associated with lettuce production.

The observation script containing the items to be observed and the questions to be asked to the farmers were prepared with the help of an expert – a lean consultant for the industrial sector – who joined us during the observation period para auxiliar a implementação do raciocínio base do VSN.

Initially, it was necessary to identify: the most representative client for each culture; the type of client (cooperative, association, private company, supply market, local market, etc.); the type of contract between the parties; what did the client buy and how often; the distance between the parties; how were deliveries scheduled; how were they negotiated; whether deadlines were met; whether or not there were penalties for defaults (on the customer side); how were sales negotiated; who negotiated the sales; and the time consumed with this process. Additional issues, such as price, average sales per year, and the latter's influence on the price were also examined. All this information is decisive for a lean diagnosis.

Direct observation focused more on a portion of lettuce cultivation on each farm. The observation script had several parts, including plot identification (name, area, planting date and lettuce development considering the number of leaves) and the technical itinerary of the lettuce (machine organization and layout, machine distance, tools, risk protection and safety equipment, and garbage dumps).

The technical itinerary for lettuce has been studied taking into account the following analytical dimensions:

1. Soil preparation before the crop (soil disinfection, solarization, fertilization, mobilizations, plastic covering);

2. Planting (how are the plants obtained – mote, alveoli or other), planting tasks;

3. Cultural operations:

- Irrigation (origin, type and frequency);

- Weed elimination (soil covered with plastic, herbicide spraying, hand or mechanical weed removal);

- Fertilization (direct application or fertigation and frequency);

- Culture protection (who assesses the risk, how is it done, who decides to treat, how many treatments are done);

4. Harvesting (how many times and for how long, including cutting, placing in boxes, washing and shipping).

For a more detailed analysis, we have decided to observe the operative modes during harvest on both farms and planting on one farm.

The triangulation of data collection techniques and the consequent data cross-checking and validation via cross-case analysis were central to expand case analysis and particularly useful in VSM analysis.

The observation records and the informal interviews with the farmers underwent a descriptive category content analysis. As we conducted the second observations and talked to the second farmers, we completed a transversal reading of the cases. This facilitated the creation of thematic categories as it expanded our understanding of the technical itinerary by establishing relationships between both contexts and revealing particularities and common aspects. The findings allowed further expansion and revisitation to the first case-study and generalization to the analyzed culture. The thematic categories were designed through data articulation. The analysis was systematized in a flow chart.

6 Discussion

6.1 Characteristics of family farms

Two farms were observed. Farm A has an area of 1.5 ha, with 0.5 ha of greenhouse, and farm B has an area of 2.35 ha, with 1.7 ha of greenhouse. Both farms have 5 plots distanced up to 5 km. These two farms are similar to many others on the coast between Esposende and Póvoa de Varzim. The plots of cultivated land come from old "masseira" fields widened by the joining of continuous fields, allowing the installation of greenhouses and easier mechanization. Vegetables such as lettuce, tomato, pepper, green beans, zucchini, cucumber, onion, carrot, turnip and cabbage are almost continuously cultivated season after season, year after year. On farm A, the work focused on lettuce cultivation in greenhouse during winter and on farm B on lettuce cultivation outdoors during summer. In farm A, the owners and farmers are a couple, both 70 years old and with the 4-year compulsory at education their time. They are self-employed and work full time with no paid workforce. The owner of farm B is a 28-year-old man who devotes himself full-time to family farming. His mother is a full-time wage worker and his grandfather, who is retired, works as an unpaid worker.

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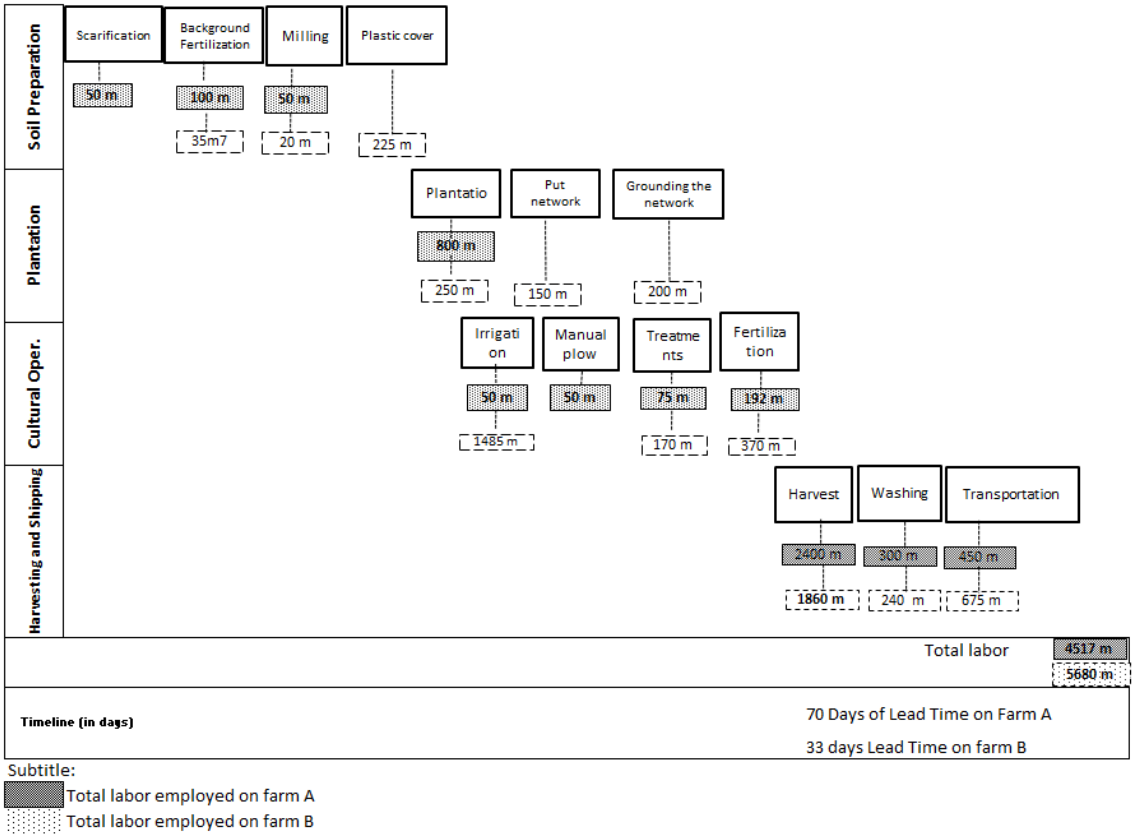

Fig. 1. – VSM of farms A and B

6.1 Lean diagnosis

VSM was performed for greenhouse and outdoor lettuce cultivation (Figure 1) by observing all phases of the productive process on farms A and B. For each cultures' mapping, we marked the operations performed and the execution times grouped in phases. Labor was counted in minutes. Whenever work was performed by more than one person, the recorded time was the sum of the time spent by each worker appointed to the operation.

The VMS presented shows all the organized operations and allows us to perceive the whole flow at a glance (bird eye), as Hartman (2015) did for a dairy farm in Denmark.

A more detailed study of lean methodology was applied to harvesting on farms A and B and to planting only on farm B. The results are presented in figures 2 and 3. Activities that add value and those that do not add value, but are necessary, as well as opportunities for improvement have been noted.

The lettuce lead time during the winter greenhouse was 70 days and the labor necessary to carry out all the cultural operations, reported to 1000 m^2, was 75 hours and 17 minutes. The lettuce lead time during summer was 33 days and the labor necessary to carry out all cultural operations from land preparation to harvesting, reported to 1000 m^2, was 94 hours and 40 minutes.

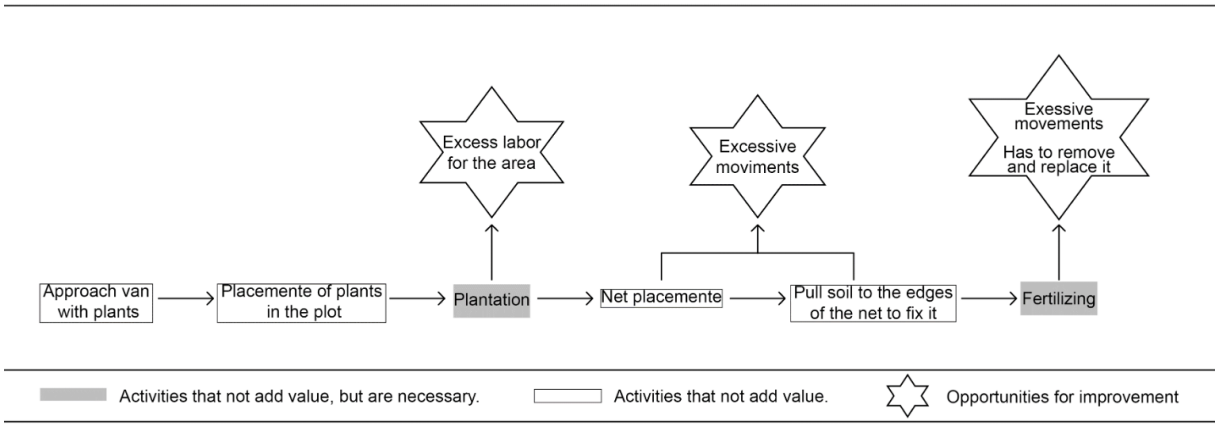

Fig. 2. Harvest flowchart of farms A and B

One major conclusion is that farmers already applied some lean principles on their farms. These included:

- The normalization of the boxes used during harvesting, a principle that facilitates the customer delivery format management;

- The van's proximity to the harvest space when picking the lettuces, which greatly reduces the farmers' movements and box transportation; this situation is very different from that observed by Mancini et al. (2016) who refers to the loss of time for travel.

- Training and standardization of harvesting work: growers harvested lettuce by exactly the same method. They knew how to cut and what leaves to remove. This meant, for example, that an entire lettuce would never be rendered unusable due to poor harvesting and it also made them faster and more productive; as mentioned by Hartman (2015), movements are rationalized for the harvest of tomatoes and cucumbers, the situation observed by us being very different from that observed by Mancini et al (2016), which points to lost time due to overwork and lack of labor.

- Relationship with the final customer was based on an agreement according to which producers are quite sure that they will sell everything they produce. Producing what is guaranteed to be sold greatly reduces the risk of difficulties in disposing of production. In other words, the irregularities and inconsistencies that the Japanese call *mura*are rather small. However, they are not null, and there may be excess production due to uncontrolled situations.

- Planting lettuce by plots at different times also favors harvests at different times for some time. This is an excellent example of the leveling of demand between consecutive operations, which greatly reduces the farm's muri and there are no unexpected workloads;

- Surface cleaning of lettuce rather than thorough washing because the customer does not value the first. This illustrates the advantage of clarifying what is value for the customer and avoiding waste of overprocessing.

As for improvement opportunities, we have identified:

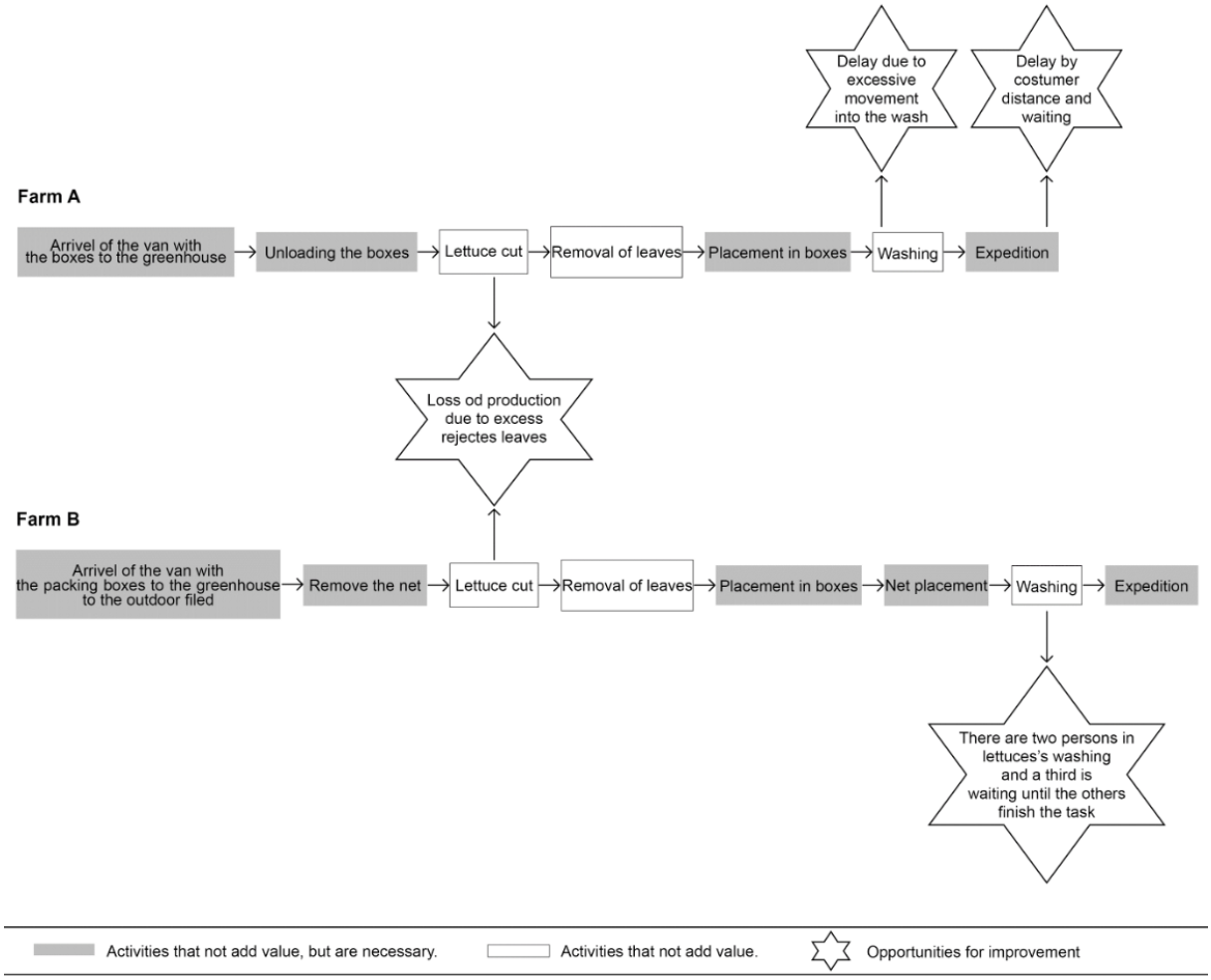

Fig. 3. Plantation flowchart of farm B

1. Loss of production due to an excess of rejected leaves, that is, during harvesting, on average, 6 leaves out of 50 of crisphead lettuce and 8 out of 48 leaves of butterhead lettuce were rejected. We wondered whether the lettuce variety influenced the number of rejected leaves and the answer was positive. One possibility to consider is to produce more crisphead lettuce (which implies fewer leaves rejected) to the detriment of varieties that lead to more losses.
2. Excessive manpower and unproductive times on farm B. Both during planting and harvesting, there were 3 people. However, most tasks were performed by 2 people simultaneously, which meant that one of the persons was temporarily unemployed. Planting would be more fluid if one of the workers distributed the plants so that these were closer to those who are planting. During planting, a delay of 1 hour and 40 minutes was recorded for the

third person for an area of 1000 m^2. During harvesting, this time raised to 7 hours and 45 minutes.

3. Excessive movements in laying the net on the open air plantation on farm B. The net's placement included extending it over the crop, placing pins in the corners for initial fixation and pulling sand up the edge of the net all the way around to fix it to the ground and prevent wind inlet. The last operation was done using the hands to hold the net down and the feet to move the sand. It is a laborious and delayed operation. In order to fix the net, and as an alternative to laying the sand with the feet, it would be possible either to use pins along the entire net length since their placement is simple and fast, or to place long quadrangular sticks on the net;
4. Excessive movements in lettuce washing on farm A. Lettuces are placed in boxes and put in the van, which then moves to the water point. Here, boxes are removed for washing (with the lettuces inside) and put back in the van. The movements linked to loading, unloading and reloading the boxes in the van could be reduced to a single movement if the washing operation was performed before the boxes were placed in the van with equipment that would not cause waterlogging inside the greenhouse.
5. Average lettuce delivery time to the customer was 45 minutes both on farm A and B because it depended on the number of producers arriving at the delivery site simultaneously. This time loss may be due to the negotiation of different delivery times.

7 Conclusions

On the family farms we analyzed, a set of practices seem close to lean methodology concepts, however in an unconscious and unintentional way. In spite of such similarity, there is room to improve operational efficiency.

A lean thinking approach, although not a complete novelty for these two farms, if deliberately implemented, could be a useful organizational innovation both in the awareness of how effective and efficient the family farmers' functioning is and how rationalization can be intensified and generalized to other operations, thus boosting competitiveness. There are some opportunities for improvement and adding value to the agricultural activity increasing its profitability and therefore potentiating endogenous territorial development.

This work has obvious limitations due to its exploratory character, including the scarce number of cases and planting and harvesting operations we have analyzed. However, thanks to an interdisciplinary combination of tools and knowledge, it provisionally suggests some opportunities for family agriculture through organizational innovation.

We believe that the farmers who were the object of this study have become aware of the possibilities for improvement and now have an opportunity to innovate by implementing one or more of the 5 recommendations arising from this study. By applying an innovative methodology to family farming, this study offered quantified values of work include in each cultivation operation, as well as of the total time (lead time). This constitutes a reference for future work on innovate practices or methods.

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However, we warn that improvements do not pervert a production system based on family, tradition and based on ancestral knowledge. This provides identity to agricultural activity, farmers and territories, and contributes to the conservation of the ecosystem.

This study was carried out with professional family farmers, that is, individuals for whom agriculture is the family's sole economic activity. It would be interesting to extend the study to family farmers for whom agriculture is a complementary economic activity.

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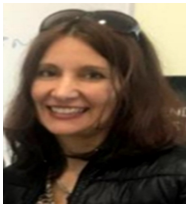
CRediT Statement: Conceptualization ; Methodology; Writing original draft.



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A Grammar of the Distinctive Competence Development at the Firm for the Solution of Systemic Problems

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Abstract. Competitiveness results from factors beyond the structural conditions and organisational boundaries, such as inter-organisational cooperation. Using evidence gathered in Brazilian credit unions, this work reveals a type of social process for generating organisational capabilities and economic goods in firms satisfying needs defined by social structures in order to solve market failures and structural deficiencies in their socioeconomic systems. An exploratory and descriptive multiple case study with longitudinal qualitative data collected from a sequence of decision-making events of deterministic nature has made possible theoretical refinements to the model of competence development in the firm. It relies upon a systematic, computer-supported Process Tracing technique using a formal language model. Two case studies showed that firms hold relationships of cooperation and contribution with partners and non-market structures in their organisational and environmental surroundings whenever their performance is constrained by competitive problems of systemic nature, for which there is no solution based on the mechanisms of market price and state intervention.

Keywords. Core Competence; Systemic Competitiveness; Critical Realism; Category Theory; Generative Grammar Theory.

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1 Introduction

Competitiveness may be defined as the level of capabilities and performance of firms, industries, and political-administrative regions for the efficient exploitation of factors of production and the adequate supply of goods and services to the market in contrast with their competitors over time (OECD, 1994).

Trying to explain the phenomenon of competitiveness, several theoretical frameworks recognise both exogenous and endogenous factors such as structural and conjunctural conditions of the economy and non-inherited productive resources. In the long term, competitiveness does not rely on the business growth, the relativity of market prices, or the exploitation of comparative advantages, which are conditions the firm cannot manage, but on the development of productive resources as a source of sustainable competitive advantage. Thus, competitiveness does not relate to the ownership of raw resources acknowledged as valuable in the industrial economies. Instead, it relates to the takeover of resources, the ability to transform inputs into outputs to produce value for consumers, the speed of information processing, and the rate of innovation.

All models of competitiveness – as the Diamond model (Porter, 1990), the Structural model (OECD, 1992) and the Systemic model (Esser, Hillebrand, Messner, & Meyer-Stamer, 1996) – assume this phenomenon is a result of the resource productivity and innovative capacity of firms. These competitive factors contribute to the expansion and diversification of the supply with reduction of market prices, fostering economic growth. However, these models diverge from each other regarding the type of process by which the phenomenon of competitiveness takes place.

For example, the Structural model of competitiveness assumes there are situations in which deficiencies in the productive system can disrupt some assumptions of market economies. In many late-industrialising countries, structural deficiencies accumulated over a historical process of development of the productive systems impose constraints on the performance of firms. If private action alone cannot solve them, then state intervention is necessary. In the past, experiments to address structural deficiencies through either state-owned investments in strategic industries or direct provision of public services occurred in countries of Latin America (Meyer-Stamer, 1998, 2005). Today, opportunities and capabilities for state intervention, even those not involving the direct allocation of public resources, such as market regulation, are increasingly limited. Furthermore, the involvement of big corporations in the efforts of technology transfer and production chain management may also be insufficient to make economic development inclusive. In these circumstances, state intervention is still necessary. In this regard, OECD (1992) argues for the selective support to firms promoting the shift from a restrictive comparative advantage-based condition to a competitive advantage-based one.

The sustainable economic performance of firms and their ecosystems of production is dependent upon actions coordinated with other actors (e.g., the government, industry supporting institutions, and the civil society). Networking is such a tool to promote the collective creation of resources and collaborative learning. In a multidimensional and systemic view of competitiveness, it becomes such a critical determinant not only of performance but of the sustainability of the firm. The firms and industry supporting institutions enrolled in collective actions coexist

within the micro and mesoeconomic levels of the organisational surroundings of their ecosystems (Esser et al., 1996).

Government action is also not restricted to be an exogenous factor of competitiveness. Some market failures and structural weaknesses can accumulate during the historical development of the productive system. If they prevent the satisfaction of a number of assumptions of that models of competitiveness, then government action – not only in the form of sectoral public policies but also of cooperation with other firms and meso level institutions – is necessary. Esser et al. (1995) justify cooperation between actors of the public and private sectors when the government objectives cannot be achieved by direct action only, as they rely on some idiosyncratic resources of firms and industry supporting institutions, or when the implementation of public programs would be very costly or ineffective without these private-sector organisations.

The Systemic model acknowledges some problems constraining the competitiveness of firms like market failures and structural deficiencies in their productive systems. In this way, either the private sector's actions relying on the price mechanism or the public sector's actions relying on state intervention mechanisms (i.e., public policies and regulation) cannot solve these competitive problems. In these circumstances, no single actor owns all the resources required to craft the definitive solution in one shot; they are called *systemic problems* (Chaminade, Lundvall, Vang, & Joseph, 2009). As a result, collective action in the search for solutions to systemic problems may arise as a kind of social process for the creation of specific assets and capabilities in firms.

Inter-organisational relationships between firms and industry supporting institutions encourage the development of capabilities in line with the trend of partial replacement of the direct state intervention by the collective action of local actors on endogenous determinants of innovation (Meyer-Stamer, 2005). The Systemic model recognises the development of capabilities in the firm to create economic goods to the market but not to meet needs from other social structures of the productive system in the search for solutions to systemic problems. The firm transforms social structures that regulate the market functioning by solving competitive problems limiting its performance in a way that improves the socioeconomic system around it as well.

This work delineates the distinction between the mechanism of cooperation between the firms and industry supporting institutions in their organisational surroundings for creating idiosyncratic resources and the mechanism of contribution from the firm to a nonmarket structure in its environmental surroundings to solve the systemic problem. Both comprise separate theoretical relations in the Systemic Competitiveness model. The firm's contribution to systemic competitiveness, neglected in the original model, is a theoretical contribution of this work. It aims to explain this social phenomenon by acknowledging the ontological and epistemological assumptions of the post-positivist paradigm known as *Critical Realism* (Bhaskar, 1975). In contrast to the mainstream paradigm, Social Positivism, there is a shift from the naïve realist assumptions like the direct measurement of phenomena to an *ontological stance* relying on a stratified reality and unobservable mechanisms yielding empirical events. Another change is the epistemological approach for theory formulation relying on a *logic of retroduction* instead of a *logic of falsification*. Both paradigms endorse deduction of hypotheses for empirical validation and evidence accumulation, but the former rejects the principle of objective rationality and the rule-of-thumb test of hypothesis against sample data as the criteria to accept the "scientificity" of a theoretical

statement. In contrast, social researchers modify the empirical model to conciliate divergences between theory and evidence due to contextual specificities.

This research is a multiple case study that applies a systematic, computer-supported process tracing procedure relying upon a discrete mathematical model (Braga, 2016, 2017, 2018). It has two components based on both combinational logic and sequential logic. The first describes every single decision-making or action event exerted by a single agent using a pair of qualitative methods. On the one hand, a deductive method applies a classification system for types of events using Qualitative Content Analysis (Krippendorff, 2013). On the other hand, an inductive method takes configurations of contextual conditions to hypothesise the best explanation for any surprising fact using Qualitative Comparative Analysis (Ragin, 1987). The second component describes a category of complex, dynamic and contingent social process using a rule-based model of patterns of relations between events in chronological order. A retroductive method suggests modifications to a formal model deduced from Generative Grammar Theory (Chomsky, 1956, 1959) much like Sequence Analysis (Abbott, 1990, 1995) on two or more instances of that social process taken together.

There are some studies relying on the concept of grammar in the social sciences, such as those focused on social practices (Bourdieu, 1977, 1980), organisational processes (Pentland, 1995), and institutions (Crawford & Ostrom, 1995). Nevertheless, none of them uses such a formal, mathematical model to provide "systematicity" for the task of empirical data analysis. The foundations of the sociology of complexity need both a stratified ontology based on the generative model and a retroductive logic based on the critical realist assumptions.

Elinor Ostrom received the 2009 Nobel Prize in Economics because of her works on the governance of common-pool resources. She proposed a grammar-based analytical approach called *Institutional Analysis and Development* (IAD) framework. This paper introduces both theoretical and methodological advances in this line of research. First, systemic competitiveness turns into a common good of firms and other organisations embedded in the same socioeconomic system. Thus, firms need making investments to preserve systemic competitiveness in the long term, which are their contributions in terms of quasi-public economic goods. Second, the Process Tracing technique, which accepts the assumptions of Critical Realism, acknowledges generative mechanisms. Indeed, the coupling of collective actions in which the firm takes part with partners in its organisational surroundings in favour of systemic competitiveness is a mechanism. Third, the Process Tracing technique also rejects the assumption of methodological individualism of Karl Popper's Situational Analysis in which Ostrom's research rests on. Finally, the data analysis procedure relies upon a discrete mathematical model that goes further in comparison to the IAD framework regarding both explanatory power and inference reliability. It identifies patterns of sequences of shared strategies, norms and rules within social processes in a more realistic way.

The theoretical and methodological approaches designed in this work can contribute to the view of the Dynamic Capabilities of the firm (David J. Teece, Pisano, & Shuen, 1997), which relies upon Evolutionary Economics (Nelson & Winter, 1982). There is no axiomatic methodology aimed to investigate the socioeconomic phenomenon of the endless reconfiguration of resources over time to adapt the firm to its competitive environment. In fact, a realistic, systems-based

theory of the firm (or an intelligence-based view of competitive advantage) is the main goal of this research program.

2 The Research Problem and the Proposed Theoretical Model

Neoclassical economics acknowledges that some system of incentives for competition is a necessary condition to make firms engage in learning processes. These incentives aim to raise the level of efficiency in resource allocation. Competition operates such as a mechanism for the structural adjustment of the market based on its prices. It implies the assumption of market self-regulation, which is the inexorable tendency for selective market pressure to eliminate inefficient firms. Their performance relies upon operational efficiency only, and then, performance heterogeneity between the firms is non-existent or transient in perfectly competitive markets. However, this assumption cannot explain differences that persist in some firms when compared to their rivals due to structural constraints causing a kind of imperfect competition (Robinson, 1933) or monopolistic competition (Chamberlin, 1933). In contrast, the higher economic performance of some firms may be explained by imperfections in the product market, which reduces the competition among them below the socially optimum level (Caves & Porter, 1977; Porter, 1979). Alternatively, the firm's superior performance may be explained by imperfections in the factor markets, which include natural resources, investment capital, labour, business skills, and technology (Rumelt, 1984; Wernerfelt, 1984). Nevertheless, these structuralist worldviews do not acknowledge the agency of entrepreneurs for the construction and renewal of competitive advantages, which is a common phenomenon (Chandler, 1962, 1992). In works of Industrial Organization, the concept of *core competence* refers to the source of such advantages that occur in innovative firms operating in competitive markets (Prahalad & Hamel, 1990).

2.1 A Social Process for the Firm's Competence Development

Borrás and Edquist (2013) say the concept of *organisational competency* belongs to the class of resource *stock* while *competence development* belongs to the class of resource *flow*. This means the creation and exploitation of a bundle of specific assets, information, knowledge, capabilities and competencies at firms to solve competitive problems through a trajectory of projects that is contingent on a specific configuration of contextual conditions (Nicolai Juul Foss, 1996). A kind of evolutionary process entails changes both inside and outside the firm to satisfy needs defined in a social structure in its environmental surroundings. While this process incessantly approaches a definitive solution to the competitive problem, it reveals competence development relying on the competencies of the firm (Bourgeois III, 1984; Javidan, 1998).

The retention of competencies in the firm is a kind of organisational learning process, a result of complex interactions between contextual conditions and the resource stock built up over time (Borgatti & Foster, 2003; Goerzen, 2007). These social interactions are the instances of types of events in the process of competence development. The development of capabilities and economic goods over time leads to the adaptation of firms to market demands in the form of at least one core competence (Nicolai Juul Foss, 1996). This phenomenon takes place through the activation

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of some underlying generative mechanisms; however, it is also constrained by the context of the firm: the conditions present in its environmental and organisational surroundings that influence its performance (Lawson, 2004).

The external environment is a sort of competitive, economic, institutional, political, technological and social conditions surrounding an organization (Esser et al., 1996; Porter, 1990). Consider that the external environment of the firm is a system of social structures influencing both its behaviour and performance. Each social structure is a recurrent pattern of interactions between social actors maintained through incentives and sanctions; it either creates or constrains opportunities and threats to the firm over time (Barker, 2005; Coleman, 1986).

From the point of view of the firm, the market is the most important social structure: it is the source of financial resources, which are those indispensable for acquiring all other resources (Coase, 1937). Nevertheless, it is not the only one. There are social structures such as dimensions of the environmental surroundings of the firm that still conditionate its behaviour. For example, credit unions are under the influence of both the regulatory environment and the community environment.

Bourgeois (1984) maintains that firms do not respond passively to the conditioning exerted by the environmental surroundings because they actively adjust their resource settings to satisfy the environmental demands and implement their business strategies. This process of change relies upon the organisational competencies of the firm, a type of knowledge-based resource. The firm may also establish types of *relationships* with other firms and industry supporting institutions in their organisational surroundings to acquire idiosyncratic productive resources, but it also develops competence internally by combining shared resources with their own stock of resources. Nevertheless, the present work proposes this kind of social process may not result in a market-oriented core competence, but in a kind of competence oriented to other social structure in the environmental surroundings of the firm that supplements the market functioning.

2.2 A Social Process for the Firm's Inter-organisational Relationships

Between the structure of the industry and the boundaries of the firm, there is a place for developing some productive factors: the organisational surroundings, which share resources that are complementary to those of the own stock of the firm. The internal environment of the firm and its relationships with other firms and industry supporting institutions embrace a social structure in the form of network enabling entrepreneurial agency.

Inter-organisational relationships enable competence development through two social processes for the creation of specific assets and capabilities at the firm (Dyer & Singh, 1998). First, the firm's process of combining idiosyncratic, non-transferable shared resources that are complementary to its own stock of resources (Doz, 1996). Second, the firm's process of information and knowledge exchange with partners that are not available to its rivals, which promotes learning and innovation (Grant, 1996). In this way, the differences between firms in their ability to exploit resources explain part of the performance heterogeneity observed in similar organisations of the same sector as well (DeCarolis & Deeds, 1999).

Firms embedded in the same inter-organisational network can collectively develop a shared com-

petence. However, Camisón (2004) observed heterogeneity between firms of the same sector, suggesting it occurs because of resources that are not available to other firms; probably due to specific relationships in the organisational surroundings and the idiosyncrasy of their stock of inherited and endogenously developed resources (Camisón, 2004; Teece, 1986). Finally, social interactions between the distinctive competence and the shared competence may generate economic value to consumers and new sources of rent to the firm. This complex of social interactions is a factor of competitive advantage.

These theoretical perspectives on competence development (Lawson, 1999) and inter-organisational relationships (Dyer & Singh, 1998) can consider social structures in the environmental and organisational surroundings when explaining the competitiveness of firms embedded in a socioeconomic system. As any rational agent, the firm makes the internal adjustment of its resource configuration to the contextual conditions of its surroundings by means of developing capabilities and economic goods to solve some competitive problems. In addition, the firm's actions supported by its partners in the organisational surroundings make changes in the social structures of its environmental surroundings (Walker Jr. & Ruekert, 1987). Any explanation for the social process of competence development in the firm needs capturing the dynamics of its own actions from a historical or processual viewpoint.

2.3 The Hypothesis of the Distinctive Systemic Competence Development in the Firm

The premise of the multidimensional and systemic competitive performance of the firm considers both the market failures and structural weaknesses of the productive systems that inhibit the operation of the mechanism for the structural adjustment of the market based on prices (Meyer-Stamer, 2005). This view assumes that the market is the locus of the competitive process, but it still acknowledges other social processes contributing to systemic competitiveness as well.

Consumers cannot directly perceive all dimensions of the firm's competitiveness in the attributes of the goods and services offered to them (Hertog, 1999). For example, there are both positive and negative externalities of the private business that markets cannot price, information asymmetries that undermines the rationality of economic agents in consumer relationships, and innovations changing preferences of consumers and creating a wholly new market. These are competitive dimensions of the firm that the market cannot price, but both the coordination and institutionalisation processes in social networks involving the regulator and other industry supporting institutions can shape these dimensions of the competitive behaviour of the firm (Finger & Varone, 2006b, 2006a).

Some productive sectors do not have enough selective pressure to eliminate all firms that do not match the efficiency standard (e.g., regulated industries, oligopolies); there is also no guarantee the observed standard is the highest possible level of excellence (Nelson & Winter, 1982). In these industries, competitiveness depends not only upon the structural conditions but also upon sectoral policies and government regulations. Limited government action and increasing competitive pressure can likely promote the search for new models of economic governance using inter-organisational processes to foster a structural change; these include the coordination of ac-

tors at the local, regional, national and multilateral levels. The socio-technical interactions and the competitive resources distributed between actors at the micro and meso levels of the socio-economic system exert a growing influence on the efficiency, innovation and strategic coherence of the actions of the firms (Esser et al., 1996).

The market cannot price many productive resources, which need the active role of the government in their creation and exploitation. Thus, the solution to systemic problems still relies upon non-interventionist government actions taken together with other firms and industry supporting institutions. This work proposes the contribution of firms to the competitiveness of their socioeconomic systems may occur through the development of a kind of competence that does not create products to the market; it rather creates organisational capabilities and quasi-public goods to satisfy needs defined in other social structures, in the search for solutions to systemic problems.

In this perspective, the environmental surroundings can shape the behaviour of the firm by establishing needs whose satisfaction may overcome some systemic problems constraining its performance. The organisational surroundings may offer idiosyncratic resources to enable the agency of the firm on social structures of its environmental surroundings. Competitiveness follows the efficient use of idiosyncratic resources for market competition. Nevertheless, it also requires the effective exploitation of these productive resources to satisfy criteria established by other social structures, creating contextual conditions for the sustainability of a socioeconomic system.

The firm has to be the protagonist of some collective actions with the support of other actors in its socioeconomic system to solve the systemic problems. The entrepreneur fosters some relationships with partners in the organisational surroundings creating capabilities and economic goods to meet both market and systemic needs. The firm is in the interface between the market and its socioeconomic system such as a privileged actor integrating information and knowledge from other social structures comprising its organisational and environmental surroundings. This behaviour contributes to the search for solutions to systemic problems.

The present work extends the Systemic model (Esser et al., 1996) by distinguishing core competence and systemic competence. In both, description of the competence development process using evidence gathered from the empirical setting of the firm is still the same: a complex pattern of relations of interdependence and socio-technical interactions between a set of firms and industry supporting institutions delimiting a kind of socioeconomic system. Instead, the purpose of the firm engaged in such an evolutionary path that is different.

The development of competence is supposed to be separate and causative of the growth of the firm; nevertheless, it is at a level of reality that is inaccessible to the perception of the researcher, constrained to the empirical evidence of events occurred during the process. Competence may be a factor of competitiveness, but it is still not directly observable in the empirical settings during research. Consequently, projects, capabilities, products, market position, and economic performance of the firm are still real-world manifestations of the events generated by hidden mechanisms underlying the competence development process at the firm (Lawson, 1999).

The firm developing competence for the sustainability of its socioeconomic system still seeks the maximisation of its economic performance; however, the firm satisfies criteria defined by

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institutions and coordination structures between diverse actors at the micro and mesoeconomic levels instead. In this analytical framework, the search for evidence of competence development relies upon an evolutionary path of chains of decision-making events taking place at the firm. The paradigmatic type of critical event is the generation of capabilities and economic goods by the firm to satisfy needs defined by systemic dimensions of its environmental surroundings. The sources of systemic competence development are micro and meso level institutions that share resources with firms comprising the socioeconomic system (Camisón, 2004). Both transferrable and non-transferrable idiosyncratic resources offered through relationships between firms and their partners in its organisational surroundings still occur in the process of systemic competence development.

The firm's projects are evidence of the social process for generating capabilities and economic goods to solve competitive problems, that is, the competence development process (Jessop, 2001). Projects are the units of analysis in this research approach. For systemic problems, the firm's projects encompass some partners in its organisational surroundings. In this case, collective actions must instead be units of analysis because they contain the empirical evidence supporting a set of theoretical propositions about the systemic competence development process.

The firm continuously fosters changes in its configuration of resources in the search for solutions to systemic problems relying on shared competence. This development occurs with the support of meso level institutions providing idiosyncratic resources to firms in the same socioeconomic systems. Both the micro and mesoeconomic levels exert pressure on the structural homogeneity of any shared competence (Camisón, 2004). Systemic competence is a kind of shared competence among firms embedded in the same socioeconomic system. It is still necessary to explain the behaviour of the firm investing in distinctive systemic competence development in light of the contextual conditions that make this a rational behaviour.

The assumption that the firm is a rational economic agent suggests there is no need for additional investments in the development of a distinctive competence when there are no conditions promoting the generation of new sources of economic rents and the creation of competitive advantages for the firm. Investing in the development of any distinctive systemic competence can be economically feasible due to at least three hypothesised contextual conditions. The first condition is the high economic impact of the systemic problem in the firm's performance by constraining both economic and social outcomes (Esser et al., 1996). Another condition is the high rivalry in both the current and potential markets limiting opportunities relying exclusively upon the core competence of the firm (Makadok, 2001, 2006). The last contextual condition is the appropriation of a part of the benefits generated by the firm for the socioeconomic system in which it operates in the form of new sources of rent (Peteraf, 1993). The theory suggests beginning with the search for flows of knowledge and information to the firm, which precedes other event of combination of non-transferable, idiosyncratic resources from its partners, and then, identifying the generation of an economic good of systemic nature. All these social processes underlying the competence development at the firm and the contextual conditions present in its environmental and organisational surroundings may enable the contribution of the firm to systemic competitiveness.

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3 The Goal and Reasons for a Multiple Case Study

This paper proposes answering the research question using the domain of Brazilian credit unions, which is organised in a kind of hierarchical network with three levels: the unions, central cooperatives, and confederations. Inter-organisational relationships between credit unions and other industry supporting institutions, including the state regulator, which is the Central Bank of Brazil, delimit their socioeconomic system.

Since the unions' competitiveness is multidimensional and systemic (Chandrasekhar, 2007; Kawai, Mayes, & Morgans, 2012), the selection of cases to investigate must maximise the chance of finding the hypothesised pattern of empirical evidence out of a sequence of events related to capabilities and economic goods generated by the firm to satisfy the needs defined by a social structure in its environmental surroundings. In other words, this firm must demonstrate a high level of contribution to at least one of the systemic environmental dimensions that are relevant to its own performance. In this situation, this case is distinctive regarding the average rational behaviour.

Credit unions operate as small-scale banking institutions in market niches, but they do not seek profits. A remarkable feature of this sector of the Brazilian banking industry is the networking organization of credit unions around central cooperatives[1]. Different from banks, whose operations are capital-intensive, credit unions are relationship-intensive regarding their members and industry supporting institutions. In this sector, competitive advantage relies upon banking product customization to the needs of the local market. The credit unions deliver suitable services in a distinctive pattern when compared to banks. Both the standard products supplied by the cooperative bank and the resources shared by partners in the organisational surroundings become merged in the search for customization (e.g., financing lines for the acquisition of technologies, readily available service stations, and unconventional credit guarantees). Of course, there are competitive problems that their core competence can still solve, such as the information asymmetries between the credit unions and their consumers that constrain the perceived value of their products and services, and the prohibitive costs of some market transactions. However, there are also problems of systemic nature.

Some products based upon the relationship between the firm and its consumers target market failures and structural weaknesses in the socioeconomic system, but they are not systemic goods offered to an environmental dimension supplementing the market. Both resemble each other because of the mechanisms that generate them – finding out solutions to problems that constrain firm's performance. The products satisfy market needs, but not the systemic needs defined by other social structures. Some solutions rely upon competence that is not market-oriented but system-oriented.

This research considers that credit unions are firms operating in competitive markets such that they carry out rational actions to raise their sustainable economic growth. The generative mechanisms underlying the competence development process should be the same in the situation

[1] In Brazil, there is a third-level institution called *Confederation*, which creates a kind of nationwide network, a *credit cooperative system*. There are four Confederations and their respective credit cooperative systems in this country.

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of systemic competence development. On the one hand, an ordinary core competence influences the attributes of products and services created to the market. On the other hand, the systemic competence influences the attributes of quasi-public economic goods created for the benefit of the socioeconomic system as a whole.

There are two social structures promoting the competitiveness of the sector of credit unions in Brazil: (1) the local community and (2) the regulatory environment. A pair of firms with evidence of excellence in systemic competence development for each of the above environmental dimensions are respectively: (1) *Cooperativa de Crédito de São Roque de Minas (Saromcredi)* and (2) *Cooperativa de Crédito dos Funcionários de Instituições Financeiras Públicas Federais (Cooperforte)*.

4 Operationalizing Process Tracing using a Grammar Model

In a qualitative research strategy based on case studies, the Process Tracing technique systematically describes a chain of events recognized in the text narrative; however, it is such a strictly descriptive research approach. Moreover, it is viable to identify some recurrent patterns between events in the course of a social process in the ontological level (i.e., regularities that are independent of the domain of study) using an analytical approach.

The achievement of this need is possible using a data analysis procedure comprising three inferential approaches: a deductive method using Qualitative Content Analysis (Krippendorff, 2013); an inductive method using Qualitative Comparative Analysis (Ragin, 1987) implementing the Quine-McCluskey algorithm for simplifying binary functions based on combinatory logic (Quine, 1952); and a retroductive method using Sequence Analysis (Abbott, 1990, 1995). Moreover, the retroductive method (Braga, 2017, 2018) relies upon a discrete mathematical model of the mechanisms involved in the generation of sequences of events which is deduced from Generative Grammar Theory (Chomsky, 1956, 1959). The mathematical grounds of this kind of modelling technique includes: Category Theory (Eilenberg & MacLane, 1945; MacLane, 1948); Disjunctive Prime Form of logical functions (Blake, 1937; Quine, 1952); and Formal Language Theory (Post, 1936; Turing, 1939), which is an extension of Set Theory that acknowledges the complex mappings that are in use in Generative Linguistics.

In the next sections, the specification of these three analytical methods relying upon that discrete mathematical model provides reliability to this multiple case study.

4.1 Deductive Qualitative Content Analysis for the Classification of Events

This section introduces the terminal symbols that are in use for the task of classifying the instances of types of action events. The categorical structure (S), the *Competence Development* (CD) process, consists of the underlying sub-processes of *Generation of Capabilities and Economic Goods* (GG) and *Relationships with Partners* (RR). The first process (GG) consists of an outcome of the type of event for the generation of an economic good (G) preceded by an instance of the inter-organisational relationships sub-process (RR). The latter is any sequence of partnerships

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occurring in projects of the firm (R): either for the combination of idiosyncratic, non-transferable resources ({c}) or information and knowledge exchange ({i}), which are alternative outcomes for events of inter-organisational relationships.

The theoretical concepts used in this paper constitute a hierarchical structure, which should be represented as shared prefix referring to the existing super-classes such that each pair of these concepts is set apart by the character '\' (Table 1).

Table 1. The relationship between mechanisms, attributes, and contextual conditions.

Types of Events	**Attributes and Contextual Conditions**
Generation of Capabilities and Economic Goods: #Event\GenerationOfEconomicGood **(G → {g})**	#**Attribute\NeedToSatisfy** ({a_1}) #**Attribute\DistinctiveContribution** ({a_2}) #Context\External\Problem ({k_1}) #Context\External\Appropriability ({k_2}) #Context\External\Rivalry ({k_3})
Combination of Non-transferable, Shared Resources: #Event\CombinationOfResources **(R → {c})**	#**Attribute\Idiosyncrasy** ({a_3}) #**Attribute\Specificity** ({a_4}) #**Attribute\StrategicComplementarity** ({a_5}) #**Attribute\Organisational Complementarity** ({a_6}) #**Attribute\CoordinationMechanism** ({a_7}) #Context\Internal\SpecificRelationship ({k_4}) #Context\Internal\IndosyncraticResourceStock ({k_5})
Interchange of Information and Knowledge: #Event\InterchangeOfKnowledge **(R → {i})**	#**Attribute\CommonKnowledgeBase** ({a_8}) #**Attribute\ExchangeRoutines** ({a_9}) #**Attribute\ExpertsAvailable** ({a_{10}}) #**Attribute\FlowOfProfessionals** ({a_{11}}) #**Attribute\FormalIncentives** ({a_{12}}) #**Attribute\InformalReciprocity** ({a_{13}}) #**Attribute\Sanctions** ({a_{14}}) #Context\Internal\SpecificRelationship ({k_4}) #Context\Internal\IdiosyncraticResourceStock ({k_5})

After a qualitative survey, the procedure for classification of empirical evidence using a technique of Content Analysis (Krippendorff, 2013) highlights all instances of the types of events in the units of analysis and their theoretical relationships.

In the structured text narrative, the segments of text, known as *registration units*, have their latent meaning defined by some codes assigned because of the interpretation by the researcher. Coding is the procedure by which empirical data becomes organised into units of meaning. This approach allows a systematic, accurate description of the relevant characteristics of each evidence of a construct in the units of analysis. In the case studies, the unit of analysis is a project of the firm carried out together with some of its partners in the organisational surroundings. All registration units must have at least one code assigned for attributes of the corresponding type of event.

Answering the research question consists of the differentiation of a subset of instances for the event of *Generation of Capabilities and Economic Goods* (G) that would have a systemic nature

({g'}). Nonetheless, a new event outcome introduces ambiguity into the grammar because there are instances acknowledged using either {g} or {g'} as a terminal symbol. A possible solution is to hypothesize a set of contextual conditions ({k_1, k_2, k_3, k_4, k_5}) that could explain this surprising fact before testing all possible combinations of them against data.

4.2 Inductive Configuration Analysis using the Quine-McCluskey Algorithm

Each type of critical event in a generative process represents a deterministic action or interaction in which contextual conditions allow its occurrence. Usually, deterministic nature does not characterise social phenomena, but a kind of category of decision-making events generated by rational agents represented in a linear rule-based fashion regarded as a deterministic set-theoretic relation is such a realistic assumption.

In decision-making events, agents choose one of the alternative outcomes for a type of event, but they are contingent on the contextual conditions in the empirical settings as causal parameters – evidence of the deterministic nature of that occurrence. Thus, this data analysis procedure consists of determining all configurations of contextual conditions that are causal for the outcome of interest relying on all instances of this type of decision-making event in the same empirical setting.

The research model uses three types of critical events. Two or more event outcomes associated with each type of event generated by such a set of alternative transition rules and their hypothesised contextual conditions come from a theoretically informed "guess" about what enables the occurrence of each event outcome (Table 2).

Table 2. The contextual conditions for the outcomes of interest in each of the analysed events.

Types of Events	Event Outcomes	Index Symbols for Contextual Conditions
Generation of Capabilities and Economic Goods for the Socioeconomic System	[1] systemic [0] not systemic	k_1 (in {g}) impact of the systemic problems k_2 (in {g}) restricted market opportunities k_3 (in {g}) appropriability of economic rents
Combination of Idiosyncratic, Non-transferable, Shared Resources ({c})	[1] idiosyncratic [0] not idiosyncratic	k_4 (in {c}) specificity of some firm's relationships k_5 (in {c}) idiosyncrasy of the firm's stock of resources
Exchange of Information and Knowledge ({i})	[1] idiosyncratic [0] not idiosyncratic	k_4 (in {i}) specificity of some firm's relationships k_5 (in {c}) idiosyncrasy of the firm's stock of resources

There is a set of algorithms for Qualitative Comparative Analysis (QCA) supporting the configurational studies using empirical evidence of discrete, linear relationships (Ragin, 1987). In this empirical study, the qualitative nature of evidence requires a procedure using configurational analysis based on categorical variables. These event outcomes took part in the development of a social phenomenon having a process-like nature. Hence, the assessment of configurations of

contextual conditions supporting the occurrence of a set of instances of the outcome of interest applies to the empirical setting under investigation.

After the classification of evidence for a set of instances of the theoretical constructs defined for each type of event, the researcher must organize the bulk of structured empirical evidence in a relational database. The classification of outcomes of a type of event relies on the observed attributes ($\{a_i\}$) of the corresponding construct.

In brief, conjunctions of contextual conditions empirically observed and calculated by configurational analysis discriminate *index symbols*. Such symbols make alternative production rules departing from a specific system state with two or more alternative event outcomes to become context-sensitive. For all combinations of the contextual conditions related to each alternative outcome of a type of event, there must be a context-sensitive production rule in the corresponding system state. Each of these conjunctions is sufficient for the event outcome to take place, even though it may not be necessary for any of them. If a contextual condition occurs in all conjunctions, it is necessary for the outcome; or else if it occurs solely, that is, in the absence of all other hypothesised conditions, then it is sufficient. It is all about the Stuart Mill's method of difference (Thiem, 2014).

4.3 Retroductive Sequence Analysis using the Generative Grammar Theory

The concept of Generative Grammar represents such a set of rules for the generation of a category of chains of discrete symbols, also called *strings* or *sentences*, which is a formal language. Therefore, a formal grammar (G) explains how an infinite set of sentences of a formal language (L), each of them consisting of symbols from a finite set called *alphabet* ($\sum$), are generated by a finite set of rules (P) that constitutes the grammar itself. Given the grammar G = (N, Σ, P, S) and its respective generative binary relation $\Rightarrow_G$ in $(\Sigma \cup N)^*$, a formal language L(G) is the set $\{w \in \Sigma^* \mid S \Rightarrow_{G^*} w\}$ of string-like sentences derived from a sequence of activations of some production rules in P ϵ $(\Sigma \cup N)^*$ starting at the non-terminal symbol S, which is the ordered set of derivations $\{w \in (\Sigma \cup N)^* \mid S \Rightarrow_{G^*} w\}$.

Each production rule (P) represents a relationship between pairs of strings consisting of some elements of the alphabet set ($\sum$), called *terminal* symbols, and of the set of states (N), called *nonterminal* symbols. Between the grammar rules, at least one must have the non-terminal symbol S $\in$ N on the left side.

The paradigm of Generative Linguistics (Chomsky, 1956, 1959) which encouraged the design this systematic, retroductive sequence analysis procedure is still suitable to describe the empirical patterns in process-like phenomena. The proposed qualitative methodology assumes that decision-making events rely upon deterministic rules using combinational logic. It also assumes that complex, dynamic and contingent processes rely on some mechanisms in the form of a set of deterministic rules acknowledging a domain of sequences of event outcomes.

Consider configuration analysis embedded into within-case sequence analysis tests for conjunctions of contextual conditions associated with a surprising event outcome. They comprise a set of instances of this type of event. In addition, the researcher runs configurational analysis for

each system state with a set of alternative transition rules triggered by contextual conditions in instances of the category of social process under analysis.

Whenever an agent performs a decision-making event, the hypothesis of deterministic causal relation means that a configuration of contextual conditions takes place in the empirical setting before any action. It is the case of all instances of this event resulted from the same deterministic function embedded in the decision-maker. Configuration analysis relying on a technique such as QCA is applicable for the inductive inference of a logic formula. The deterministic relationship of causal nature between decision-making events becomes the critical assumption. Consider generative mechanisms that are inherent to the social structures conditioning the behaviour of the agent in such a concrete situation within a particular range of space and time. In conjunction with some specific configurations of contextual conditions enabling the activation of these mechanisms, if they explain the generation of all instances of that type of event, then such a deterministic relationship exists.

After configuration analysis, each configuration of contextual conditions in a specific system state suggests a new production rule in the generative grammar model for the social process under enquiry. If the mutual exclusion of all possible event outcomes is a valid assumption, then there is no intersection between the sets of configurations of contextual conditions for each one of them. Contrarily, ambiguity is inherent to such a system state, and further exploratory research is still necessary to discover previously unknown contextual conditions. Replacing a set of alternative state transition rules by equivalent context-sensitive rules eliminates ambiguity. In the case of G → {g} and its alternative production rule G → {g'}, at least the last one must turn out to be a context-sensitive rule, or G → K[g'],{g} in the form of Indexed Grammars (Aho, 1968, 1969). Otherwise, the researcher should endorse a stochastic process model to grasp ambiguity in this set of alternative transition rules.

The configuration analysis of the raw data collected in the empirical setting suggests some modifications to theoretical propositions translated into the initial grammar, which arises in the first sequence analysis. The sequence of events highlighted in the structured text narrative is the only evidence of the generative mechanisms proposed by the grammar model translated from the theory. The rules of the grammar reflect the set of theoretical propositions, adjusted to the design principles of the generative grammars (Figure 1).

The Qualitative Sequence Analysis research approach does not consider the attributes that manifest the occurrence of an event because Qualitative Content Analysis already does it. In the Process Tracing technique, there is no benefit to analyse this kind of classificatory attribute. The terminal symbols standing in production rules of a formal grammar describe the outcomes of events only, not their discriminative attributes. The example of a categorical-generative structure is graphically representable as in Figure 1.

The initial grammar (S) of the competence development process (CD) has a recursive rule CD → GG, CD denoting the pattern that there are two or more contributions of the firm to the search for a solution to a particular competitive problem. This rule pushes CD into the stack representing the working memory of the agent (using the *Last In First Out* stack of the Pushdown automaton), which are the types of events expected to take place in the future. Nevertheless, this context-free grammar does not acknowledge a context-free language yet, but a regular language. Even though


```
S  → GG, CD
CD → GG, CD
   | GG
GG → RR, G
RR → R, RR
   | R
R  → {c} | {i}
G  → {g}
```

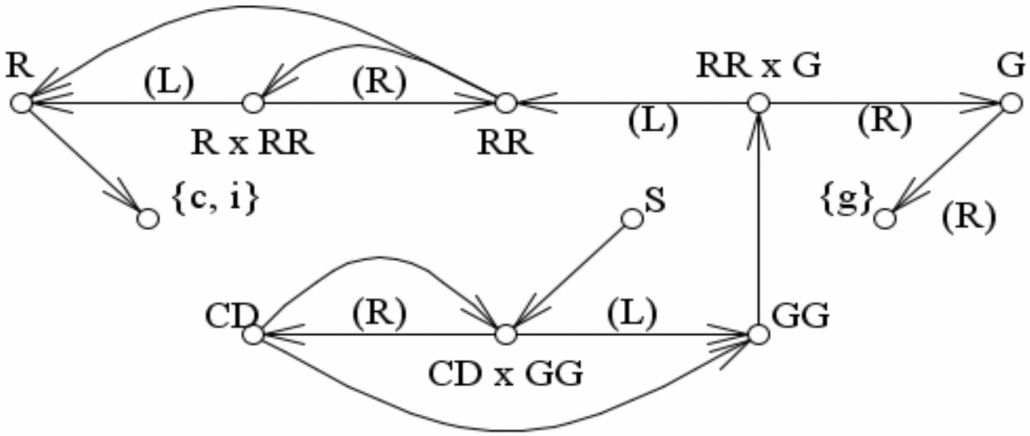

Fig. 1. The initial categorical-generative structure of the competence development process.

the competence-based view of the firm predicts there is such a recursive relation between projects required to generate an economic good, the formal grammar above does not acknowledge it. This would increase the computational complexity of the grammar with a recursive rule pushing intermediary goods on the stack; including at least one systemic good needed to generate an economic good at the end of this instance of the social process. The goal of this research is the acknowledgement of configurations of contextual conditions enabling the generation of a systemic economic good ({g'}). Consequently, competence development (CD) turns out to be a contingent process. Since it is possible to accept this feature as a strictly context-sensitive production rule of such a contingent mechanism, the extended category of social process, without acknowledging any recursive rule, still belongs to the class of regular languages.

Because of the cumulativeness and equifinality features of these processes (Abbott, 1990, 1995), it is not trivial to predict the precise moment of the transition between two states of the generative grammar model based on the known types of events and mechanisms. In contrast, the goal of the process tracing procedure grounded on the logic of retroduction is to improve the predictability of state transitions, eliminating ambiguities and reducing non-determinism in the grammar by replacing the sets of alternative state-transition rules by equivalent context-sensitive rules. The abduction of a new hypothesis about contextual conditions of activated mechanisms raises the level of the computational complexity of the grammar, which is the main goal of this retroductive, within-case sequence analysis procedure (Easton, 2010; George & Bennett,2004); although it will

never become an exhaustive search nor it will ever create a definitive model because that system is open.

5 Results of the Within-case Analysis

This section presents the results of each within-case analysis, that is, the systemic competence development processes discovered in each credit union as sequences of capabilities and economic goods generated by the firm in the search for solutions to a systemic problem. The types of social processes underlying the competence development in the firm – the combination of specific assets and capabilities and the exchange of information and knowledge with partners in the organisational surroundings – are in this description too.

5.1 The Community Dimension Case Study: Saromcredi

São Roque de Minas is a Brazilian municipality located in the Canastra Mountains, in the mid-west of the state of Minas Gerais (MG), with 2,108 km^2 and a population that has remained steady for at least twenty years at about seven thousand inhabitants. It is the headquarters of *Cooperativa de Crédito de Livre Admissão de São Roque de Minas Ltda.*, also known by the acronym *Saromcredi* since its foundation in 1991. In the area of the Canastra Mountains, the most relevant economic activity is agriculture, followed by local services, which is concentrated in the three municipalities having the suitable conditions for scale and diversification of such activity – Cássia, Passos, and Piumhi.

Saromcredi's competitive strategy relies on three core products (Prahalad & Hamel, 1990). First, the infrastructure for accessing the products and services provided by the credit union. Second, sustainable fundraising for the firm's lending operations. The third core product is a set of channels for dedicated credit lines to grab new customers based upon their economic profile. All products have shown value attributes to retain customers relying on at least one of these core products.

However, Saromcredi has no distinctive core competence for banking and financial businesses. The portfolio of products and services and the infrastructure for accessing them, the sources of funding and fundraising capabilities, and the dedicated credit lines do not differ from the other credit unions of Sicoob. Most of these credit unions offer the same service found in any other commercial bank. The local implementation of these shared core products has shown no customized features differentiating Saromcredi from its potential rivals and other credit unions of the Sicoob system.

Between the projects offered to the community environment in which Saromcredi takes part, those contributing to the solution of a systemic problem make evident an ongoing process of systemic competence development in this credit union (Table 3 and Table 4). This competence development is distinctive when the systemic problem harms the firm's performance in such a way that the benefits exceed the costs of the firm taking part in collective efforts to generate a quasi-public economic good.

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Table 3. The core products and systemic competence development processes of Saromcredi.

Core Products (B) versus Systemic Competence Development Processes (C)	**B1. Infrastructure for accessing the products and services**	**B2. Sustainable fundraising for lending operations**	**B3. Channels for dedicated credit lines to reach their target audience**
C1. **To solve structural weaknesses in the local economy with funding from the credit union.**	1 project	9 projects	11 projects
C2. **To mobilize members of the credit union and other people and entities in the local community around educational initiatives.**	2 projects		

Among 35 projects in which Saromcredi has taken part, at least 23 of them have contributed to the solution of a systemic problem in the community environment. These projects are organised in programs, which comprise competence development in the credit union. The first program searches for solutions to structural weaknesses in each of the four local economic sectors (i.e., agriculture, cattle and cheese, local commerce and tourism) with funding from Saromcredi. The second mobilises people in the boroughs of the Canastra Mountains to attend financial education initiatives hosted in some public events promoted with partners in the region.

The programs suggest that there are two systemic competence development processes in Saromcredi. The first one aims the creation of new business opportunities in the local economy by solving structural weaknesses in each of the four main productive sectors, which creates demand for loans that may benefit the credit union. These projects address structural weaknesses or exploit business opportunities that result from the competitive problems solved. The second

Table 4. The descriptive statistics of the projects, members, and resources of Saromcredi.

Types of Events	**Projects**	**Members**	**Resources**	**Exchange**
C1. To solve structural weaknesses in the local economy with funding from the credit union.	**31**	**41**	**82**	**28**
P2. Problems in the agriculture value chain.	9	9	24	4
P3. Problems in the cattle and cheese value chain.	8	13	23	9
P4. Problems in the tourism sector.	6	7	15	5
P5. Problems in small business and infrastructure sectors.	8	12	20	10
C2. To mobilize members of the credit union and other people and entities in the local community around educational initiatives.	**4**	**6**	**8**	**2**

process concerns the mobilisation of people that are or can turn into members of the credit union to expand the customer base for its products and services.

5.2 The Regulatory Dimension Case Study: Cooperforte

Cooperativa de Economia e Crédito Mútuo dos Funcionários de Instituições Financeiras Públicas Federais Ltda (*Cooperforte*) is the only credit union for the employees of all Brazilian federal government banks (i.e., BB, Caixa, BNB, BASA, BNDES) and public servants of the Central Bank of Brazil. It operates through a nationwide, virtual presence supported by a technological infrastructure for call center and internet banking services. There are only five service stations: the headquarters in Brasília (DF), Belo Horizonte (MG), São Paulo (SP), Rio de Janeiro (RJ) and Porto Alegre (RS).

Cooperforte is among the leaders of the credit cooperative market segment in most of the indices of performance. At the time of this empirical research (2014), Cooperforte was the eighth largest credit union in Latin America and the third of Sicoob, the cooperative system in which it takes part.

While Cooperforte's operations rely upon a nationwide virtual presence, most of the other credit unions of Sicoob operate by a local physical presence, including the two leaders of the cooperative system at the time (Credicitrus and Cocred). The Sicoob's leaders have 50 and 25 service stations compared to the five of Cooperforte, whose operational infrastructure (e.g., the operating system, the internet & phone banking platform, the internal control, and the risk management) is fully separated of Sicoob. At the time of the data collection, Cooperforte had the smallest administrative cost per member, R$ 382.00 (about 112,000 members), against R$ 1,825.00 for Credicitrus (about 50,000 members) and R$ 2,237.00 for Cocred (about 18,700 members). The virtualization of the operations of Cooperforte enabled operational and administrative cost savings per member.

Cooperforte's business model is idiosyncratic when compared with the other two leaders of Sicoob. The banks of the federal government provide most products and services free of charge to employees (e.g., checking account, credit card) or at lower costs compared to other commercial banks in the market (e.g., insurance, pension plans). However, Cooperforte maintains its business model sustainable by delivering a very small portfolio of loan and saving products and no banking products other than checking account and debit card. Cooperforte's products and services, as well as its operational infrastructure, exist fully separated from Sicoob.

Cooperforte's competitive strategy seems to reveal two core products: (a) the internet-banking infrastructure supporting the remote access to all products and services provided by the credit union and (b) an operational and administrative infrastructure apart of Sicoob. All value attributes of Cooperforte's products and services rely on at least one core product. Cooperforte has no distinctive core competence compared to the other credit unions and rivals. It also has less diversification in both the banking infrastructure and the portfolio of products and services when compared to other institutions in the financial industry. This fact suggests the cost leadership competitive strategy is in use by this credit union. These empirical results are in line with this

Table 5. The core products and systemic competence development processes of Cooperforte.

Core Products (B) versus Systemic Competence Development Processes (C)	B1. Infrastructure for remote access to the products and services of the credit union	B2. Operational and administrative infrastructure with efficiency and independence
C1. To develop governance, internal control, and risk management mechanisms.		6 projects
C2. To mobilize members of the credit union and other people and entities in the local community around the idea of cooperativism.	2 projects	

hypothesis such that any distinctive competence will necessarily support this kind of competitive strategy.

Cooperforte is such a critical case study because of its competencies for governance, internal control, and risk management. All of them still manage compliance with regulatory requirements and promote the business sustainability based on these capabilities. Other organisations in the Brazilian credit cooperative systems (e.g., confederation, central cooperatives, and cooperative bank) and the state regulator (i.e., Central Bank of Brazil) also foster shared competence in the credit unions contributing to systemic competitiveness. Nevertheless, Cooperforte's evolution still seems to be distinctive. In line with the theoretical propositions of this work, distinctive systemic competence development takes place if and only if the credit union can appropriate part of the benefits generated for the socioeconomic system in the form of private economic rents.

Some projects of the credit union, which contribute in the search of solutions to the systemic problems that exist in the regulatory environment, highlights the systemic competence development process. Between 18 projects identified in Cooperforte, at least eight of them have contributed to the search for solutions to systemic problems (Table 5).

Table 6. The descriptive statistics of the projects, members, and resources of Cooperforte.

Systemic Competence Development Processes	Projects	Members	Resources	Exchange
C1. To develop governance, internal control, and risk management mechanisms.	6	3	12	5
C2. To mobilize members of the credit union and other people and entities in the local community around the idea of cooperativism.	2	3	3	zero

Cooperforte's strategic objectives were the expansion of the number of members of the credit union and the achievement of operational and administrative independence from Sicoob, but guaranteeing economic efficiency. Still, it is a case of distinctive competence development for the regulatory environment compared with the rivals in the local market (Table 6).

6 Results of Cross-case Analysis

The cross-case analysis is the ultimate step of a multiple case study. The main goal is the refinement of the theoretical model by suggesting new constructs, attributes and relationships. It encompasses the analysis of all divergences between the theoretical propositions and the empirical patterns found in each pair of subsequent within-case studies (Easton, 2010; George & Bennett, 2004). Each divergence is resolved by accepting it as a modification of the theoretical model, but only after identifying all configurations of contextual conditions discriminating all the instances in the set of mutually exclusive event outcomes. The present work implements a Process Tracing technique relying upon a formal model deduced from Generative Grammar Theory. Each theoretical concept must translate into a type of sub-process and each theoretical relation into a kind of generative mechanism working on specific types of sub-processes or types of events. All sub-processes embedded in the category of social processes are under investigation.

Consider the surprising fact introduced as an alternative outcome ({g'}) for the type of event of the generation of capabilities and economic goods in the firm (G). The systemic competence development process (CD') is any chain of capabilities and economic goods generated to satisfy a social structure's need in the environmental surroundings. Systemic competence is a kind of distinctive competence preceded by some firm's partnerships that are unavailable to the competitors and other similar organisations (RR'). This type of sub-process occurs after one or more instances of a surprising fact for the combination of idiosyncratic and non-transferable resources ({c'}) and the exchange of information and knowledge ({i'}). The modified grammar must acknowledge them (Figure 2).

Each surprising fact suggests the modification of the initial grammar that expands the set of event outcomes; nevertheless, the new outcome introduces ambiguity, whose elimination using rules of the indexed grammar class also increases computational complexity to the level of mildly context-sensitive grammars. Thus, the competence development process (CD) expects at least another economic good (g) in the future after the first one takes place, but some systemic goods (g') may also take place in the meantime.

Based on the feature of recursion, the parser can trace the composition of economic goods to acknowledge any sequence of events of a concrete category of competence development, although at the cost of increasing complexity. Some conditions in the organisational and environmental surroundings of the firm tracked for all instances of the types of events become configurations related to one of the mutually exclusive event outcomes. Therefore, there is at least one rule like A[K..] → K[..], B[..]. This means that the index symbol K pushed upon the index stack for the hypothesised configurations of contextual conditions relates to the event outcome B. Pay attention that the index stack is expected empty (i.e., []) if there is no evidence of systemic

```
-- read the first r'(1) or else read an ordinary GG again
S -> CD[]
CD[] -> GG[^φr'(1)], CD[^φr'(1)] | GG[^μr'(1)], CD[^μr'(1)] | GG[], CD[]
-- read a g' and its r'(i) which is already in the context for CD
CD[^φr'..] -> CD[^r'..]
CD[^r'(i)..] -> GG[^φr'(i)..], CD[^φr'(i)..]
-- read a NEW r'(i) and its g' then add it to the context for CD
CD[^φr'..] -> CD[^r'..]
CD[^r'(i)..] -> GG[^φr'(i+1)r'(i)..], CD[^φr'(i+1)r'(i)..]
-- read a r'(i) which is already in the context for CD but no g'
CD[^γr'..] -> CD[^r'..]
CD[^r'(i)..] -> GG[^γr'(i)..], CD[^γr'(i)..]
-- read a NEW r'(i) but no g' then add it to the context for CD
CD[^μr'..] -> CD[^r'..]
CD[^r'(i)..] -> GG[^μr'(i+1)r'(i)..], CD[^μr'(i+1)r'(i)..]
-- or else read an ordinary GG again
CD[χ..] -> CD[..]
CD[..] -> GG[χ..], CD[χ..] | GG[χ..]
GG[^..] -> RR[^..], G[^..]  -- read only RR' but no G' OR both them
GG[] -> RR[], G[]  -- read an ordinary GG
RR[] -> R[], RR[] | R[]
RR[χ..] -> RR[]    -- a r'(i) was found! Success!
RR[^δ..] -> RR[^..]  -- continue searching for a r'(i)
RR[^φr'(i)..] -> RR[^μr'(i)..]
RR[^μr'(i)..] -> R[^χr'(i)..], RR[^χr'(i)..] | R[^χr'(i)..]
RR[^μ..] -> R[^δμ..], RR[^δμ..] -- no r'(i) found yet but read R
RR[..^r'(i)..] -> R[χ..^r'(i)..], RR[χ..^r'(i)..] | R[χ..^r'(i)..]
RR[..^r'(i)..] -> RR[..r'(i)^..] -- continue searching for a r'(i)
RR[..^] -> R[^δ..], RR[^δ..] -- no r'(i) found yet but read a R
R[χ..] -> R[..]
R[^δ..] -> R[]          -- read an ordinary R
R[..^r'(i)..] -> K[..^r'(i)..], {c'} | K[..^r'(i)..], {i'} -- read R'
R[] -> {c} | {i}
G[^γ..] -> G[^μ..] -> G[^χ..] -> G[] -- read an ordinary g
G[^..] -> K[^..], {g'}    -- read a systemic g'
G[] -> {g}
```

Fig. 2. An extension of the grammar S using the Indexed Grammar formalism (Aho, 1968).

competence development. In this case, the rule A[] → B[] does not mean the same as A[..] → B[..], which indicates the index stack is either empty or filled with symbols.

The resulting categorical graph is the same as in Figure 1, except that there are now self-referenced arrows on CD, GG, G and R to indicate the function of the test of hypothesis on configurations of contextual conditions in the empirical setting. This graph purposely omits index symbols for hypothesised configurations of contextual conditions (K) as part of the best explanation for the surprising facts; they do not belong to the set of types of events of the category of social process. They represent the internal structure between event outcomes instead of being part of the external structure between sub-processes and events – an issue of using Set Theory rather than Category Theory even though it also implies a natural transformation of the concrete category.

Consider the hypothesis that any distinctive competence development process is systemic in nature if and only if there are three contextual conditions in the firm's environmental surroundings: (a) high economic impact of the systemic problem; (b) appropriability of part of the benefits generated by the firm for the system in the form of private economic rents; and (c) high rivalry in the local market with no possibility of entering into other markets. Among these three hypothesised conditions to the occurrence of the development of systemic competence, only "*Rivalry*" (c) was not considered a necessary condition; it could not be verified empirically in all instances of the type of event for the generation of capabilities and economic goods in the benefit of the socioeconomic system in which the firm is positioned. There are two functionally equivalent production rules suggested, but one of them does not acknowledge this contextual condition (Figure 3).

K[g'..] → **{ k1 , k2 , k3 }**
| { k1 , k2 }

Fig. 3 The environmental surrounding's contextual condition of "*Rivalry*" is optional.

The event outcomes of the underlying process for the combination of idiosyncratic, non-transferable resources ({c}) and the exchange of information and knowledge ({i}) both take place alternately until the occurrence of a single event of generation of capabilities and economic goods ({g}). This is a recurring empirical pattern. Still, it is not possible to predict the occurrence of each event solely based upon the contextual conditions in the environmental and organisational surroundings of the firm because of the cumulativeness feature of a category of social processes; configurations of contextual conditions are necessary but eventually not sufficient for a type of event outcome to occur.

Either #Context\Internal\SpecificRelationship (k_4) or #Context\Internal\ResourceStock (k_5) is necessary for the occurrence of the corresponding type of event for the combination of idiosyncratic, non-transferable resources (Figure 4).

K[c'..] → **{ k4 , k5 } | { k5 }**
K[i'..] → **{ k4 }**

Fig. 4. The contextual conditions "*ResourceStock*"and "*SpecificRelationship*".

In contrast, the condition #Context\Internal\ResourceStock (k_5), or the idiosyncrasy of the firm's resource stock, is difficult to occur empirically in the instances of the event outcome for exchange of information and knowledge. Based on the researchers' theoretical and substantive knowledge, it is recommended that the modified grammar model should not have this contextual condition anymore.

The contextual condition {k_4} enables {c'} and {i'} to occur, although {k_5} enables only {c'} to occur. In an attempt to monitor the presence of contextual conditions for events of an inter-organisational relationship (R) and generation of capabilities and economic goods (G) in the firm revealed by Configuration Analysis, such an extended formal grammar is proposed using K[c'] and K[i']. The acknowledgment of this event outcome in the chain of terminal symbols takes place if and only if the verification of exogenous contextual conditions in the surroundings of the firm precedes it.

In conclusion, acknowledging the feature of recursion in the competence development process

increases the complexity of the formal grammar described, in which context-sensitiveness is not strict anymore. Recall it is only necessary to acknowledge the feature of contingency of the systemic competence development process. The parsing task always turns out to be more difficult if the computational complexity of the formal grammar increases. For example, the grammar does not monitor the minimum number of systemic goods generated because of the additional complexity required to answer the research question. In addition, a grammar acknowledging only the feature of contingency can parse more instances than a grammar acknowledging the features of recursion and contingency. Nevertheless, the goal of this research approach is to test more complex grammar models against data in order to explain the surprising fact. If the empirical data is not enough to be conclusive, then there is a need to collect more data.

Any sequence of projects is planned in advance to generate a kind of economic good, but it admits changes because of unanticipated events to such an extent that the competence development process becomes contingent on some past event outcomes; the historical context of an instance of the concrete category of social process under study. Nevertheless, the precedence between the economic good, which is the goal of the process of competence development, and other intermediary goods that are necessary to build up the first one, eventually including one or more systemic goods, takes place in the configuration of the pushdown automaton. All intermediary goods pushed above the economic good on the bottom of the stack are in the exact order that they take part in the assembling process.

In addition to the hypothesis of recursion in the category of competence development process, one that is not tested neither by the first modified grammar (Figure 5), nor by the second grammar (Figure 6), there is the precedence of at least one event outcome of information and knowledge exchange ({i'}) before zero or more combinations of shared idiosyncratic resources ({c'}). Again, a test of the hypothesis of a generative mechanism improves the realism of the process model, but at the cost of increasing the complexity of the formal grammar. Although the theory suggests this is another unobservable generative mechanism, the observed pattern of events using the empirical evidence from those credit unions is still not conclusive. Consequently, more data or even more case studies are still necessary to keep going on this line of research.

7 Conclusions

There are many existing social structures conditioning the firm's strategic behaviour to solve competitive problems that improve the market functioning. The economic theory acknowledges this kind of social phenomenon. In addition, this work proposes that the search for solutions to systemic problems can turn into a competitive strategy of the firm when contextual conditions make this behaviour rational. If a competitive problem is systemic in nature, then some social structure can establish needs that the firm seeks to satisfy in the search for solutions to it. However, it is possible if and only if there is a high economic impact of the problem on the profitability of the firm and it is possible the appropriation of part of the benefits generated for the socioeconomic system in the form of private rents.

There are some organisational capabilities and economic goods generated in the firm enabling problem-solving actions for the benefit of its socioeconomic system. These are actions not orien-

S -> CD[], GG[] — the goal of this competence development process
CD[] -> GG[^ϕr'(1)],CD[^ϕr'(1)] | GG[^μr'(1)],CD[^μr'(1)] | GG[], CD[]
-- read a NEW r'(i) and its g' then add it to the context for CD
CD[^ϕr'..] -> CD[^r'..]
CD[^r'(i)..] -> GG[^ϕr'(i+1)r'(i)..], CD[^ϕr'(i+1)r'(i)..]
-- read a r'(i) which is already in the context for CD but no g'
CD[^γ..] -> CD[^ϕ..], GG[^ϕ..] | CD[^φ..], GG[^φ..] | CD[^r'..]
CD[^r'(i)..] -> GG[^γr'(i)..], CD[^γr'(i)..]
-- read a NEW r'(i) but no g' then add it to the context for CD
CD[^μ..] -> CD[^ϕ..], GG[^ϕ..] | CD[^φ..], GG[^φ..] | CD[^r'..]
CD[^r'(i)..] -> GG[^μr'(i+1)r'(i)..], CD[^μr'(i+1)r'(i)..]
-- or else read an ordinary GG again
CD[χ..] -> CD[..]
CD[..] -> GG[χ..], CD[χ..] | ε
GG[^..] -> RR[^..], G[^..] -- read only RR' but no G' OR both them
GG[] -> RR[], G[] -- read an ordinary GG
RR[] -> R[], RR[] | R[]
RR[χ..] -> RR[] -- a r'(i) was found! Success!
RR[^δ..] -> RR[^..] -- continue searching for a r'(i)
RR[^ϕr'(i)..] -> RR[^μr'(i)..]
RR[^μr'(i)..] -> R[^χr'(i)..], RR[^χr'(i)..] | R[^χr'(i)..]
RR[^μ..] -> R[^$\delta\mu$..], RR[^$\delta\mu$..] -- no r'(i) found yet but read R
RR[..^r'(i)..] -> R[χ..^r'(i)..], RR[χ..^r'(i)..] | R[χ..^r'(i)..]
RR[..^r'(i)..] -> RR[..r'(i)^..] -- continue searching for a r'(i)
RR[..^] -> R[^δ..], RR[^δ..] -- no r'(i) found yet but read a R
R[χ..] -> R[..]
R[^δ..] -> R[] -- read an ordinary R
R[..^r'(i)..] -> K[..^r'(i)..], {c'} | K[..^r'(i)..], {i'} -- read R'
R[] -> {c} | {i}
G[^γ..] -> G[^μ..] -> G[^χ..] -> G[] -- read an ordinary g
G[^..] -> K[^..], {g'} -- read a systemic g'
G[] -> {g}

Fig. 5. An extended grammar S that is mildly context-sensitive with recursion.

ted to market needs, but to another kind of opportunity to create economic rents. Some projects of the firm do not relate to consumers' needs defined in the market but to socioeconomic system's needs defined in other social structures in charge of its governance. The market and all other social structures supplementing it are environmental dimensions creating opportunities and threats to the firm. Most strategic management studies focus on the market dimension, but this research found empirical evidence that other social structures create opportunities to generate private economic rents, which can be as relevant to the growth of the firm as those generated in the market. The problems in the socioeconomic system that are constraints on the performance of the firm are systemic in nature: mechanisms of market price and state intervention cannot solve them.

The present research concludes that the firm's competitive strategy can rely partially upon distinctive competence development to contribute to the search for solutions to systemic problems. Any systemic competence supporting the economic growth of the firm is in line with its competitive strategy. In this situation, economic growth may occur because of the strategic positioning of the firm not only in the market structure but also in a kind of systemic structure surrounding

it. When the commitment of the firm to systemic problem-solving by collective action means an opportunity to create economic rents, it may be the case of distinctive systemic competence development in the firm helping to create a sustainable competitive advantage.

If social structures of governance only impose constraints on the firm's behaviour that is profit-maximising in perfectly competitive markets, then distinctive contribution of the firm to systemic competitiveness is not economically possible. The generation of capabilities and economic goods to satisfy the needs defined in the social structures in charge of solving the competitive problems in the socioeconomic system would be a source of costs only. According to the rational behaviour assumption, only industry supporting institutions would implement projects to solve systemic problems in the socioeconomic system, but rarely firms. In this case, there would be no distinctive systemic competence development in the firm embedded in a socioeconomic system.

This kind of conceptual distinction between cooperation for competition in the market and co-operation for contribution to social structures of economic governance relies on the mode of exploitation of the resources created collectively. This kind of rationality seeks sustainable competitive advantages in markets by improving the socioeconomic system as well. Further research, particularly on the evolution of ecosystems over time, may improve the proposed analytical framework and methodology, but it may not be the case to apply it to non-local research questions because of the critical realist assumptions and the qualitative, set-theoretic nature of the mathematical model in use.

A research strategy of multiple cases study using the Process Tracing technique aimed to refine theory that relies upon a retroductive procedure of sequence analysis and a formal model deduced from Generative Grammar Theory is the main contribution of this work to qualitative methodology. The process tracing approach to enquiry targets to explain a kind of surprising or anomalous fact that is inconsistent with the widely acknowledged theory. This is the case of the chain of projects performed by the firm to satisfy systemic needs rather than those of consumers in the market.

However, a process tracing research approach tackled in a purely descriptive fashion does not comply with the quality criteria of most of the researches in the mainstream paradigms of economics and management. Our work deduces a discrete mathematical model from Formal Language Theory enabling a systematic, retroductive, sequence analysis procedure implementing the Process Tracing technique, which relies upon the assumptions of Critical Realism. There has never been a mathematical model guiding a data analysis procedure in line with this epistemological paradigm.

Category Theory is a kind of language for description and analysis of mathematical models that are either discrete or continuous in nature. Therefore, it applies for either qualitative or quantitative research since it is a tool to specify natural transformations and to check the functional equivalence between pairs of theoretical relations within a couple of empirical models in use. In this sense, the transformation of the concepts in the starting model of empirical data analysis into functionally equivalent concepts of another model preserves the internal structure of the existing relations between them. This is a valid assumption for instances of a structure-preserving map from empirical patterns in a collected data set into the given theoretical model. This research quality criterion of *model equivalence validity* is still uncommon in the social sciences literature.

In this sense, the proposed methodology is a kind of *semiosis* (Peirce, 1907) in the studying of chains of empirical events using a grammar model and the language of Category Theory too.

Therefore, this work raised the research question about the competitive advantage of the firm getting involved in collective efforts in the search of solutions for systemic problems relying on the assumption of contextual rationality in competitive markets. Unquestionably, there is a need for statistical models enabling quantitative research in this kind of research paradigm based on the assumption of the algorithmic complexity of social phenomena. However, the complex, dynamic and contingent nature of these processes also established another need for a category-theoretic modelling approach that preserves the functional equivalence between the models in use. This kind of qualitative assessment is often necessary in the same way that qualitative assessment occurs in dynamical systems analysis. The finite automata realising regular grammars are discrete-state and discrete-time dynamical systems. Thus, a quantitative, statistical model of either regular grammar or context-free grammar, which are respectively Hidden Markov Chain and Stochastic Context-Free Grammar, is an adequate research modelling approach after qualitative assessment of the kind discussed here.

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