Are High-Tech Companies More Competitive Than Others? An Empirical Study of Innovative and Exporting French SMEs

Manon Enjolras, Mauricio Camargo, and Christophe Schmitt

> *"Technology is changing so fast that knowledge about specifics can quickly become obsolete. That's why so much of what technicians learn is on the job."*
>
> Robert B. Reich
> Professor of Public Policy
> and former US Secretary of Labor

The main objective of this research work is to question the relationship between the technological intensity of SMEs (defined by the share of R&D expenditure in turnover, according to the OECD) and their growth potential (defined by their innovation and export capabilities). Through a multiple case study conducted with a panel of nine French SMEs, and through an analysis combining a qualitative approach (illustrative cases study) and a quantitative one (multidimensional statistical methods), several hypotheses were tested. Finally, this study points out that technological intensity, as defined by the OECD, is not directly correlated with the growth potential of SMEs. On the other hand, a company's technological intensity would have an impact on the way it manages its innovation and internationalization process, and thus the way it manages its internal practices.

Introduction

For several years, the global ranking of the most innovative companies has been clearly dominated by the largest multinationals in the high-tech sector (Google, Apple, etc.) (Ringel et al., 2018). These companies seem to have particular abilities to launch innovations on a regular basis. But what about small structures? It is commonly accepted that small and medium-sized enterprises (SMEs) face more difficulties than large enterprises in activities such as innovation or internationalization (Dhanaraj & Beamish, 2003; Okręglicka et al., 2015; Paul et al., 2017). However, startups and high-growth firms are seen as particularly fertile ground for innovation (Demir et al., 2017). They are agile and dynamic, and their flexibility allows them to be particularly competitive in their markets. Moreover, they are generally inherently international (e.g., born-global firms), which considerably fuels their growth potential (Cannone & Ughetto, 2014).

In view of this context, this article aims to question the technological intensity of a company as a determining factor of its potential growth. Is technological intensity a real facilitator for business competitiveness? Can traditional and low-tech companies compete with these intrinsically innovative and dynamic high-tech firms? Through an analysis of nine business cases in France, we will focus on the particular context of SMEs and study the impact of the technological intensity of these companies on their innovation and export capabilities.

Our analysis is therefore based on empirical experience. Nine innovative and exporting SMEs were evaluated on the basis of a joint diagnosis of the companies' innovation and export capabilities: the Potential Export and Innovation Index (PE2I) (Enjolras, 2016). The results of these evaluations make it possible to establish the degree of maturity of the evaluated companies concerning nine innovation and export best practices: Strategy, Intellectual Property, Corporate Culture, Customer Relationship Management, Technological and Commercial Intelligence, Networking, Knowledge Management, Project Management, and Human Resources Management.

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These companies were then ranked according to their technological intensity. For that purpose, the industries' classification proposed by the OECD was used (Hatzichronoglou, 1997). This classification assigns to each activity sector a technological intensity according to the following graduated scale: Low technology, Medium/Low technology, Medium/High technology, High technology. Thus, a degree of technological intensity was assigned to each company and was related to its profile in terms of innovation and export practices.

This multiple-case study was conducted in a qualitative way. Moreover, several multivariate data analysis methods have been used to explore potential trends enriching the cases. Our objective was to describe how the relationship between technological intensity and innovation and export capabilities could be qualified into the sample of French SMEs. Does a high technological intensity imply a high innovation and export performance? Does it imply a particular profile in terms of internal processes?

Literature Review

1. The dominant paradigm: Technological intensity defined by R&D expenditure

Technological intensity has become an integral part of the discussion of economic policy in recent decades (Kirner et al., 2009). The notions "high-tech" and "low-tech" derive from the OECD definition of the share of R&D expenditure in an industry's turnover. According to this definition, firms with more than 5% of annual turnover invested into R&D are classified as "high-tech" and those with less than 5% of annual turnover invested into R&D as "low-tech" (Hirsch-Kreinsen et al., 2008). This classification is based on the assumption that a high level of R&D expenditure is directly linked to significant growth. High-tech industries, through their high level of R&D investment, are therefore strategic industries with high growth potential (Guillou, 2006).

Innovation and export were identified as the main drivers of economic growth (Love & Roper, 2015; Pla-Barber & Alegre, 2007). Yet, prior studies suggest R&D expenditure as a key factor in determining a firm's innovation capability (van Beers & Zand, 2014; Shefer & Frenkel, 2005). So, a positive relationship between industry-level dynamism and firm-level innovation is put forward by the literature. In the dynamic high-tech manufacturing sector, the percentage of firms introducing new products was more than double that of the low-tech sector (Thornhill, 2006). Moreover, high-tech companies are generally positioned in international markets. Indeed, several empirical studies favour the level of R&D investment or other technological variables to explain export performance (Carlin et al., 2001; Fagerberg, 1994; Landesmann & Pfaffermayr, 1997). According to the OECD (Hatzichronoglou, 1997), firms that are more technologically intensive innovate more, gain new markets, use available resources more productively, and generally offer higher remuneration to their employees. High-tech industries are the fastest growing industries in international trade, and their dynamics contribute to improving the performance of other sectors. In the same way, Colombo and co-authors (2016) note that high-tech entrepreneurial ventures have responded to the economic crisis through investments in product innovation and expansion into international markets. On the other hand, low-tech industries faced additional difficulties because they require greater internal organizational capabilities to adapt themselves to their external environments.

In the context of SMEs, several findings put forward the hypothesis that SMEs with a high technological intensity (and therefore a high level of R&D investment) would be more competitive than others through their innovation performance, on one hand, and their international activities on the other. From the point of view of Heidenreich (2009) and Kirner and colleagues (2009), most low-tech SMEs are less likely to engage themselves in formal R&D so they are less technologically innovative and are less export intensive than high-tech SMEs. They therefore have lower growth potential.

This previous research could therefore be related to the resource-based theory. According to this theory, companies can be considered as a set of resources that are distributed heterogeneously within companies (Teece et al., 1997). Some of these so-called strategic resources are considered to be the foundations of competitive advantage in the domestic and international market (Barney, 1991). Thus, by considering that a company's technological intensity (i.e., its degree of investment in R&D) represents a strategic resource for its growth dynamic, a high-tech company is then better able to regularly propose innovations on its domestic market but also internationally. So, based on this dominant paradigm, a first theoretical hypothesis is proposed:

> **H1:** The innovation and export capabilities of an SME are influenced by its technological intensity (i.e., its R&D investment).

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2. An R&D-oriented point of view challenged by the Schumpeterian vision of innovation

Many research studies challenge the OECD approach (focused on the degree of R&D investment) by highlighting two factors that appear to play a role in influencing these issues: the nature of the innovation and the way of managing it (Aydalot & Keeble, 2018).

Indeed, innovation has often been correlated only to R&D activities and to new product development. However, the OECD's Oslo Manual (Mortensen, 2005) defines four types of innovation: product innovation, process innovation, marketing innovation, and organizational innovation. Most of the attention has been given to product innovation, in particular technological product innovation. Some research works therefore propose to move away from the technological vision of innovation, linked to pure R&D investment, in order to move towards a more Schumpeterian understanding where innovation is a means to an end, the end being economic success, increased competitiveness, or growth (Schumpeter, 1934).

For example, this was highlighted by (Raymond & St-Pierre, 2010) who stated that "the link between R&D activities and innovation in SMEs still requires clarification and further understanding". According to them, high-tech manufacturers seem to gain more benefits from R&D investment in product development, while low-tech firms seem to gain benefits from investment on process innovations. In the same way (Lindman et al., 2008), studied SMEs in the creative industries sectors, which demonstrated high levels of innovation despite having non-technological innovations.

Reboud and colleagues (2014) formulated a hypothesis that the level of innovative activity among SMEs with low R&D intensity will be lower than that of SMEs with high R&D intensity. Through a comparative study of French and Australian SMEs using a discriminant analysis procedure, this hypothesis has been refuted in favour of a second hypothesis that emphasizes that firms with high R&D intensity will focus more on product innovations than other types of innovation.

In a more general manner (Mazzarol & Reboud, 2011) suggest that the difference between the low-tech firms and their high-tech counterparts relies on the number and type of innovations generated and how such firms manage the process of commercialization.

So, this Schumpeterian vision puts forward that the R&D-intensive firms are considered as been highly innovative because of the large number of product innovations they implement. But low-tech firms, with their lower R&D intensity, are also able to show a high level of innovation, albeit with greater orientation toward process innovations. Taking into account this vision, a second hypothesis is proposed:

> **H2:** Low-tech firms develop more process innovations than high-tech firms, which are more product-oriented.

3. An R&D perspective challenged by the contingency theory (Mintzberg, 1979)

The R&D expenditure vision of technological intensity is also challenged by several authors (Hirsch-Kreinsen et al., 2008; von Tunzelmann & Acha, 2006), who consider that this vision necessarily implies a sectorial and aggregative view of R&D intensity and does not apply in detail to the level of the single firm (Kirner et al., 2009). In order to take into account the level of the firm, we rely on Mintzberg's contingency theory. Based on this theoretical paradigm, it is possible to consider that there is no good organization "in itself". Mintzberg states that the structure of an organization depends both on its own characteristics and on the nature of its environment. There is therefore no universal structure that can be adapted to all situations. A "good" structure must be adapted to its environment, and an environment shapes the organizations that make it up.

So, the internal routines of a company must be as varied as the environment with which it must deal. To remove the constraints linked to its environment, the company must adjust its behaviour by taking strategic decisions (Uzunidis, 2016) to set up a coherent and specific internal functioning that will allow it to improve its performance and to have an impact on the structure of its own market (Tirole, 1988). So, in a growth dynamic, firms can follow different innovation and exportation paths.

Previous works in this field support this theoretical vision, showing, for example, that low-tech sectors do not lack opportunities for innovation, but these opportunities often take a different form than those in the high-tech sectors (Haudeville & Bas, 2016). Moreover, high- and low-tech industries require different types of innovation resources (Zouaghi et al., 2018). Besides developing new products, manufacturing firms can also develop new product-related services, introduce innovative manufacturing technologies, or implement innovative organizational concepts. Each of these innovation types can be a source of competitive advantage in itself

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(Kirner et al., 2009). Research by Reichert and colleagues (2016) highlights that innovation occurs and is important not only for industries active at the technological frontier, but also for low-technology industries. The innovative capability of low-tech firms does not necessarily derive from R&D investment. Instead, high innovation capacity can result from the profitable deployment of resources to create capabilities that do not involve R&D.

So, it seems that companies can implement different internal practices to manage their growth process. There are thus various contingency factors that directly affect the structuring of companies. They concern both the specific characteristics of the organization, but also the nature of its environment (Mintzberg, 1979). Based on this theoretical background, we propose to test if technological intensity can also be considered as a contingency factor impacting the structure and practices of innovative and exporting SMEs. We therefore propose a third hypothesis:

> **H3:** The way a company manages its innovation and export activities depends on its technological intensity. Specific profiles can be identified according to the internal practices in place within the companies.

Figure 1 illustrates the relationship between the three hypotheses built from the literature.

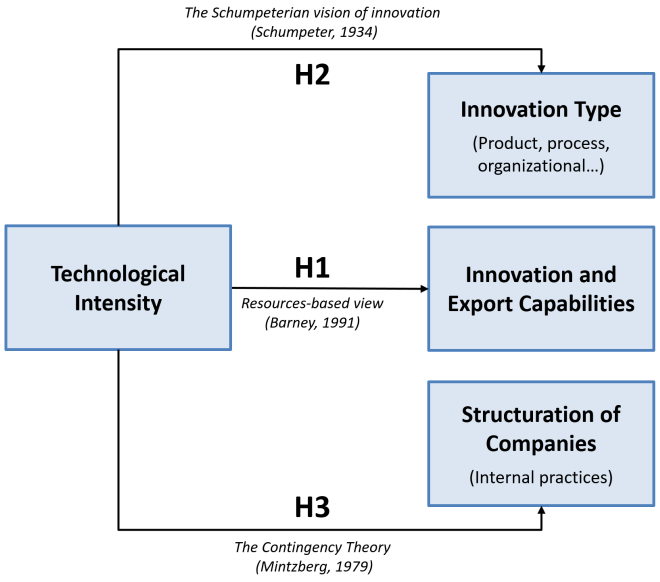

Figure 1. The framework underlying the research hypotheses tested in this study

Methodology

Theoretical background

This research focuses on the relationship between technological intensity and the potential growth of firms that has been defined as their innovation and export capabilities. For that purpose, different theoretical foundations have been mobilized.

First, we chose to use the OECD's classification of technological intensity (Hatzichronoglou, 1997) in order to assess the firms in the panel. This classification is based on a grouping by industrial sector within which the notion of technological intensity has been translated into the ratio of R&D expenditure to value added. Four categories were thus identified: low-tech, medium-low, medium-high, and high-tech. Although this classification has been criticized by many authors in the scientific literature (Hirsch-Kreinsen et al., 2008; von Tunzelmann & Acha, 2006), it has the main advantage of providing a simple and consistent instrument for international comparisons. Furthermore, based on the Standard International Trade Classification (SITC) revision 2, it combines both a sectoral approach (industry classification) and a product approach (list of manufactured products according to categories) (Hatzichronoglou, 1997).

The second theoretical basis concerns the evaluation of the innovation and export capabilities of SMEs. Given that the objective is to evaluate the potential correlations between technological intensity and innovation and export capabilities, it is essential to propose an evaluation of the companies on a standard basis in order to be able to make comparisons. It was therefore decided to use a mixed innovation/export diagnostic tool in order to put into practice a joint vision of these two activities within SMEs. So, the innovation/export relationship in SMEs, traditionally thought of in a causal way, was envisaged through the prism of the complementarity (Enjolras et al., 2016). By improving one of these activities, companies activate a single lever that simultaneously improves innovation and export capabilities. In the context of SMEs, for whom the lack of resources is a major difficulty, it makes perfect sense. This diagnostic tool, called the potential exportation and innovation index (PE2I), relies on a joint evaluation methodology of the innovation and exportation capabilities of SMEs (Enjolras, 2016). Thus, the main specificity of this tool is that it concentrates on the activities/resources/skills that an SME has to mobilize first and foremost to simultaneously improve its innovation and export performance while reducing the effort

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associated with its performance improvement. This index measures the firm's maturity in the joint activities of innovation and export (Figure 2). It makes it possible to propose a diagnosis of the situation of a company by identifying its strengths and its weaknesses, and it gives an indication of its potential domain of preference (innovation or export). Another advantage of this diagnostic tool is that it does not evaluate innovation or export based on performance indicators (export turnover, number of patents, etc.).This tool measures a degree of maturity regarding internal practices or routines in place within the company. It makes therefore possible to identify the profile of the companies evaluated in terms of innovation management and international activities. These findings may highlight significant differences in terms of the internal functioning of companies.

Methodological approach

Based on a sample of nine innovative and exporting French SMEs, this study was conducted by combining a qualitative multiple-case study approach and a quantitative approach through multivariate statistical methods.

The case study is a qualitative research method. According to Yin (2013), it is a research strategy using empirical investigation in real context. It seeks to understand a contemporary phenomenon and mobilizes many sources of information. It is traditionally used in an exploratory way, but according to Hlady Rispal (2016), its contributions can be much more numerous. For this research work, the case study approach is used in a qualitative deductive logic. This means comparing a "theoretical" model (research hypotheses) with the reality on the ground (SMEs context).

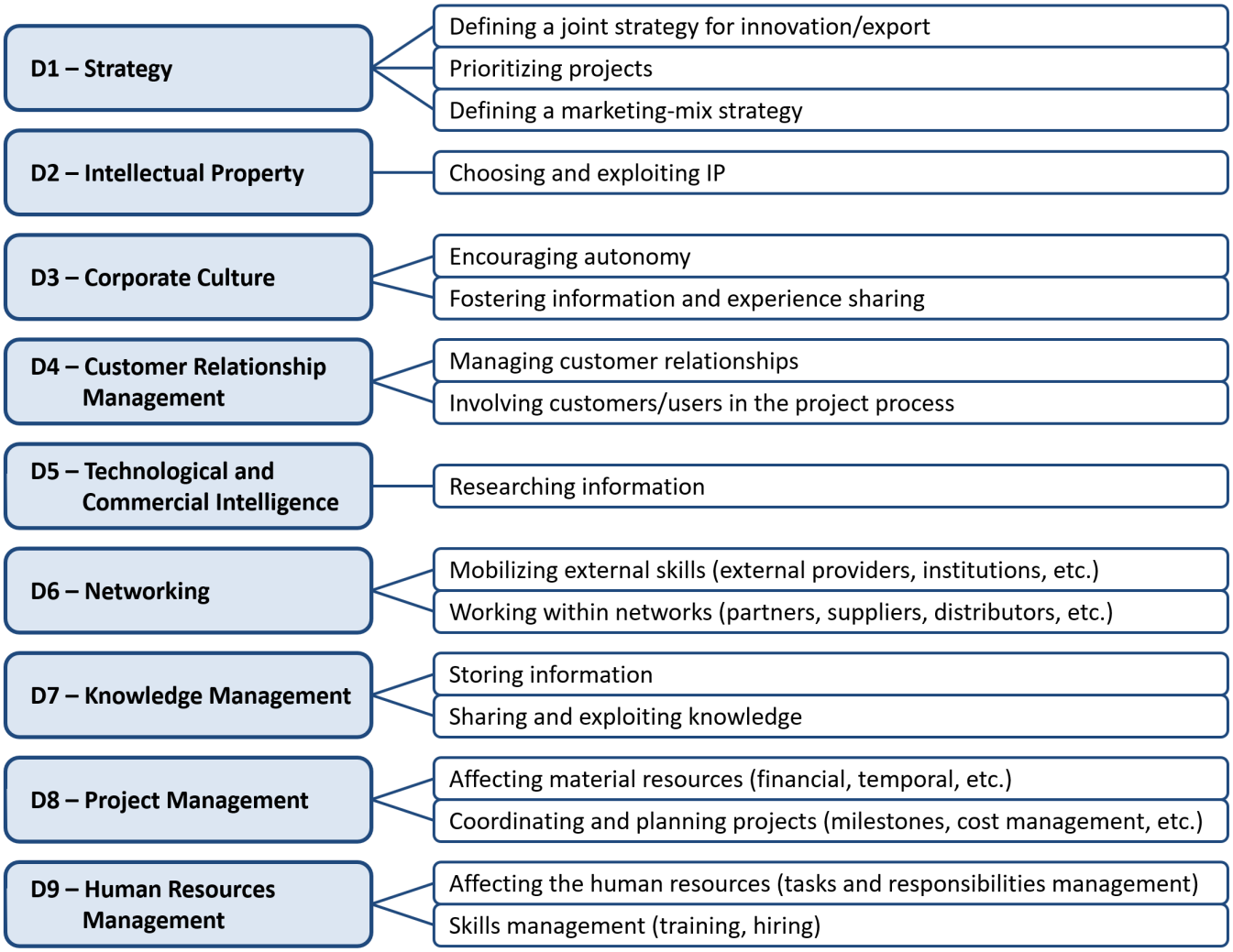

Figure 2. Joint innovation/export practices of the PE2I tool

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Step 1: Case selection
We selected nine French companies to form our panel (Table 1). The selection criteria were as follows:

- The company had to be an SME, as defined by the European Commission (2003): it must therefore meet several criteria in terms of number of employees (<250 employees) and annual turnover (<€50M; ~$75M CAD).
- The company had to be involved in an innovation process (i.e., product or process innovation as defined in the Oslo Manual).
- It had to achieve an export turnover, even if it represented a very small proportion.
- It had to be in a process of development and growth. This selection criterion, relating to the company's strategy and its manager intention, makes it possible to focus this study on growing companies, without considering that this is the case for all SMEs.

Particular attention was paid to the fact that the panel should bring together companies from different business sectors and offer diversity in terms of technological intensity as defined by the OECD.

Step 2: Interviews
The nine companies in the panel were studied through semi-directive interviews with four stages: context analysis, PE2I evaluation (diagnosis of their innovation and export capabilities), discussion of results, and recommendations. Each interview lasted between 1 and 2 hours. The first part of the interview was dedicated to the company's context analysis. What is its main activity? Who are its customers? How does it work on a daily basis? Then, based on this information, the PE2I evaluation was conducted. The discussion with the business manager allows for the evaluation of the maturity level of the company concerning the joint activities innovation/export of the PE2I. Then, the information gathered during these interviews was then processed in order to build a database.

Step 3: Identification of illustrative cases
Finally, a global report of each interview was written to put forward the specificities of the case. The objective of these reports was to record the information obtained during the interviews, to contextualize it, and to put it in perspective with the notion of technological intensity. The use of these reports, combined with an analysis of the database (step 2), made it possible to identify illustrative cases highlighting observations of interest for this research work.

Table 1. Profile of the nine companies in the sample

	Sector	Size (Workforce)	Technological Intensity (OECD)	Export Turnover (%)	Innovation Type (Oslo Manual)
C1	Scientific Instruments	9	Medium-High	53	Product innovation
C2	Food Industry	10	Low Technology	4	Process Innovation
C3	Agricultural Machinery	200	Medium-High	6	Product Innovation
C4	Thermoplastic Materials	30	Medium-Low	15	Process Innovation
C5	Scientific Instruments	20	Medium-High	90	Product Innovation
C6	Biotechnology	5	Medium-High	5	Process Innovation
C7	Biotechnology	3	Medium-High	1	Process Innovation
C8	Food Industry	100	Low	5	Process Innovation
C9	Electronics, Automation	16	High	1	Product Innovation

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In order to support the identification of illustrative cases, multivariate statistical tools were used to analyze the database. Due to the small number of companies in the panel, the statistical analysis was considered as a quantitative supporting tool and did not aim to reach statistically significant conclusions. However, the objective of using a quantitative tool to support our qualitative approach was to highlight trends within the database. These trends could then be potentially used to identify specific illustrative cases put into context. These statistical tools make it possible to orient the reflections carried out and to exploit the data as well as possible in order to transform them into value-added information. Based on this value-added information, it was possible to apply our three research hypotheses to our multiple-case study.

The statistical method used as a supporting quantitative tool was the principal component analysis (PCA). This method delivers graphical representations of a sample according to two principal axes defined in regard to different variables (Syms, 2008). In this research work, the PCA was used to identify the correlations between the variables of the database. Each variable is represented by a vector represented in a three-dimensional space and then brought back to a two-dimensional plane constructed by two main axes: the principal components. The graphical representation of this methodology results in a loading plot: a plane where the variables are represented by vectors and where their position determines their level of correlation between them. If two variables are represented in the same direction, they are positively correlated. If they are represented in opposite directions, they are negatively correlated. Finally, if the vectors of two variables are orthogonal, there is no correlation between them. In addition, a variable is well represented in the plan of the main components when the vector approaches the limit of this plan (i.e., a circle containing the majority of the data in the sample) (Lever et al., 2017).

This method was used because it is a well-known technique enabling researchers, through an unsupervised linear dimensionality reduction algorithm, to find a more meaningful basis or coordinate system for a set of data. It works based on covariance matrix and is used mainly to find the more relevant features and, by doing

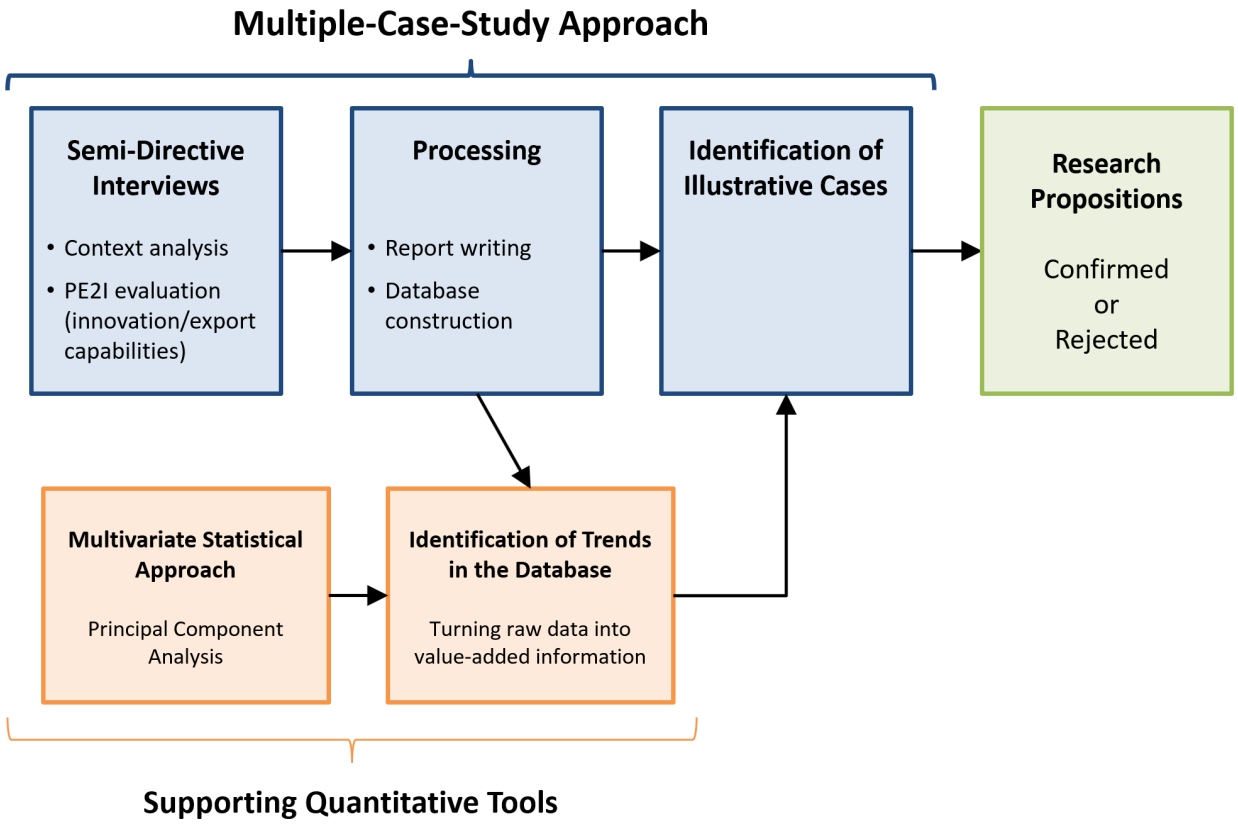

Figure 3. Methodological approach

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so, to reduce the number of redundant features. In this exploratory case, it was used in order to have a better perspective on the patterns from the gathered data from the set of case studies.

Results and Discussions

In this section, we present the results of testing each of the three hypotheses and discuss their implications. We will first focus on the outputs produced by companies, testing the relationship between innovation type and technological intensity (Hypothesis H2). Then, we will extend our investigation to a more global vision of the company, by testing the H1 and H3 hypotheses, in order to approach the internal organization of companies allowing them to produce these outputs.

H2: Low-tech firms develop more process innovations than high-tech firms, which are more product-oriented.
Our second hypothesis (H2) was used to identify if the technological intensity is correlated with the type of innovation proposed by companies. Relying on the database, two variables were compared: Technological Intensity and Innovation type. Another contextual variable was added to this analysis: Industrial Sector.

The results of this analysis are presented in Table 2 below. Note that, in our panel, Technological Intensity is not systematically correlated with Innovation Type. The variable Technological Intensity seems to be slightly positively correlated with the product innovation variable: the medium-high and high-tech firms are mainly concerned with product innovation and the low- and medium-low-tech firms focus on process innovation. But this observation is not true for firms C6 and C7, which are considered as medium-high-tech firms and focus on process innovations.

So, according to this analysis, the second hypothesis is not supported by our sample of SMEs. But, considering the sample in a more detailed way, the specific case of the companies C6 and C7 could be explained by the particularity of their industrial sector: biotechnology. This analysis put forward two specific illustrative cases rejecting our second hypothesis (H2). It seems that the biotechnology industry shows its own specificities in terms of innovation type.

H1: The innovation and export capabilities of an SME are influenced by its technological intensity (i.e., its R&D investment)
The results of the PCA conducted to identify the potential correlation between the level of technological intensity of the firms and their innovation and export capabilities are shown in Figure 4. It indicates a strong correlation between the innovation capability (represented by the IIP vector) and the export capability (represented by the IEP vector). This finding was expected because the PE2I diagnosis has been designed on the hypothesis that innovation and export capabilities are

Table 2. Comparison of the Technological Intensity and Innovation Type variables

Company	Sector	Technological Intensity	Innovation Type	Category
C9	Electronics, Automation	High	Product	High-Tech SMEs
C1	Scientific instruments	Medium-High	Product	
C3	Agricultural machinery	Medium-High	Product	
C5	Scientific instruments	Medium-High	Product	
C6	***Biotechnology***	***Medium-High***	***Process***	
C7	***Biotechnology***	***Medium-High***	***Process***	
C4	Thermoplastic materials	Medium-Low	Process	Low-Tech SMEs
C2	Food industry	Low	Process	
C8	Food industry	Low	Process	

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strongly correlated. However, another interesting result appears in the loading plot. Because the Technological Intensity variable is almost orthogonal to the IIP and IEP variables, it seems that, in our sample of French SMEs, the technological intensity is not correlated with the innovation and export capabilities. This result challenges our first hypothesis (H1) based on an R&D-oriented vision of the technological intensity and a technological view of innovation. Based on this observation coming from the PCA analysis, and looking at the panel in a more detailed way, it is possible to identify two illustrative cases showing that a low-tech company is able to have a high innovation and export capability and vice versa. These 2 illustrative cases were analyzed to identify their specificities. Their own profiles in terms of innovation and export internal practices were described based on their PE2I evaluations.

The first illustrative case is company C9. It belongs to the high-tech category in terms of technological intensity. Its main activity is the production of electronic boards dedicated to the control of programmable logic controllers (PLCs) installed in difficult climatic conditions. Its innovation and export capability is medium, with three strong points: networking, knowledge management, and human resources management (Figure 5). This company is a young exporter and works mainly

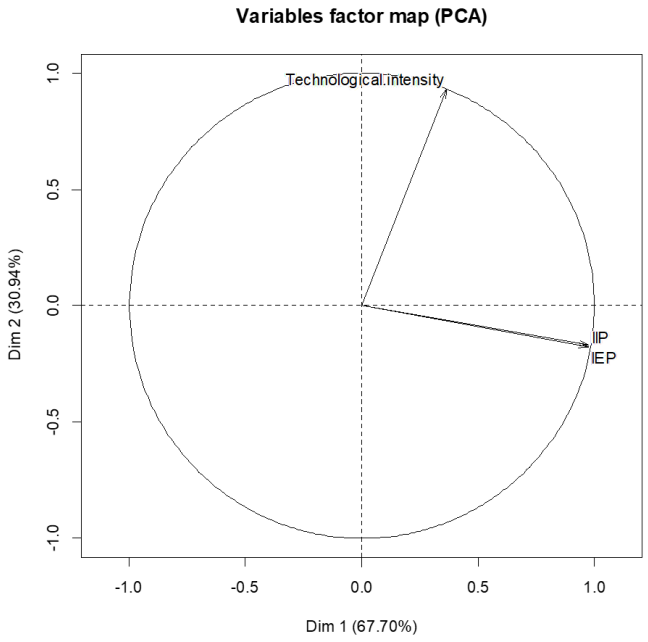

Figure 4. PCA loading plot of Technological Intensity / Innovation Performance (IIP) and Export Performance (IEP)

under make-to-order strategy and on design specifications. It does not therefore work in product design in the strict sense. Each order is a new project to be managed, which leaves less room for creativity because of an established set of specifications. This operating mode is a brake on identifying and penetrating new markets because the prospective approach of anticipating customer needs when they are not formulated in the form of specifications is not at the heart of the company's practices. On the other hand, the company relies on highly qualified personnel to suggest ways of development and improvement to its customers during the various projects.

This case therefore highlights the importance of the qualification of human resources for high-tech sectors to be able to make proposals. This does not necessarily imply a strong innovation and export capability, but it reflects an ability to react to customer demand, which is essential in this field. This requires, among other things, a strong capitalization of integrated knowledge within the company. In this case, a shared and collaborative platform has been set up, which is unusual in this type of small company. Company C9 is, therefore, not an extremely proactive company but its mode of operation and its sector of activity urges it to be reactive to its customers' needs and to know how to adapt to them.

As a counter example, company C2 is a low-tech company in the food industry. It sells processed products with low added value. It has the particularity of selling its products in several countries throughout the world and is able to adapt its products and therefore its manufacturing process for each of its target countries. Its assessment in terms of innovation and export is therefore very good, despite the fact that it shows very limited technological intensity. This is clearly reflected in its very balanced profile of innovation and export practices, with a weak point on project management (Figure 6).

More precisely, this company adapts its product range according to the standards of every country, according to the local consumption and packaging habits, but the company does not drastically modify its own products. Company C2's innovation activity results from its ability to adapt and develop its manufacturing process to best meet the needs of its customers and to stand out from the competition, but their products remain traditional and "Made in France" realizations. The company shows a proactive approach through its clear and long-term strategic positioning and its desire to constantly renew its product range. In general, demand plays a crucial role in these industries, and product differentiation is a

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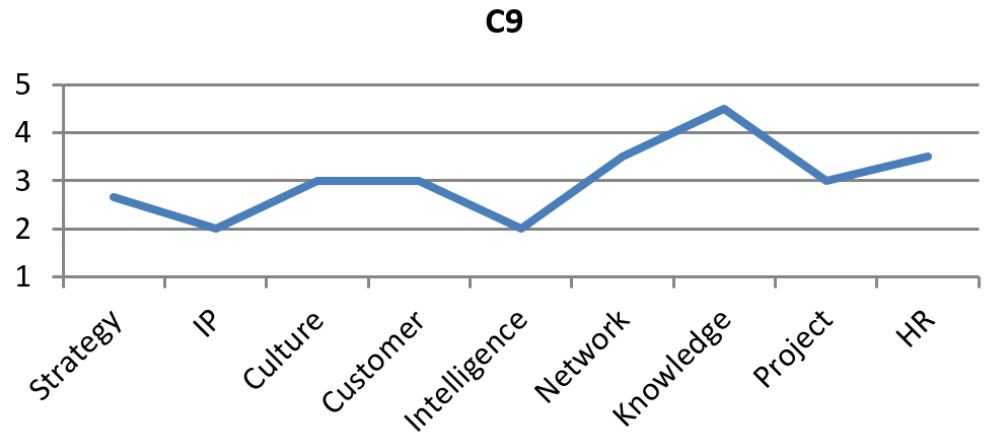

Figure 5. Practice profile of company C9

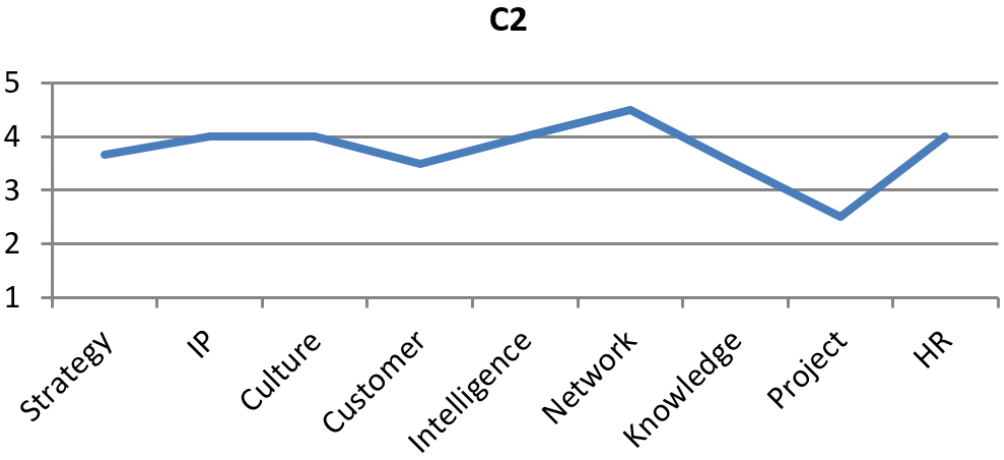

Figure 6. Practice profile of company C2

powerful driver of innovation (von Tunzelmann & Acha, 2006). So, its low technological intensity is therefore not a brake on its innovation and export capability. On the contrary, it is a factor influencing the manner how it manages the evolution of its processes and its international activities. This company does not make purely product innovation; it makes also process innovation.

This result highlights an interesting issue concerning the influence of technological intensity on the innovation and export capability of companies. This analysis shows that, in this specific sample of French SMEs, a high technological intensity does not imply a high innovation and export capability. So, our first hypothesis (H1) is not validated in this specific context. Moreover, it seems to confirm that low-tech firms and high-tech firms show different behaviour and profiles in terms of internal practices, as mentioned in our third hypothesis (H3), as discussed in the next section.

H3: The way a company manages its innovation and export activities depends on its technological intensity. Specific profiles can be identified according to the internal practices in place within the companies.

In order to more precisely explore the observation from the previous illustrative cases, a second PCA was conducted with the goal of identifying some potential correlations between the technological intensity and the maturity of firms related to the innovation and export practices (Figure 7).

In order to conserve a good representativeness of the variables, this analysis was divided into two loading plots. The first one shows the correlations between the

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Technological Intensity and the practices of "Networking", "Knowledge Management", "Project Management", and "Human Resources Management". The second loading plot shows the correlations between the Technological Intensity and the practices "Strategy", "Intellectual Property", "Culture", "Customer Relationship Management", and "Technical and Commercial Intelligence".

The main finding of this analysis concerns the positive correlation between Technological Intensity and the Knowledge Management practice (the loading plot on the left side of Figure 7). These two variables are oriented in the same direction. However, the global representativeness of the variables for the first loading plot is not high (66% of the data are represented on this plot). Indeed, the variable Technological Intensity is not so close to the circle. So, the results of this PCA analysis have to be balanced. Nevertheless, the data analysis put forward a potential trend linking the technological intensity of firms with their maturity in terms of knowledge management. In order to confirm this trend, the average profiles of the companies belonging to each technological category have been calculated (Figure 8).

Note that the four profiles in Figure 8 are quite different, but these differences are not necessarily related to technological intensity. The most mature companies in terms of internal practices are not always those that are categorized as high-tech firms. It strengthens the previous observation according to which our panel rejects the first hypothesis (H1).

More precisely, Figure 8 highlights that, unlike other practices, the Knowledge Management practice shows a maturity level strictly in accordance with the level of technological intensity. The most mature companies are those in the high-tech category and vice versa. It confirms the trend identified through the PCA analysis (Figure 7).

This correlation can be illustrated with several cases in our panel. For example, the high-tech firm C9 put in place a collaborative and integrative platform in order to capitalize and share its knowledge within all the company. This kind of practice is rather unusual within small businesses. The medium-high-tech firm C1 experienced a global process of knowledge formalization and capitalization through a standard procedure. This firm

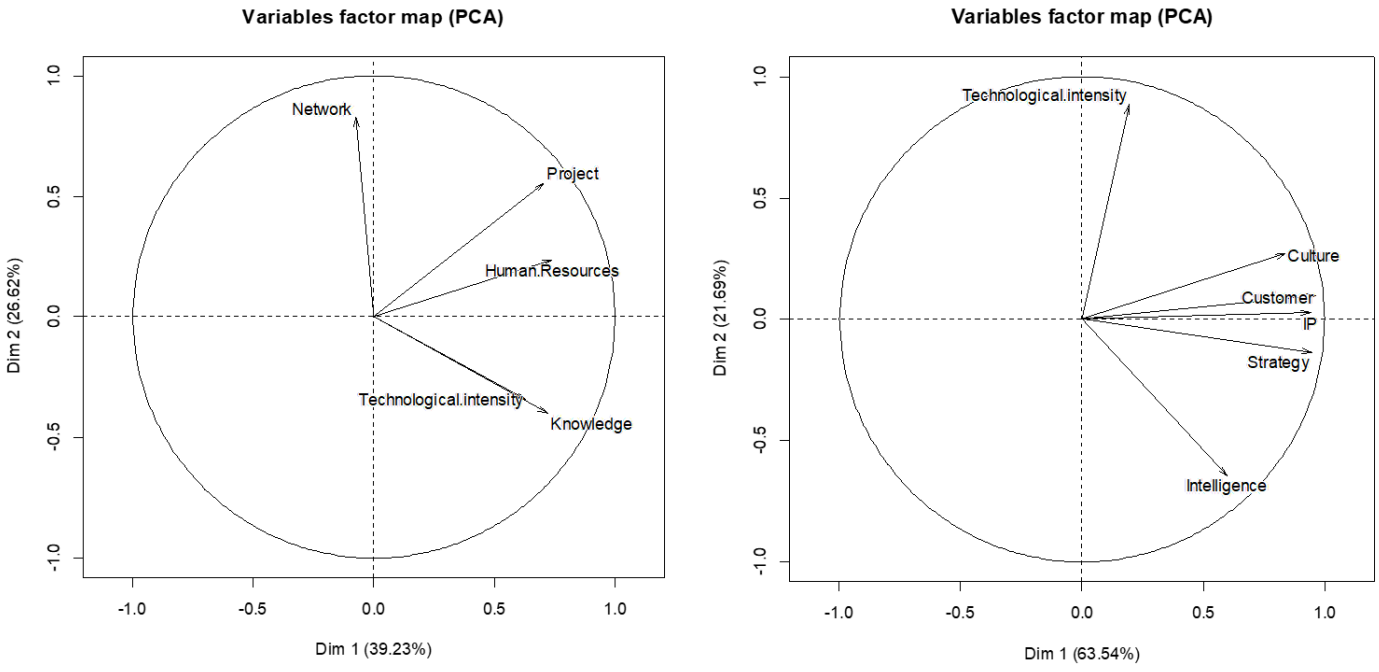

Figure 7. PCA loading plots of Technological Intensity / Practices

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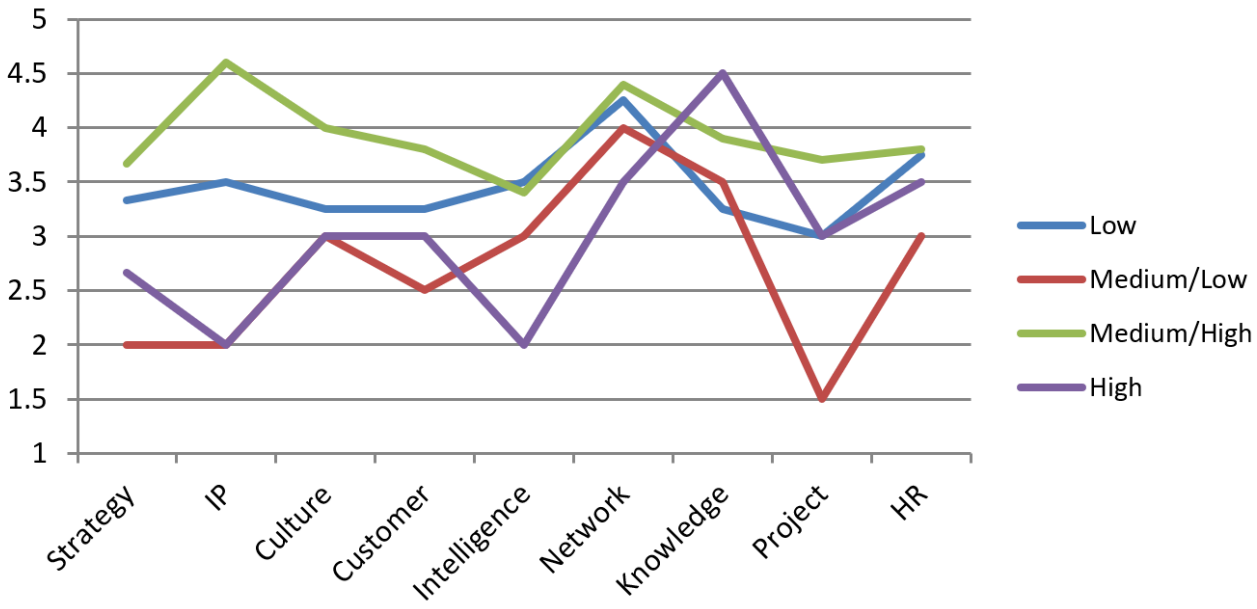

Figure 8. Average company profiles across the four categories of technological intensity

is not considered as a small business because of its important workforce. However, knowledge capitalization is a crucial point of its global strategy. Finally, firm C6 shows a medium-high technological intensity and put in place a sharing process of its knowledge because of its international multi-site configuration. Working in the biotechnology sector and being "born global", this very small company uses a collaborative platform to make its knowledge accessible simultaneously in several places in the world and over several time zones.

This observation could be explained by several arguments. First, innovative new products had the greatest impact on revenue growth of high-tech firms when knowledge assets were high. This is consistent with the resource-based view considering that knowledge is a competitive resource within the firm. So, for high-tech companies, this knowledge management is essential because it conditions the success and continuity of innovations as well as a high level of exports (Sandu & Ciocanel, 2014). On the other hand, low-tech industries appear to be less exposed to changes, and when they appear, the changes are less extreme and less pronounced. So, for them, knowledge management is less critical, especially with regard to the adaptability of human resources (Thornhill, 2006). Whereas high-tech companies have a large number of "non-productive" employees who hold and yet produce the majority of the necessary knowledge, low-tech companies have a larger number of "productive" employees who produce and transfer their own knowledge, which is closer to "know-how" and therefore more difficult to capitalize on a formal way (Aydalot & Keeble, 2018).

Knowledge management therefore appears to be a critical point for high-tech companies because it conditions their functioning and growth. In particular, it is a critical point to be able to adapt to the changing context of their environment. For low-tech companies, the capitalization of knowledge potentially takes a different form, closer to human resources management or even companionship in order to maintain know-how within the company.

Conclusions

Generally speaking, innovation, international development, and growth are associated with companies from high-tech sectors. However, many examples show that growth is not just reserved for large digital multinationals. Born globals, high-growth firms, and small structures are also strong players in the global economy, and companies in traditional or low-tech sectors are not left out. Thus, the ambition of this article was to conduct a multiple case study with French innovative and exporting SMEs to study the relationship between technological intensity and innovation and export capability. A qualitative approach was used, supported by statistical

multivariate tools in order to build a set of illustrative cases to support or refute trends into our SMEs panel. Based our findings, we offer several conclusions.

First of all, it would seem that, contrary to what is traditionally accepted, the technological intensity of an SME would not be directly linked to the type of innovation it proposes. Indeed, within our panel, high-tech SMEs were more product-oriented, whereas low-tech companies implemented process innovations. However, this is not true for biotechnology companies. The type of innovation would therefore be related more to the business sector than to the technological intensity.

On the other hand, the panel studied refutes the hypothesis that the most innovative and exporting companies are those from high-tech industries. Indeed, low technology companies show very good performance in terms of innovation and international activities. However, the differentiating element between high- and low-tech seems to be the way companies manage their innovation process and their international activities. Indeed, high- and low-tech SMEs show different profiles in terms of innovation and export management practices. The routines in place within companies are different, and this is particularly evident in the case of knowledge management. Despite their small size, high-tech SMEs have implemented very successful knowledge management practices, whereas low-tech companies are not as mature on these particular issues.

This study therefore highlights various questions in our current understanding of technological intensity. First, the definition of technological intensity in the form of R&D expenditure proposed by the OECD can be questioned because, even if the return on investment on such expenditure may be limited in the case of low-tech firms in view of the less significant competitive pressure they suffer (Hansen & Winther, 2014), these investments nevertheless remain important for setting up a long-term innovation approach (Kafouros et al., 2008). R&D expenditure is therefore not necessarily representative of a technological intensity, but rather of a proactive vision of companies. Second, the technological vision of innovation should also be questioned because this study shows that innovations in terms of process, organization, or marketing are also vectors of growth for companies, whatever their size and technological intensity. Finally, the maturity of a company in terms of innovation and international activity must be put into perspective according to these specific characteristics, namely in the context of this study its business sector and its technological intensity. Different typical innovation and export profiles could thus be built in order to highlight the specificities of contingent factors such as these ones (business sector, size, technological intensity, export turnover, etc.).

Finally, we acknowledge the limitations of this study and the need for further research. Our objective was to use quantitative tools in support of a qualitative approach to highlight trends within the database. This article represents an initial, exploratory approach before a larger campaign of data gathering, and we encourage others to contribute further studies to enhance our understanding of the relationship between the technological intensity of SMEs and their growth potential.

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