Can Industry 4.0 foster the backshoring of production? Insights from a Delphi study in France.

Fabienne FEL (fel@escpeurope.eu)
ESCP Europe

Jennifer CAYLA
ESCP Europe

Valentina CARBONE
ESCP Europe

Abstract
While the trade press highlights the potential impact of industry 4.0 on backshoring to France, academic literature still treats these two topics separately. To help bridge this gap in the literature, we carried out a Delphi study with a panel of 18 experts. Our findings show that industry 4.0 can foster backshoring in companies of all sizes, identify contributing factors as well as barriers, and analyse the foreseeable consequences of this backshoring on corporate supply chains.

Keywords: Industry 4.0, Backshoring, Delphy study

Introduction
The topic of backshoring of manufacturing facilities has received great media attention in France with both the trade and general press asserting that the factory of tomorrow — which will be smart, automated and flexible — will represent a factor leading to the backshoring of previously offshored manufacturing facilities. Academic literature, on the other hand, still addresses the topics of backshoring and the factory of the future independently from one another. Our study therefore aims to assess whether the backshoring of French production can be fostered by the roll-out of the industry of the future.

Offshoring is an ambiguous, complex, widely-discussed yet little-defined notion. Regardless of the definition that is chosen, however, the term refers to the transfer of activities to a foreign country. In this study, following Fratocchi et al. (2014), we will consider backshoring as the reverse process of offshoring, meaning returning all or part of production to the original country to serve the local, regional and/or global market as part of a voluntary strategic approach.

In the literature, industry 4.0, which is also called "the industry of the future" or "smart manufacturing", does not seem to refer to a single, common definition. Nevertheless, experts agree that digital technology will play an essential role: industry 4.0 production processes will incorporate autonomous technology and tools that will communicate with one another throughout the value chain, thereby disrupting the role of operators and managers. To understand the potential impact of the development of industry 4.0 on the backshoring of industrial activity to France, we carried out a

prospective study following the Delphi method, consulting 18 experts identified by their (academic or professional) publications on the topic in two successive rounds. The experts included economists, educators, representatives of the public sector, industry players and consultants.

Our article is organised as follows: after first outlining our research questions and methodology, our findings and their managerial implications will then be presented.

1. Literature review

To find studies focusing both on backshoring and industry 4.0, we entered the following three pairs of keywords into the Ebsco, Emerald and Elsevier databases: "*relocation* and *industry 4.0"*, "*reshoring* and *industry 4.0"* and "*backshoring* and *industry 4.0*", and searched for them in titles and abstracts. This search only produced a single article published by Barbieri et al. (2017). These authors point to the "possibility" of a relationship between backshoring to Western countries and the emergence of technologies used in industries of the future.

Meanwhile, studies on industry 4.0 carried out by consulting firms provide only limited, contradictory answers. Blanchet (2016) explains that, in an industry of the future that is "insensitive" to labour costs, production facilities may be backshored to countries with high labour costs such as France. The report published by Deloitte (2014) shows, on the contrary, that industry 4.0 will not lead to a decline in offshoring, which is more concerned with serving local markets rather than seeking low-cost production. Reports published by McKinsey (2015) and CapGemini (2015), meanwhile, make no reference to a potential link between the industry of the future and backshoring.

Faced with a lack of more comprehensive literature on the topic, we have chosen to review the literature about backshoring and the industry of the future separately, in order to examine potential areas of convergence.

1.1 Backshoring

In general, authors who study backshoring define this phenomenon as the reverse process of offshoring. Although there are different nuances to their definitions, many authors (Kinkel, 2014; Gray et al., 2013; Bals et al., 2015) consider that backshoring refers to returning previously offshored production to the original country, whether this production is carried out by a subsidiary or an external supplier.

In this study, backshoring will be considered as the reverse process of offshoring, meaning returning all or part of production that has previously been offshored to a non-neighbouring country to the original country. This decision must be the result of voluntary, strategic reasoning by the company with an aim to serve a local, regional, and/or global market. We will not make a distinction between the chosen method of ownership (internalisation or externalisation). It should be noted that this definition has been adopted by Fratocchi et al. (2014).

It difficult to assess the extent of the current backshoring movement since viewpoints on the subject differ greatly. According to Dachs and Zanker (2014), instances of backshoring remain rather marginal. However, a number of recent studies on backshoring suggest that it is a growing phenomenon (Bals, Daum, Tate, 2015; Fel and Griette, 2017). Many of today's scholars expect companies to increasingly turn to this new way of thinking about production (Arlbjørn and Mikkelsen, 2014).

Many studies have examined the reasons that push companies to backshore. Though the authors generally agree on the causes, there are a number of differing views on the

relative weight of these factors: certain authors consider that the main factor leading companies to backshore is an attempt to correct what is usually a short-term strategic error due to underestimation of hidden costs and problems with quality and responsiveness (Kinkel and Malocca, 2009; Kinkel, 2014). However, the most recent studies show that the main factor leading to backshoring is the long-term consequence of social and economic changes in low-cost countries, with higher wages being the first explanation (White and Borchers, 2016; Fratocchi et al, 2016; Fel and Griette, 2017). Moreover, in developed countries, many automated tools have been implemented thereby improving productivity in Western countries (Albjorn and Mikkelsen, 2014).

For other authors (Martinez-Mora and Moreno, 2014), backshoring is linked both to financial developments in the host countries and many companies' aim to increase responsiveness. Marketing arguments based on "*made in*" labels and environmental-friendliness have emerged, strengthened by recognised labels **(**Van den Bossche et al., 2014; Fratocchi et al. 2015). Still other scholars underscore the benefit of bringing design and production closer together to boost innovation (Abecassis-Moedas and Moatti, 2015).

While many authors have attempted to determine the factors that contribute to backshoring, few have sought to understand the factors limiting this phenomenon (Wiesmann et al., 2017). As Atkinson (2012) points out, one problem is making sure that the skills and ecosystem required for the backshored company to operate exist in the original country. Such skills and ecosystems are often lacking in developed countries with a high degree of offshoring.

Lastly, a number of different studies have focused on which sectors are most affected by backshoring and have provided contrasting results: for Dachs and Zanker (2014), European industries that are very technological are the most affected, while studies by Fratocchi et al. (2015, 2016) show that the sectors most impacted by the backshoring phenomenon are the textile, footwear, electronics, mechanics and furniture sectors.

Though there is no consensus about which industrial sectors are most likely to backshore, scholars do agree that backshoring is more common among large companies than small ones (Dachs and Zanker, 2014; Fratocchi et al., 2016).

1.2 **Industry 4.0**

Now that the notion of backshoring is clear, we will turn our attention to industry 4.0. Once again, this can be quite a confusing term since so many different definitions exist. Indeed, BITKOM, the German association of telecommunications companies, has identified over 100 different definitions for industry 4.0. This can be explained by the rather abstract and forward-looking nature of this phenomenon (Bidet-Mayer, 2016). We will nevertheless now attempt to clarify the various dimensions and implications of industry 4.0, which is also called "the factory of the future" or "smart manufacturing".

A simple definition, proposed by Bidet-Mayer (2016), describes "connected factories that are made flexible and smart through networks of machines, products and individuals." Schumacher et al. (2016) provide a more detailed definition of Industry 4.0 by referring to recent technological developments where the internet and support technologies provide a backbone for incorporating physical objects, human beings, smart machines, product lines and processes across organizational boundaries in order to form a new sort of smart, networked, agile value chain. Industry 4.0 therefore implies constant communication with all of the parts of the value chain that are outside the company, especially suppliers and customers. Real-time sharing of information among

all the different stakeholders makes the supply chain more responsive (Thoben et al., 2017). In addition to this horizontal integration of the value chain, there is also vertical integration: all the operations carried out in the company may now be connected and optimised in an integrated network (Geissbauer et al., 2016).

The pursuit of efficiency is at the core of the factory of the future, where tasks that do not add value are automated. Maintenance becomes predictive (Smit et al., 2016) and quality is maximised, with sensors on products and machines making it possible to quickly ensure compliance (Blanchet, 2016). The factory of the future helps meet growing demand for customised products: the degree of agility and flexibility provided by the technology implemented makes it go from a mass rationale to a mass customisation rationale, while conserving unit costs similar to those found in mass manufacturing (Blanchet, 2016; Bidet-Mayet, 2016; Smit et al., 2016).

Some go so far as to assert that industry 4.0 will disrupt current business models since the goal will no longer be to simply produce and sell goods, but to provide a much broader, comprehensive service. This will represent a new sort of hybrid good (Smit et al., 2016).

2. **Research questions and methodology**

2.1 Research questions

The following research question guided our work: to what extent may the backshoring of production to France be fostered by development and deployment of industry 4.0?

The literature review helped identify the factors leading to backshoring, along with the potential barriers. Since the sector and size of a company seem to have a real effect on its likeliness to backshore its production, we also looked at these characteristics.

2.2 Methodology: Delphi method

The Delphi method is a forecasting technique in which experts are consulted in order to determine areas of convergence on a subject with many areas of uncertainty. Experts are defined as any individual with extensive practical or theoretical knowledge of the subject being studied. This method makes it possible to reach a well-reasoned consensus based on a set of complete, reliable information. In addition, it presents the analyst with perspectives on the subject that he/she may not have considered.

For this research, the method was implemented in seven main steps. As we will see, the iterative nature of this approach is what makes it unique. This study is based on two successive rounds of questioning (with the same experts consulted each time, and therefore required to commit to two rounds of interviews).

- First of all, we wrote the questionnaire for the study, making sure to ask the questions in a precise, targeted manner.
- We then established a list of experts, based on an organised analysis of publications on our topic. In order to compare and contrast different viewpoints and obtain a more objective view of the phenomenon, particular attention was given to targeting a wide range of experts: economists, teachers, representatives from the public sector, industry players and consultants.
- An introductory email was sent to contact the identified experts, present the project and the chosen analysis method and offer them the possibility of participating in the study.
- The experts who agreed to participate in the project were questioned during a first round of interviews. The questionnaire was sent to them the day before the

discussion. The first round, which was meant to be open and exploratory, consisted of a telephone conversation with each expert, which lasted an average of 45 minutes. They were not provided with any information concerning the answers. Three introductory questions were asked in the beginning of the interview in order to determine their understanding of the terms "backshoring" and "industry 4.0." Twenty experts were interviewed between 25 January and 3 March 2017.

- We then performed a first analysis phase in order to compile the responses collected during the first round of interviews. Following this phase, the questionnaire was remodelled in such a way so as to reveal the group opinion for each question.
- The experts were asked to participate in a second round of interviews carried out online. They took an average of 25 minutes to fill in this questionnaire. At this stage, the study had a more quantitative character. The experts were again asked to give their opinion on each subject, but this time they were informed of the group opinion. Eighteen experts were interviewed (two experts withdrew from the process between the two rounds) between 14 March and 3 April 2017.
- We then carried out a final analysis, which allowed us to reach a conclusion about each of the topics examined. In keeping with Booto Ekionea et al. (2011), the experts' consensus on the proposed opinions was interpreted as follows: strong (between 80 and 100 %), moderate (60 to 79.9 %) and weak (50 to 59.9 %). A percentage lower than 50% was considered as a lack of consensus.

As required by the Delphi method, anonymity was strictly observed. This method can be relatively tedious for the experts, however, as they are asked to respond to the same questions two different times, which can sometimes lead to a significant drop-out rate. In our case, the drop-out rate was only 10%, which left us with an adequate sample to use for our study.

3. RESULTS

3.1 Backshoring, a process fostered by the development of industry 4.0

The first conclusion of this study is that there is indeed a cause and effect relationship between industry 4.0 and backshoring of production to France. 72% of the experts responded positively to the question, "Do you believe that industry 4.0 may lead to a wave of backshoring of production to France?"

However, significant differences exist among the experts who uphold this relationship. We did not obtain consensus as to the possible extent of this backshoring movement: some experts consider that industry 4.0 will create a great wave of backshoring of production to France, while others believe that it will probably not be a massive phenomenon, and that industry 4.0 will simply be one of many factors. Changes in demand, for instance, may provide greater incentive for companies.

In order to assess how lasting this phenomenon may be, we chose to consider three time scales: short, medium and long-term. In the near future, 72% of the experts believe that offshoring and backshoring will continue to occur in parallel, depending on the positioning of companies and products. However, in the medium term, it is highly likely that the backshoring movement connected to industry 4.0 will grow (61% of the experts), sometimes to the detriment of offshoring. It is much more difficult, however, to determine whether this phenomenon will continue in the long term. The heterogeneity of the opinions collected may be explained by the fact that it is complicated to provide an opinion about such a forward-looking subject.

3.2. Factors leading to backshoring to 4.0 factories

Our literature review led us to propose 22 potential factors explaining why companies may be tempted to backshore their production to smart factories in France. We obtained a consensus, ranging from moderate to strong, for 13 of these factors as illustrated in the table below.

Factors likely to lead a company to backshore to 4.0 factories in France	**Responses**
Ability to provide a hybrid good, between product and service, reflecting what customers are increasingly looking for	83%
Ability to have an automated but flexible industrial tool, which was not possible before, since industrial automation was rigid and did not allow for the production of a specific type of predefined product	83%
Ability to offer fully customised products	72%
Benefiting from a positive corporate image by striving to respond to customers' needs and desires in a short time	72%
Being close to the final customers, and therefore more able to understand their needs	67%
Ability to replace people with machines, thereby lowering the cost of labour in France	67%
Benefiting from a better brand image with the "*made in France"* label	61%
Ability to benefit from facilitated research and development activities	61%
Ability to offer a shorter manufacturing lead time using sophisticated 4.0 technology	50%
Ability to offer shorter delivery times	50%
Ability to ensure that products are of impeccable quality through the use of 4.0 production tools	50%
Ability to benefit from an attractive French ecosystem with many startups	50%
Ability to innovate more easily than in offshoring countries	50%

Table 1- Factors contributing to backshoring to 4.0 factories

The factors for which there was the greatest consensus among the experts relate to changing customer demands, with customers increasingly seeking customized products and related services. Virtually all the experts (83%) agree that companies may be tempted to backshore their production to 4.0 factories in France in order to offer hybrid goods, midway between a product and service. Because the services must be responsive, seeking proximity with customer markets is a major factor contributing to backshoring.

The factory of the future, with its flexible and automated equipment, will make it possible to produce extremely customized goods that meet customers' needs more effectively, since it will be located nearby and will be in constant communication with them in order to better understand their needs.

The experts also agree, but to a lesser extent, on the fact that seeking responsiveness and quality could play an important role in the decision to backshore. Lastly, seeking a better corporate image through the "made in France" label is also a factor that can lead to backshoring for 61% of our panel.

We have seen that a number of scholars highlight these factors contributing to backshoring decisions: some assert the importance of seeking responsiveness and quality (Kinkel and Malocca, 2009; Kinkel, 2014), while others point to the importance of locating factories in proximity to customer markets in order to produce small customized series (Martinez-Mora and Moreno, 2014). Seeking this type of responsive supply chain would then appear to provide a strong argument for backshoring to 4.0 factories in France.

Backshoring could also be fostered by financial considerations. Two thirds of the experts consider the search for lower labour costs to be a compelling factor for backshoring to factories of the future, where tasks with no added value can be automated. This is in line with conclusions of Albjorn and Mikkelsen (2014) who identified automation – though at a stage less advanced than the 4.0 factory - to be a factor in backshoring by lowering the labour cost differential between developed and emerging countries.

The great majority of the experts assert that backshoring to a factory of the future would also allow for better use of production tools, since they could be both flexible and automated, which is not usually the case with the previous generation of tools.

Our experts also point to the advantages of facilitated research and development activities. The research tax credit (CIR) provides financial assistance. In addition, companies may hope to benefit from the French ecosystem, which is considered to be quite advantageous with its great number of startups. Lastly, half the experts underscore the benefit of locating production facilities near design centres, in order to foster innovation and speed up the development of new products. This goes along with arguments outlined by Abecassis-Moedas and Moatti (2015).

3.3 Barriers to backshoring to 4.0 factories

We provided a list of 20 main barriers to our panel and obtained a consensus for 9 of these barriers, as illustrated in the following table:

Main barriers to the backshoring of French production to 4.0 factories	Responses
Industry 4.0 is not exclusive to France. Companies may choose to take advantage of industry 4.0 in emerging or neighbouring countries	78%
Labour legislation is rather strict and not very advantageous in France	67%
Business leaders display a certain naivety and do not consider industry 4.0 to be a pressing issue	61%
Leaders are under the impression that industry 4.0 is expensive and that there is not enough return on investment	61%
Some companies aim to supply a local market in emerging countries. Therefore, backshoring to France does not make sense.	61%
French leaders have not yet come to grips with this industrial revolution	56%
The tax environment in France is not very favourable	56%
Customers are not necessarily seeking high value-added products. They may rather pay lower prices for less customized products, with longer delivery times	56%
It requires a significant investment for the company	50%

Table 2- barriers to backshoring to French 4.0 factories

The barrier for which there was the greatest consensus is related to the very nature of the industry of the future, which makes it possible to improve productivity and product quality, regardless of where the site is located: industry 4.0 is clearly not exclusive to France. Therefore, some companies have no reason to backshore production to France and may decide to take advantage of the development of industry 4.0 in emerging countries or in countries neighbouring France. However, the geographic distribution of the stakeholders in the value chain would be different, along with the economic, social and political factors. These dimensions will be decisive in companies' choice to return to France or not.

The second category of barriers identified by the experts involves the French institutional environment. The majority of experts interviewed (67%) point to labour code legislation in France, which is considered to be rather strict and not very favourable. 56% of the experts also believe that French taxes, which are often seen as high and complicated, could be a barrier to backshoring production to 4.0 factories.

A number of barriers identified by the experts relate to industrial leaders' reluctance to adopt 4.0 factories. Many question the technological maturity of industry 4.0 and consider that the ecosystem is not advanced or mature enough. The majority of the experts (61%) also assert that too many business leaders still believe that industry 4.0 is expensive and that there is not enough return on investment. Finally, 56% of the experts believe that French business leaders have not yet fully come to grips with this industrial revolution. And yet, they are the ones responsible for deciding whether to backshore to French 4.0 factories.

To conclude, companies whose clients are not seeking customized, high value-added products with rapid delivery times and companies that have offshored production to supply local markets in emerging countries are clearly not interested in the possibility of backshoring to 4.0 factories in France.

3.4.Types of companies likely to backshore to 4.0 factories in France

To define more precisely the types of companies most likely to be affected by the movement to backshore production to French 4.0 factories, we studied two key dimensions: business sector and company size.

In terms of sectors, we proposed a series of 15 items to our panel and obtained a (weak) consensus for two of these items: the majority of experts interviewed (56%) maintain that the sectors in which companies are the most likely to backshore their production to 4.0 factories in France are those subject to the dual constraint of customisation of goods and quick delivery time. The supply chain must be very short in such situation. Moreover, half of the experts (50%) report that the sectors most likely to be affected are those in which companies must be located as close as possible to consumers, in an attempt to better understand and serve their specific needs. This confirms our previous results.

We were not able to obtain a consensus concerning the precise sectors: according to 72% of the experts, the only industries that appear to be excluded from this phenomenon are heavy and process industries. The constraints of these sectors, from extremely complicated processes to large-scale investment, rule out backshoring.

Our second question sought to determine the size of companies likely to decide to backshore to a factory of the future. 67% of the experts interviewed assert that

companies of all sizes (SMEs, mid-caps and major firms) may choose to backshore to 4.0 factories for two main reasons. First of all, industry 4.0 makes it possible to produce in small workshops, which are accessible for all companies, whether SMEs or major firms, though bigger companies would probably be able to backshore to larger factories of the future. Secondly, the entry barriers for these new technologies have broken down as their acquisition costs have decreased.

3.5. The consequences of backshoring on companies' supply chains

We provided our panel with a list of nine proposals concerning foreseeable changes in supply chains, and obtained a consensus for four of them.

First of all, nearly three quarters of the experts interviewed (72%) report that companies' supply chains will be drastically transformed by the hybridisation of industry and services introduced by 4.0 technologies. Services including product repair, specification, and updating will have to be incorporated into companies' supply chains.

72% of the experts also assert that backshoring to 4.0 factories in France will allow companies to achieve real time supply chain management. Therefore, at any given moment, companies will be able to determine where products are in their lifecycle.

The majority of experts (67%) believe that such a movement will lead to a tighter, shorter and simpler supply chain for companies. Customers and suppliers will be more incorporated in the process. By backshoring to 4.0 factories in France, companies will be able to ensure just-in-time flows. Products will be designed and manufactured close to the final consumer and upon request, making it possible to minimise transport and inventory. And global supply chains will become increasingly rare.

Lastly, 56% of the experts say that companies' supply chains will have to be more flexible. They will be organized in order to allow companies to easily manage significant fluctuations in activity.

Conclusion

At the academic level, our research ties together two topics that are generally examined separately and contributes to a better understanding of the impact of the arrival of 4.0 technologies on decisions related to the backshoring of production to France. In particular, this study helps show that the development of factories of the future may call into question the current thought process for choosing locations for manufacturing facilities. This first approach to a very forward-looking topic was made possible through the use of the Delphi method and paves the way for new areas of research and debates on the topic.

At the managerial level, our research shows that it is essential for companies currently pursuing an offshoring strategy to question the appropriateness and sustainability of their approach. We have seen that the movement to backshore production to factories of the future cannot, at this stage, be limited to certain specific sectors and that it is likely to affect companies of all sizes. Lastly, when companies are faced with a need to be located in proximity to their customers, offer customisation services for their goods or quick delivery, they must evaluate the opportunity provided by the backshoring of production. Only heavy and process industries can be excluded from this approach. Companies that have offshored production can refer to the list of contributing factors and barriers to backshoring to determine which ones are relevant in regard to their business, evaluate their importance, and make an assessment to decide whether or not it is appropriate to begin looking into opportunities for backshoring.

References

Arlbjørn J.S., Mikkelsen O.S., (2014), « Backshoring manufacturing: Notes on an important but under-researched theme », *Journal of Purchasing & Supply Management* 20, 60-62

Abecassis-Moedas C., Moatti V., (2015), « Location decisions in the European fashion industry: behind the mirror », *Actes de la XXIV Conférence Internationale de Management Stratégique*, Paris

Ancarani A., Di Mauro C. (2018) Successful digital transformations need a focus on the individual. In: Schupp F., Wöhner H. (eds) *Digitalisierung im Einkauf*. Springer Gabler, Wiesbaden, p 11-26

Atkinson, William (2012), « How to Benefit from Reshoring », *Distributor Focus*, juillet

Barbieri P., Ciabuschi F., Fratocchi L. and Vignoli M., (2018) "What do we know about manufacturing reshoring?", *Journal of Global Operations and Strategic Sourcing*, Vol. 11 Issue: 1, pp.79-122

Bals L., Daum A., Tate W.L. (2015), « From Offshoring to Rightshoring: Focus on the Backshoring Phenomenom », *Academy of International Business Insights*, Vol. 15, No. 4, 3-8

Bidet-Mayer, T.(2016), *L'industrie du futur : une compétition mondiale,* Paris, Presses des Mines

Booto Ekionea J.-P., Bernard P. and Plaisent M. (2011),« Consensus par la méthode Delphi sur les concepts clés des capacités organisationnelles spécifiques de la gestion des connaissances », *Recherches Qualitatives*, Vol. 29(3), pp. 168-192

Blanchet, Max (2016), *Industrie 4.0 : la transition quantifiée*, Roland Berger (éd.), avril

Capgemini (2015), *Industry 4.0 – The Capgemini Consulting View*

Dachs B., Zanker C. (2014), *Backshoring of Production Activities in European Manufacturing*, Fraunhofer Institute (éd.), december

Deloitte (2014), *Industry 4.0 : challenges and solutions for the digital transformation and use of exponential technologies*.

Fel F., Griette E., (2017) "Near-reshoring your supplies from China: a good deal for financial motives too", *Strategic Direction*, vol 33, n°2.

Fratocchi L., Di Mauro C., Barbieri P., Nassimbeni G., Zanoni A. (2014), « When manufacturing moves back: Concepts and questions », *Journal of Purchasing & Supply Management* 20, 54-59

Fratocchi L., Ancarani A., Barbieri P., Di Mauro C., Nassimbeni G., Sartor M., Vignoli M., Zanoni A. (2015), « Manufacturing Back-Reshoring as a Nonlinear Internationalization Process », *The Future of Global Organizing*, 365-403, 16 octobre

Fratocchi L., Ancarani A., Barbieri P., Di Mauro C., Nassimbeni G., Sartor M., Vignoli M., Zanoni A. (2016), « Motivations of manufacturing reshoring: an interpretative framework », *International Journal of Physical Distribution & Logistics Management*, Vol. 46 No. 2, p.98-127

Gray J., Skowronski K., Esenduran G., Rungtusanatham J. (2013), « The reshoring phenomenon: what supply chain academics ought to know and should do », *Journal of Supply Chain Management*, Volume 49, Number 2, april

Kinkel S. (2014), « Future and impact of backshoring – Some conclusions from 15 years of research on German practices », *Journal of Supply Chain Management* 20, 63-65

Kinkel, S., and Maloca, S. (2009), "Drivers and antecedents of manufacturing offshoring and backshoring, A German perspective", *Journal of Purchasing & Supply Management*, 15(3): 154-165.

McKinsey & Cie, (2015), *Industry 4.0: How to navigate digitization of the manufacturing sector*

Martinez-Mora and Moreno (2014), "Offshoring in the Spanish footwear industry: A return journey?", *Journal of Purchasing and Supply Management*, Volume 20, Issue 4, December 2014, p.225–237.

Smit J., Kreutzer S., Moeller C., Carlberg M. (2016), *Industry 4.0*, Study for the ITRE Committe, European Parliamant (éd.), february

Schumacher A., Erol S., and Sihn W. (2016), *A Maturity Model for Assessing Industry 4.0 Readiness and Maturity of Manufacturing Enterprises*", Procedia CIRP 52, 161 – 166

Thoben, K.-D.,Wiesner, S., and Wuest, T., (2017), "Industrie 4.0" and Smart Manufacturing
– A Review of Research Issues and Application Examples", *Int. J. of Automation Technology*, Vol.11 No.1, p.4-16

Van den Bossche P., Gupta P., Gutierrez H., Gupta A. (2014), « Solving the Reshoring Dilemma », *Supply Chain Management Review*, janvier/février, p.26-33

Wallace E. and Riddick F., (2013), "Panel on Enabling Smart Manufacturing,"State College, USA,

White W. and Borchers A., (2016), "Motivation Behind Reshoring Decisions in Manufacturing", *Operations and Supply Chain Management*, vol 9, n°3, p.205-209

Wiesmann B., Snoei J.R., Hilletofth P., Eriksonn D. (2017), « Drivers and barriers to reshoring: a literature review on offshoring in reverse », *European Business Review*, Vol. 29 Iss 1 p.15-42