RESUMEN AMPLIADO

Título: Industry 4.0 in industrial district SMEs: understanding collective knowledge transfer by research and transfer institutes

Hervas-Oliver JL, jose.hervas@omp.upv.es

Departamento: DOE

Universidad Politècnica de Valencia

Área Temática: *Sesion Especial 07 Industry 4.0 in clusters,*

Resumen:

Digitization or Industry 4.0 in regions, clusters and districts is a very nascent phenomenon that remains under-researched (e.g.Pagano et al., 2021; Bettiol et al., 2021; Hervas-Oliver et al., 2019). This study analyzes place-based innovation policy for digitizing traditional industrial districts (MIDs). In particular, we compare different Industry 4.0 initiatives across industrial districts in Spain, analyzing the different approach followed in each of them for tailoring to each place.

This study approaches Industry 4.0 in MIDs by analyzing the initiatives undertaken in Spanish industrial districts by research and transfer institutes (RTIs) that support and promote digitization in their focal territories. Assuming that RTIs complement and support knowledge generation and diffusion in districts (e.g. Cooke et al., 1997; García-Quevedo and Mas-Verdú, 2008; Hervas-Oliver et al., 2012; Belso et al., 2018), we analyze their activities to co-design and implement digitization initiatives along with policymakers and other local actors, following a place-sensitive adaptation of the same regional policy program.

In this context, we ask the following question that constitutes this study's goal: how are developed place-based innovation policies to digitize districts?

We refer to place-based innovation policies (e.g. Wolfe and Creutzberg, 2005; Barca 2009; Ebbekink & Arnoud Lagendijk, 201; Neumark and Simpson, 2015; Dohse,

Fornahl & Vehrke, 2018; Magro and Wilson, 2019) as initiatives built upon associative structures of governance that are bottom-up, decentralized, open, consultative, involve local actor coordination and allows the co-design of those initiatives by public and private stakeholders that present a common understanding about the territory and its change. Similarly, Feldman and Lowe (2018) posit that effective policies are based upon bottom-up endogenous negotiations among local actors that include subsequent adaptations and incremental changes in response to changing conditions. These initiatives are constructed upon creative actions and collective decisions that take into account local social conditions and the interactions of actors in the policy. This collective learning occurs in local communities of practices that share a set of problems or expertise and interact, and are based upon social practice and interactive learning, where people learn through engaging in a social practice and interactive learning, building upon the basis of collectively shared understanding of a territory's strategic needs and priorities (Ebbekink & Arnoud Lagendijk, 2013:749). These initiatives are oriented to solve future problems, present a diversity of multi-actors, and are oriented to joining complementary capabilities from different actors and industries, enticing cross-fertilization of ideas and promoting joint or collective action (e.g. Uotila et al., 2012). Magro and Wilson (2019) refer to a similar concept, highlighting the debate and co-design of initiatives by different local stakeholders that cross-fertilize ideas to find a solution in a collaborative atmosphere.

We argue that designing and implementing digitization in districts requires from collective actions and *collective actors*. By collective actor, we refer to public and private organizations formed by a coalition of industry, government and science representatives that are geographically, institutionally and socially embedded (e.g. York et al., 2016).

Thus, the study contributes to understanding much better place-based initiatives to digitize districts, showing how effective policies need to be tailored to the local specificities, technologies and actors. This study's focal change is digitization policies in three different districts in Spain: the *Vinalopo* footwear district (e.g. Belso-Martinez et al., 2018), the Toy-Valley district (e.g. Balland et al., 2016) and the Ceramic tile district of Castellon (e.g. Hervas-Oliver et al., 2017). This study's method includes literature review and empirical evidence through 24 interviews.

REFERENCES:

Albors-Garrigós, J., Rincon-Diaz, C.A., Igartua-Lopez, J.I., 2014. Research technology organisations as leaders of R&D collaboration with SMEs: role, barriers and facilitators. Technology Analysis and Strategic Management 26. https://doi.org/10.1080/09537325.2013.850159

Allen, T.J., 1977. Managing the Flow of Technology. MIT Press Cambridge MA.

Apa, R., de Noni, I., Orsi, L., Sedita, S.R., 2018. Knowledge space oddity: How to increase the intensity and relevance of the technological progress of European regions. Research Policy 47. https://doi.org/10.1016/j.respol.2018.06.002

Autio, E., Nambisan, S., Thomas, L. D. W., & Wright, M. (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, *12*(1), 72–95. https://doi.org/10.1002/sej.1266

Bailey, D., Pitelis, C., Tomlinson, P.R., 2018. A place-based developmental regional industrial strategy for sustainable capture of co-created value. Cambridge Journal of Economics 42, 1521–1542. https://doi.org/10.1093/cje/bey019

Barge-Gil, A., Modrego-Rico, A., 2008. Are technology institutes a satisfactory tool for public intervention in the area of technology? A neoclassical and evolutionary evaluation. Environment and Planning C: Government and Policy 26. https://doi.org/10.1068/c70m

Becattini, G., 1990. The Marshallian industrial district as a socio-economic notion, in: Industrial Districts and Inter-Firm Co-Operation in Italy. International Institute for Labour Studies, pp. 413–431.

Belso-Martínez, J. A. (2010). International outsourcing and partner location in the Spanish footwear sector: an analysis based in industrial district SMEs. *European Urban and Regional Studies*, *17*(1), 65-82.

Bellandi, M., de Propris, L., Santini, E., 2019. Industry 4.0+ challenges to local productive systems and place-based integrated industrial policies, in: Transforming Industrial Policy for the Digital Age. Edward Elgar Publishing., pp. 201–218. https://doi.org/10.4337/9781788976152.00016

Bellandi, M., Santini, E., Vecciolini, C., de Propris, L., 2020. Industry 4.0: Transforming local productive systems in the Tuscany region, in: Industry 4.0 and Regional Transformations. Routledge.

Bellini, N., Pasquini, F., 2018. The Case of ERVET in Emilia-Romagna, in: Regional Development Agencies in Europe. https://doi.org/10.4324/9781315000206-18

Belso-Martinez, J.A., Diez-Vial, I., Lopez-Sanchez, M.J., Mateu-Garcia, R., 2018. The brokerage role of supporting organizations inside clusters: how does it work? European Planning Studies 26. https://doi.org/10.1080/09654313.2017.1422482

Belussi, F., Sammarra, A., Sedita, S.R., 2010. Learning at the boundaries in an "Open regional innovation system": A focus on firms' innovation strategies in the Emilia Romagna life science industry. Research Policy 39. https://doi.org/10.1016/j.respol.2010.01.014

Bettiol, M., di Maria, E., Micelli, S., 2020. Knowledge Management and Industry 4.0: New Paradigms for Value Creation. Springer.

Boari, C., Lipparini, A., 1999. Networks within industrial districts: Organising knowledge creation and transfer by means of moderate hierarchies. Journal of Management and Governance 3. https://doi.org/10.1023/A:1009989028605

Breschi, S., Lissoni, F., 2001. Knowledge spillovers and local innovation systems: A critical survey. Industrial and Corporate Change 10. https://doi.org/10.1093/icc/10.4.975

Brusco, S., 1992. Small firms and the provision of real services, in: Pyke, F., Sengenberger, W. (Eds.), Industrial Districts and Local Economic Generation. Geneva, pp. 110–300.

Büchi, G., Cugno, M., Castagnoli, R., 2020. Smart factory performance and Industry 4.0. Technological Forecasting and Social Change 150. https://doi.org/10.1016/j.techfore.2019.119790

Clausen, T., Pohjola, M., Sapprasert, K., Verspagen, B., 2012. Innovation strategies as a source of persistent innovation. Industrial and Corporate Change 21. https://doi.org/10.1093/icc/dtr051

Cooke, P., 2001. Regional innovation systems, clusters, and the knowledge economy. Industrial and Corporate Change 10, 945–974. https://doi.org/10.1093/icc/10.4.945

Cooke, P., Uranga, M.G., Etxebarria, G., 1997. Regional innovation systems: Institutional and organisational dimensions. Research Policy 26. https://doi.org/10.1016/s0048-7333(97)00025-5

Cruz-Castro, L., Sanz-Menéndez, L., Martínez, C., 2012. Research centers in transition: Patterns of convergence and diversity. Journal of Technology Transfer 37. https://doi.org/10.1007/s10961-010-9168-5

Dalenogare, L.S., Benitez, G.B., Ayala, N.F., Frank, A.G., 2018. The expected contribution of Industry 4.0 technologies for industrial performance. International Journal of Production Economics 204. https://doi.org/10.1016/j.ijpe.2018.08.019

de Propris, L., Bailey, D., 2020. Industry 4.0 and Regional Transformations, Industry 4.0 and Regional Transformations. https://doi.org/10.4324/9780429057984

Ebersberger, B., Bloch, C., Herstad, S.J., van de Velde, E., 2012. Open innovation practices and their effect on innovation performance. International Journal of Innovation and Technology Management 9. https://doi.org/10.1142/S021987701250040X

Edler, J., Fagerberg, J., 2017. Innovation policy: What, why, and how. Oxford Review of Economic Policy 33. https://doi.org/10.1093/oxrep/grx001

Feller, I., Glasmeier, A., Mark, M., 1996. Issues and perspectives on evaluating manufacturing modernization programs. Research Policy 25. https://doi.org/10.1016/0048-7333(95)00834-9

García-Quevedo, J., Mas-Verdú, F., 2008. Does only size matter in the use of knowledge intensive services? Small Business Economics 31. https://doi.org/10.1007/s11187-007-9090-x

Gilbert, B.A., 2012. Creative destruction: Identifying its geographic origins. Research Policy 41. https://doi.org/10.1016/j.respol.2011.11.005

Giuliani, E., 2011. Role of Technological Gatekeepers in the Growth of Industrial Clusters: Evidence from Chile. Regional Studies 45. https://doi.org/10.1080/00343404.2011.619973

Giuliani, E., Bell, M., 2005. The micro-determinants of meso-level learning and innovation: Evidence from a Chilean wine cluster. Research Policy 34. https://doi.org/10.1016/j.respol.2004.10.008

Glasmeier, A., 1991. Technological discontinuities and flexible production networks: The case of Switzerland and the world watch industry. Research Policy 20. https://doi.org/10.1016/0048-7333(91)90070-7

Glasmeier, A.K., 1999. Territory-based regional development policy and planning in a learning economy: The case of "real service centers" in industrial districts. European Urban and Regional Studies 6. https://doi.org/10.1177/096977649900600106

Hassink, R., 1997. Technology transfer infrastructures: Some lessons from experiences in Europe, the US and Japan. European Planning Studies 5. https://doi.org/10.1080/09654319708720404

Hervas-Oliver, J.L., Albors-Garrigos, J., 2014. Are technology gatekeepers renewing clusters? Understanding gatekeepers and their dynamics across cluster life cycles. Entrepreneurship and Regional Development 26. https://doi.org/10.1080/08985626.2014.933489

Hervas-Oliver, J.L., Albors-Garrigos, J., de-Miguel, B., Hidalgo, A., 2012. The role of a firm's absorptive capacity and the technology transfer process in clusters: How effective are technology centres in low-tech clusters? Entrepreneurship and Regional Development 24. https://doi.org/10.1080/08985626.2012.710256

Hervas-Oliver, J.L., Estelles-Miguel, S., Mallol-Gasch, G., Boix-Palomero, J., 2019. A place-based policy for promoting Industry 4.0: the case of the Castellon ceramic tile district. European Planning Studies 27. https://doi.org/10.1080/09654313.2019.1642855

Hervas-Oliver, J.L., Lleo, M., Cervello, R., 2017. The dynamics of cluster entrepreneurship: Knowledge legacy from parents or agglomeration effects? The case of the Castellon ceramic tile district. Research Policy 46. https://doi.org/10.1016/j.respol.2016.10.006

Hervás-Oliver, J. L., Albors-Garrigos, J., Estelles-Miguel, S., & Boronat-Moll, C. (2018). Radical innovation in Marshallian industrial districts. *Regional Studies*, *52*(10), 1388-1397.

Hoppmann, J. (2021). Hand in hand to Nowhereland? How the resource dependence of research institutes influences their co-evolution with industry. Research Policy, 50(2), 104145.

Intarakumnerd, P., Goto, A., 2018. Role of public research institutes in national innovation systems in industrialized countries: The cases of Fraunhofer, NIST, CSIRO, AIST, and ITRI. Research Policy 47. https://doi.org/10.1016/j.respol.2018.04.011

Isaksen, A., 2018. From success to failure, the disappearance of clusters: A study of a Norwegian boat-building cluster. Cambridge Journal of Regions, Economy and Society 11. https://doi.org/10.1093/cjres/rsy007

Jensen, M.B., Johnson, B., Lorenz, E., Lundvall, B.Å., 2007. Forms of knowledge and modes of innovation. Research Policy 36. https://doi.org/10.1016/j.respol.2007.01.006

Kapetaniou, C., Rieple, A., Pilkington, A., Frandsen, T., Pisano, P., 2018. Building the layers of a new manufacturing taxonomy: How 3D printing is creating a new landscape of production eco-systems and competitive dynamics. Technological Forecasting and Social Change 128. https://doi.org/10.1016/j.techfore.2017.10.011

Kauffeld-Monz, M., Fritsch, M., 2013. Who Are the Knowledge Brokers in Regional Systems of Innovation? A Multi-Actor Network Analysis. Regional Studies 47. https://doi.org/10.1080/00343401003713365

Kaufmann, A., Tödtling, F., 2002. How effective is innovation support for SMEs? An analysis of the region of Upper Austria. Technovation 22. https://doi.org/10.1016/S0166-4972(00)00081-X

Kline, S., Rosenberg, N., 1986. An Overview on Innovation, in: The Positive Sum Strateg.

Knockaert, M., Spithoven, A., 2014. Under Which Conditions Do Technology Intermediaries Enhance Firms' Innovation Speed? The Case of Belgium's Collective Research Centres. Regional Studies 48. https://doi.org/10.1080/00343404.2012.708405

Koch, L., Simmler, M., 2020. How important are local knowledge spillovers of public R&D and what drives them? Research Policy 49. https://doi.org/10.1016/j.respol.2020.104009

Laumann, E.O., Marsden, P. v., 1979. The Analysis of Oppositional Structures in Political Elites: Identifying Collective Actors. American Sociological Review 44. https://doi.org/10.2307/2094524

Lazerson, M.H., Lorenzoni, G., 1999. The firms that feed industrial districts: A return to the Italian source. Industrial and Corporate Change 8. https://doi.org/10.1093/icc/8.2.235

Lissoni, F., 2001. Knowledge codification and the geography of innovation: The case of Brescia mechanical cluster. Research Policy 30. https://doi.org/10.1016/S0048-7333(01)00163-9

Lorenzoni, G., Lipparini, A., 1999. The leveraging of interfirm relationships as a distinctive organizational capability: A longitudinal study. Strategic Management Journal 20. https://doi.org/10.1002/(SICI)1097-0266(199904)20:4<317::AID-SMJ28>3.0.CO;2-3

Martinelli, A., Mina, A., & Moggi, M. (2021). The enabling technologies of industry 4.0: Examining the seeds of the fourth industrial revolution. *Industrial and Corporate Change, Forthcoming*.

Magro, E., Wilson, J.R., 2019. Policy-mix evaluation: Governance challenges from new place-based innovation policies. Research Policy 48. https://doi.org/10.1016/j.respol.2018.06.010

Mitra, A., O'Regan, N., Sarpong, D., 2018. Cloud resource adaptation: A resource based perspective on value creation for corporate growth. Technological Forecasting and Social Change 130. https://doi.org/10.1016/j.techfore.2017.08.012

Moeuf, A., Lamouri, S., Pellerin, R., Tamayo-Giraldo, S., Tobon-Valencia, E., Eburdy, R., 2020. Identification of critical success factors, risks and opportunities of Industry 4.0 in SMEs. International Journal of Production Research 58. https://doi.org/10.1080/00207543.2019.1636323

Molina-Morales, F.X., Martínez-Cháfer, L., 2016. Cluster Firms: You'll Never Walk Alone. Regional Studies 50. https://doi.org/10.1080/00343404.2014.952719

Morrison, A., 2008. Gatekeepers of knowledge within industrial districts: Who they are, how they interact. Regional Studies 42. https://doi.org/10.1080/00343400701654178

Müller, J.M., Buliga, O., Voigt, K.I., 2018. Fortune favors the prepared: How SMEs approach business model innovations in Industry 4.0. Technological Forecasting and Social Change 132. https://doi.org/10.1016/j.techfore.2017.12.019

Müller, J. M., Buliga, O., & Voigt, K. I. (2020). The role of absorptive capacity and innovation strategy in the design of industry 4.0 business Models-A comparison between SMEs and large enterprises. *European Management Journal*.

Munari, F., Sobrero, M., Malipiero, A., 2012. Absorptive capacity and localized spillovers: Focal firms as technological gatekeepers in industrial districts. Industrial and Corporate Change 21. https://doi.org/10.1093/icc/dtr053

Olazaran, M., Albizu, E., Otero, B., 2009. Technology transfer between technology centres and SMEs: Evidence from the basque country. European Planning Studies 17. https://doi.org/10.1080/09654310802618010

Østergaard, C.R., Park, E., 2015. What Makes Clusters Decline? A Study on Disruption and Evolution of a High-Tech Cluster in Denmark. Regional Studies 49. https://doi.org/10.1080/00343404.2015.1015975

Pagano, A., Carloni, E., Galvani, S., Bocconcelli, R., 2021. The dissemination mechanisms of Industry 4.0 knowledge in traditional industrial districts:evidence from Italy. Competitiveness Review. https://doi.org/10.1108/CR-12-2019-0160

Parrilli, M.D., Aranguren, M.J., Larrea, M., 2010. The Role of Interactive Learning to Close the "Innovation Gap" in SME-Based Local Economies: A Furniture Cluster in the Basque Country and its Key Policy Implications. European Planning Studies 18, 351–370. https://doi.org/10.1080/09654310903497660

Porter, M.E., 1998. Clusters and the new economics of competition. Harvard business review 76.

Porter, M. E., & Heppelmann, J. E. (2014). How smart, connected products are transforming competition. In *Harvard Business Review* (Issue November 2014).

Porter, M. E., & Heppelmann, J. E. (2015). How smart, connected products are transforming companies. In *Harvard Business Review* (Vol. 2015, Issue October).

Pouder, R., st. John, C.H., 1996. Hot spots and blind spots: Geographical clusters of firms and innovation. Academy of Management Review 21. https://doi.org/10.5465/AMR.1996.9704071867

Rammer, C., Czarnitzki, D., Spielkamp, A., 2009. Innovation success of non-R&D-performers: Substituting technology by management in SMEs. Small Business Economics 33. https://doi.org/10.1007/s11187-009-9185-7

Rõigas, K., Mohnen, P., Varblane, U., 2018. Which firms use universities as cooperation partners? - A comparative view in Europe. International Journal of Technology Management 76. https://doi.org/10.1504/ijtm.2018.088703

Rush, H., Hobday, M., Bessant, J., Arnold, E., 1995. Strategies for best practice in research and technology institutes: an overview of a benchmarking exercise. R&D Management 25, 17–31. https://doi.org/10.1111/j.1467-9310.1995.tb00897.x

Sforzi, F., Boix, R., 2019. Territorial servitization in Marshallian industrial districts: the industrial district as a place-based form of servitization. Regional Studies 53. https://doi.org/10.1080/00343404.2018.1524134

Sommer, L. (2015). Industry 4.0: Are German Manufacturing SMEs the First Victims of this Revolution? *Journal of Industrial Engineering and Management*, *8*(5), 1512–1532. https://doi.org/10.3926/jiem.1470

Spithoven, A., Clarysse, B., Knockaert, M., 2011. Building absorptive capacity to organise inbound open innovation in traditional industries. Technovation 31. https://doi.org/10.1016/j.technovation.2010.10.003

Staber, U., 2009. Collective learning in clusters: Mechanisms and biases. Entrepreneurship and Regional Development 21. https://doi.org/10.1080/08985620802529526

Staber, U., Sautter, B., 2011. Who Are We, and Do We Need to Change? Cluster Identity and Life Cycle. Regional Studies 45. https://doi.org/10.1080/00343404.2010.490208

Tomlinson, P.R., Robert Branston, J., 2018. Firms, governance and development in industrial districts. Regional Studies 52. https://doi.org/10.1080/00343404.2017.1324199

Tucker, K., Bulim, J., Koch, G., North, M., Nguyen, T., Fox, J., Delay, D., 2018. Internet Industry: A Perspective Review through Internet of Things and Internet of Everything. International Management Review 14.

Vickers, I., North, D., 2000. Regional Technology Initiatives: Some insights from the English regions. European Planning Studies 8. https://doi.org/10.1080/713666413

York, J.G., Hargrave, T.J., Pacheco, D.F., 2016. Converging winds: Logic hybridization in the Colorado wind energy field. Academy of Management Journal 59. https://doi.org/10.5465/amj.2013.0657

Palabras Clave: industrial districts; Industry 4.0; place-based innovation policy; innovation
Clasificación JEL: O3, R1