

The effect of institutions fostering Industry 4.0 transition in traditional Marshallian Industrial Districts

Preliminary draft

Díez-Vial, I.¹ Belso-Martínez, J.A.²; Hervás-Oliver, J.L.³; ¹Complutense University of Madrid

²University Miguel Hernández, ³University Polytechnic of Valencia,

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Abstract

Marshallian industrial districts (MIDs) have a relevant role in the development of Industry 4.0 based innovation as they may provide the proper meso-level context for developing opportunities from the new digital paradigm. Using a multi-level approach, we focus on the role that formal and informal local institutions from the MID play and propose that they depend on degree of formalization that firms established in their direct networks with clients and providers (i.e. through contractual agreements).

Results obtained in 117 firms from the Elche footwear Industrial District endorse our theoretical expectations. On the one hand, formal local institutions at the district level positive affect Industry 4.0 innovation. On the other hand, the degree of formalization of the inter-firm relationships reinforces the influence of the district formal institutions. Therefore, policy makers and practitioner should be aware of the need of alignment of firm-level and district level formal institutions fosters Industry 4.0 innovation.

Introduction

Industry 4.0 or digitization encompasses changes in industrial and organizational activities, processes, and capabilities in order to seize opportunities from the new digital paradigm, impacting directly to existent products, services, innovation processes and business models¹.

Pioneering efforts have recently developed the application and development of digitization and that of Industry 4.0 in regions and industrial districts (MIDs)².

The objective of this research is understanding the effect that local institutions play for transition into Industry 4.0 in a MIDs, considering the degree of formalization in associated inter-firm networks. We consider that local institutions would foster Industry 4.0 development as long as they are aligned with the kind of contract that firms established in their direct networks with clients and providers.

Formal local institutions promote innovation and Industry 4.0 development by protecting firms for knowledge leakages and R&D appropriability problems⁶. Informal local institutions could play a similar role, but mainly for those firms that have developed relationships with providers and clients that are also informal. Informal local institutions provide social mechanisms of control and coordination that relegate formal ones. A high degree of formalization reduces the willingness of firms to develop informal relationships, based on trust, mutual confidence and shared values⁷.

Firms' contractual relationships with providers and clients are shaped by their internal routines; that is, firms with informal relationships would have specific internal procedures that are not easily changed or adapted to formal ones⁸. Informal local institutions of the MID would be easier to be understood and incorporated for coordinating knowledge exchange and preventing leakages with providers and clients in those relationships that are already informal⁹. The same arguments would apply for formal relationships with formal local institutions.

Theoretical framework

Institutions, described as 'the rules of the game' (North 1990) are applied to the study of clusters and industrial districts since the beginning of the theorization of the concept of localization economies³. Local institutions may help MIDs to adjust and react to innovations due to their capacity to coordinate and control firms' behaviour, while they can also hamper local innovative initiatives due to the lock-in effect⁴. Pioneering efforts have recently developed the application of digitization and that of Industry 4.0 to MIDs.

Local institutions can be formal (laws, rules and regulations) and informal (norms and values) having a different effect on Industry 4.0⁵. We posit that local formal institutions would foster Industry 4.0 development for those firms that have a high degree of formalization in their contractual relationships with providers and clients. On the contrary, local formal institutions would have a negative effect on Industry 4.0 for those firms that sustain their relationships with providers and clients on informal bases.

Sample and variables

We conducted an analysis of the district's firms using mix-methods, with 30 face-to-face in-depth interviews and 117 structured questionnaires from district firms in the Elche footwear Industrial District (EFID) located in the Valencia region (Spain).

This district is one of the most vibrant (and old) European footwear district, along Riviera del Brenta in Veneto, containing not only SMEs but large multinationals such as Zara (Tempe, Zara's footwear division) or Stuart Weitzman's luxury shoes manufacturing plants, mixing different institutional landscapes driven by multinationals and local SMEs. From an initial sample of 471 firms we obtained the questionnaire from 117 participants.

Along with the variables of the model that measure formal and informal local institutions of the MID and the kind of contractual relationships with providers and clients, we control for internal capabilities of each firm.

Table 1. Regression. Dependent variable: Industry 4.0 based Innovation

	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
Constant	***-3,065	1,478	***-3,224	1,398	*-2,367	1,407
Size	,174	,423	,102	,400	,157	,398
Firm's capabilities	2,849	,620	2,349	,606	***2,362	,602
Local network formalization (customers)	,152	,566	,196	,535	,428	,539
Local network formalization (suppliers)	-,125	,538	,026	,511	-,518	,520
MID informal institutions	,092	,369	,024	,349	-,021	,349
MID formal institutions	**843	,417	**-,3,484	1,421	**-,2,929	1,215
LNF (customers)*MID formal Inst.			***1,752	,553		
LNF (suppliers)*MID formal Inst.					***1,588	,484
R2	,280		,334		,340	,340
F-Statistic	***4,161		***5,381		***5,516	***5,516

***p<0,01; *p<0,05; *p<0,1

Results

Model 1, which includes the control variables and the main effects of the explanatory variables corroborates the positive effect of district's formal institutions (p-value<.05). In Model 2 and Model 3, the interaction between the local formal institutions and degree of formalization of firm's relationships with customers and providers are introduced. Results confirm the positive effect of both interaction teams at p-value<.01.

Discussion and conclusions

We reveal the higher complexity of the effects of the institutional framework of MID in promoting Industry 4.0 based Innovation. Rather than a direct effect, when the regional level is combined with firms level, interactions become crucial.

We observe that for 4.0 innovations, the interaction of formal and informal institutions is negative. Under circumstances where the trustful atmosphere of the cluster engender by norms and values represent efficient tools of relational dynamics, then increasing the level of formalization may difficult collective action as relying on contracts and rules is less efficient. To some extent, this suggests a substitutive effect.

When we turn to the first multi-level analysis. The negative sign of the interaction between Informal MID institutions (trust atmosphere) and degree formalization of the firm's specific relationships suggests that the misalignment of micro and meso level institutions detracts 4.0 innovation. Conversely, when micro and meso level institutions are aligned, they foster innovation. This suggest that having strong MID formal institutions negative affect interactions based on traditional norms and values. On the contrary, high formalized inter-firm relations in a high formal context foster I4I. In sum, there should a coherent alignment between the micro and the meso level institutions to promote Industry 4.0 based Innovation.