

Digital Ecosystems Adoption at Local Level: A Preliminary Comparative Analysis

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Abstract. This article focuses on the process of Digital Ecosystem adoption at territorial level. We present our views on the European approach to Digital Ecosystem. We try to define the process of DE territorial adoption as it has been modeled in last years. We carried out a preliminary analysis of ongoing comparative research about DE adoption and described the methodology used in the research process. With reference to the research preliminary data, we project how and to what extent the theoretical model of DE adoption elaborated in DBE and OPAALS projects and has been adapted and used at local level. The territorial process described here is introducing DE in different industrial sectors and originate from very diverse socio-economic situations. For this reason, interviewers are introducing DE at local level by adapting the DBE model to local needs. A preliminary analysis of these strategies and of actors involved in the process is presented. A first gaze on the technological side of DE adoption in term of infrastructure used and service developed is also provided. From the analysis, we indicate steps for future research and delineate those open questions that deserve a deeper analysis in the near future.

Keywords: Digital Ecosystems, Social Science, DE Territorial adoption, Regions, Comparative analysis.

1 Introduction

Digital Ecosystems (DEs) is a novel, not yet stabilized research field: its research objects are emerging and only a limited number of initial implementations exist. One of the main approaches is known as the “European” DE approach that emerged from the European Commission FP6 DBE projects cluster [1]. The European approach to DE is based upon an open framework with key ingredients including flexible community leadership, use of a P2P, distributed and decentralized infrastructure and Open Source Software. In this paper we apply this approach together with the socio- technical theory.

We believe that a comparative analysis of DE adoption in local/regional settings could provide useful inputs and motivations for future research. Therefore, the objective of this paper is to give preliminary results of such a comparative analysis we are conducting on experience collected from several Digital Ecosystem adoptions at local level.

The paper is organized as follows. In Section 2, we start by describing digital ecosystems as it was defined within the framework of the DBE project and then how it has been further developed within the OPAALS project. Then we outline the process that can lead a region or a community to the use of the digital ecosystem approach in a self-sustaining way by briefly describing how these processes have been modeled recently. We present our research methodology in Section 3 which is based on an initial questionnaire, interviews for deeper investigation and a workshop. In Section 4 we present and analyze preliminary data about how this model has been used, adopted and developed in different local contexts. We conclude the paper in Section 5 by highlighting some issues for the further work of our comparative analysis.

2 DE Territorial Adoption¹

We consider the DE [1] adoption, or deployment at local level, as a socio-technical process [2], [3]. This translates a process for technological environment development and knowledge creation and sharing in different local contexts, and maximizes its potentialities in term of economic development, social capital improvement, ICT diffusion and knowledge diffusion democratization. In socio-technical systems, society and technology construct and reconstruct each other in a complex process. Moreover, to understand DEs we used the metaphor of the socio-technical infrastructures [4], [5]: DEs are artifacts emerging from practice, directly connected to human activities and material structures that should be jointly analyzed with the technological and social frameworks (see: [6]). Consequently, DE adoption is a long-term investment that implies also a process of network-building, participation and the activation of multiple collaboration and involvement of diversified stakeholders (universities, intermediate actors, SMEs, policy makers and knowledge hubs) (see [7]).

In the DBE projects cluster two understandings of territorial adoption have been evolved. We will therefore present the models stemming from the DBE project and from the OPAALS one, and then we will argue for the need of a comparative adoption analysis.

2.1 The DBE Model

At the end of DBE project [7] the process of local adoption of DEs has been defined as influenced by different variables, and as a process that needs to be adapted to local needs, user behaviors, and specific historical/economic junctures (see Figure 1).

Although the DE adoption process, as DE technology, needs to be planned with the aim of being adaptable to specific local needs, we synthesized the process in the following steps:

1. DE concept dissemination and awareness building.
2. Socio-economic regional analysis: Regional/territorial Maturity Grade and/or DEII.

¹ An important disclaimer is needed here: these process models are intended to be used by local stakeholders in a phase in which (as in the current one) the technology is not yet stable and the user community is still limited. Once the technology will be fully developed (both at the infrastructure level and in terms of basic services) the process will need to be fine-tuned.

3. Regional Catalyst definition and engagement.
4. Industry/sector/community definition.
5. Users’ definition (Cluster and SMEs identification and selection, or research community identification, etc).
6. Development of a shared road-map for the development of the first habitat.
7. Training.
8. Service development and ecosystem population.
9. Pilot action evaluation (with DEII) and planning of systemic deployment of DEs.
10. Steps from 3 to 8 can be replicated for different habitats adapting the activities to the specific needs of each industry/sector/community.

This first model, that has the positive characteristic of being easily understood by local stakeholders, is based on a useful, but problematic simplification: it is mainly based on a linear process.

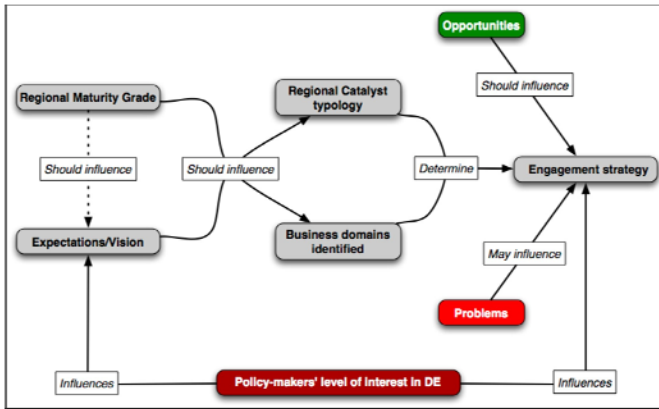


Fig. 1. DBE model of local implementation process for DEs

2.2 The OPAALS Model

An addition to the DBE model has been proposed [8], [9]. In this complementary model, the concrete actions to be taken at local level are analysed in depth and a participatory methodology is suggested. Thus, in this second approach the top-down nature of the first model is mitigated, and the local community (future users) gains a bigger role in the DE definition process. The top-down element of DE adoption, however, cannot be eliminated; due to the fact that DE deployment at local level is undoubtedly a political action that needs to involve policy-makers and needs to be connected to the institutional process of innovation policy development (this is particularly true at the present stage of digital ecosystem technology development). [8], [9] brought forth the following points to the attention of research community for consideration:

- Start from concrete local needs
- Work with people at various levels: In addition to the policy makers, innovation should involve both the management and the lower levels of business organizations and communities
- Work on what makes sense for participants, not only on the digital ecosystem idea: instead of ‘implementing’ a digital ecosystem (or a digital community ecosystem) as the core objective, focus on developing meaningful innovations for the community and use the digital ecosystem idea as a tool
- Avoid using the term “digital ecosystem” or “ecosystem”: the result of this innovation should be something meaningful for local communities also in its label. It is improbable – but not impossible – that they will adopt their own vocabulary.

In this model (Figure 2), therefore, the top-down approach meets the bottom-up processes that always exist at local level, and the Regional Catalyst becomes the principal actor responsible for the area in the middle, in which the institutional level needs to meet the necessities and aspirations of the community level.

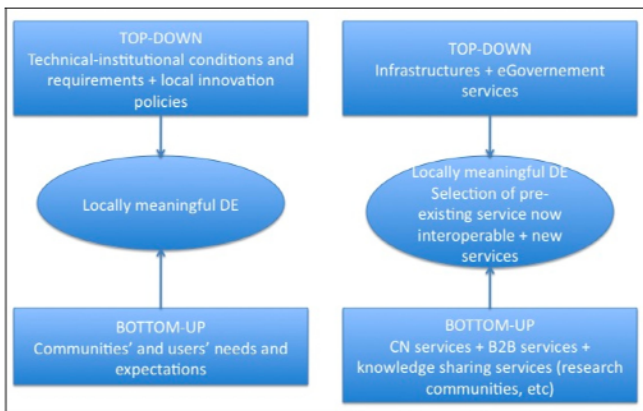


Fig. 2. A second model of DE adoption, Passani (2009) abstraction and further development from Botto and Szabo (2008)

The role of Regional Catalyst², in this model, is that of translating the digital ecosystem research into the ‘local language’ and of facilitating the process of bottom-up introduction of DE. It is consistent with the hermeneutic approach of the OPAALS projects and can be seen as an application of the participatory design and action research ideas to a complex local innovation process [10], [11].

² It is important to notice that the role of Regional Catalyst can be played in a collaborative way by more than one local actor. For example a local development agency can act as RC in the first steps of the process positively engaging the institutional level. Then a research centre or an innovative software enterprise can take action as Regional Catalyst when dealing with participatory service design. This issue has been already covered during the DBE project, see D31.6 (Passani, 2007).

The combination of the two DE adoption models accounts for Foucault’s discursive approach by taking in consideration the definition that local actors give to a DE. In addition, it also acknowledges issues of power and democratic processes by introducing participatory decision-making processes.

In this new approach to DE adoption, partially already tested in Trento and in Lazio regions, we can see a better balance between the top-down and the bottom-up approaches and the role of the Regional catalyst evolved significantly. In this model the knowledge generated by the OPAALS project (and other projects in the DBE cluster) reaches out beyond the local level because of the emphasis on the complexity of the language layer of innovation. The local DE adoption can be seen as a process in which knowledge is provided by the research community to local stakeholders that then can use it for creating new knowledge, accordingly to their concrete needs.

Power asymmetries (between the institutional and the user layer on one hand and between knowledge providers and users on the other) are also acknowledged and mitigated thanks to participatory decision-making process (participatory development of a DE adoption roadmap) and participatory service development. The discourse layer is also taken into account enabling and facilitating users to develop their own definition of what a digital ecosystem can be for them. Figure 3 shows a global summary of the participatory process of DE adoption.

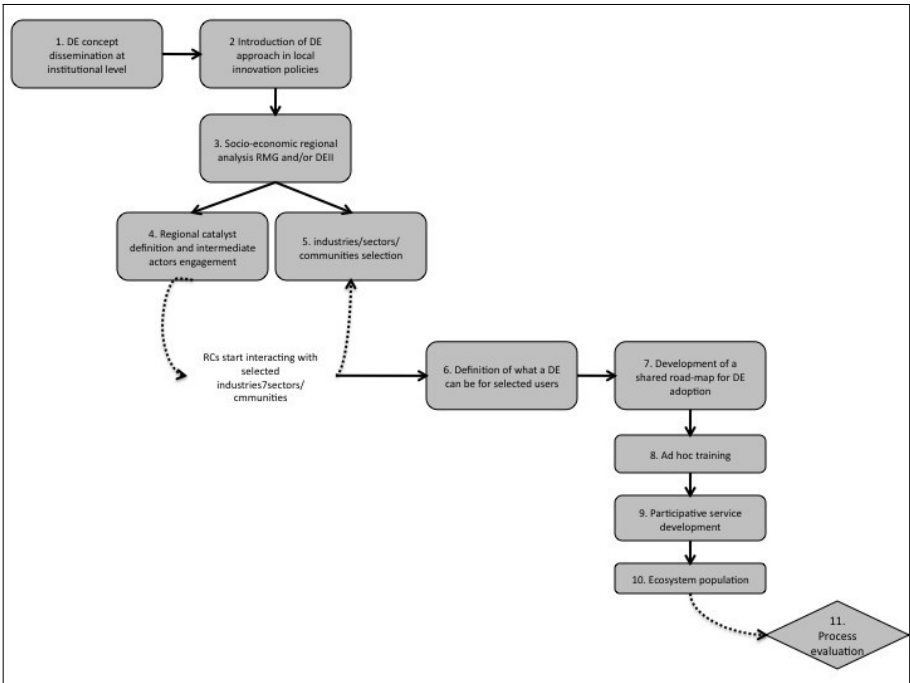


Fig. 3. OPAALS model of DE adoption

2.3 The Need for a Comparative Analysis

This paper is not the first report regarding the DE adoption cases in the DBE cluster projects. In the literature, a description of five regional cases is presented: Aragon (Spain), West Midlands (UK), India, Ireland and Brazil (see: [1]). Since the presentations of adoption cases are performed by the catalyst persons, they have the value of the first information coming from the field of real life adoption of technologies and services. Therefore the presentations are relevant because of their self-narration of adoption phases, problems encountered, expected impacts and first lessons learned. Besides this, DBE projects produced several deliverables about territorial experiences from the point of view of the regional catalysts [12], [13] and from that of the SMEs engaged [14]. The Peardrop project produced a dissemination analysis of the Aragon (Spain) and Welles (UK) cases designed especially for policy- makers.

Conversely, previously descriptions lack of (1) a common analysis framework, and (2) a critic, ex-post evaluation approach that could evidence what is working or not and why. A serious and clear analysis of successes and failures is commonly considered as a warranty of farsighted research. For this reason we started working on a comparative DE adoption analysis.

3 Methodology

As we will describe, this preliminary analysis takes into consideration the OPAALS regional cases community and some other experiences related to DE cluster projects (Eurokleis, SEAMLESS, Pearldrop and ONE) and local experiences carried out by OPAALS colleagues (DBE Lazio project).

The research strategy we delineated is articulated as follow:

1. Preliminary *questionnaire* to start investigating the core dimensions.
2. *Interviews* for further investigation of the cases.
3. *Workshop*: participative work analyzing and fine-tuning research outputs.

The analysis that follows is based only on the data gathered at the first level of the research. In this first round we took in consideration 10 cases of DE deployment, carried out by 8 organizations. Table. 1. contains the list of the organizations (both institutions and companies) to which we sent the questionnaires: all of them responded by providing the required information.

Table 1. Institutions that filled out the questionnaire

No	Institution/company	Nation
1	T6 Ecosystems srl	Italy
2	CREATE-NET	Italy
3	University of Modena and Reggio Emilia	Italy
4	Indian Inst. of Technology Kanpur (IITK)	India
5	Cambridge University	UK
6	NUI Maynooth	Ireland
7	CM International Ireland	UK
9	Instituto Tecnoloogico Aragon (ITA)	Spain

The aforementioned organizations have been or are being actually engaged in projects of DE deployment, not necessarily in the region in which they are legally located.

The map in Fig. 4 visualizes the regions in which DE deployment projects have been or are being currently activated. This first round of questionnaires took into consideration only some of the projects of DE deployment, and we cannot consider this selection exhaustive of the DE community universe. In fact, in the map, we visualized (with numbers in black) regions that are working on DE deployment and that we interviewed in this first round survey (see also Section.4); with numbers in red we indicate those regions and territories that have shown interest in the DE concept and may develop a local DE in the future.



Fig. 4. Regions working on the DE deployment³

Most of the regions marked with numbers in red belong to Den4Dek project: a network of regions working together with the specific aim of delineating a regional DE deployment plan. Beside the territories marked in the map, we have to acknowledge possibly many other territories that encountered the DE approach in the past (as was the case of West Midlands and Tampere during the DBE project) or in other projects with whom we would need to enter in touch in the next phases of this research. In the next section we will describe why we started our analysis from this group of organizations and how we are going to possible enlarge the sample.

³ Region marked with black number are reported at the beginning of Section 4. The list of the regions marked in red is as follows: 11= Basque country (Spain); 12= Valencia (Spain); 13= Umbria (Italy); 14= Extremadura (Spain); 15= Galicia (Spain); 16= Madeira (Portugal); 17= East-Slovak region (Slovak); 18=State Vorarlberg (Austria); 19= Southern Great Plain region (Hungary); 20= Helsinki region (Finland); 21= Buenos Aires area (Argentina).

3.1 Cases Selection

It is important to underline that this is a qualitative survey with a yet not well identified universe. In fact, we are not aware of a complete list of territories and/or organizations working on DE concept and deployment. Due to this situation, we decided to use our social capital, our social and scientific networks, as first instrument for selecting the cases. We started this survey with organizations and territories participating in the OPAALS Network of Excellence. Thanks to the participation in this project and in others (ONE, DEN4DEK, DBE) we contacted researchers that are still working on DEs, excluding experiences that can be considered closed (such as the cases of West Midlands and Tampere from the DBE project). We are using a snow ball effect in order to enlarge the case sample; the criterion we are using during this process is to focus on cases that are actually deploying DE or that have at least a clear plan about how to implement it and that, possibly, have already contacted policy-makers and other territorial stakeholders.

4 Analysis

As we mentioned this first round of questionnaires took into consideration only some regional experiences, more specifically this analysis gives account of the projects undertaken/being undertaken in the following territories:

1. Lazio region (Italy)
2. Trentino (Italy)
3. European area, sector of European Cooperatives
4. Emilia Romagna (Italy)
5. Aragon (Spain)
6. India
7. Dublin (Ireland)
8. Wales (UK)
9. East Midlands (UK)
10. Cambridge and Peterborough (UK)

Beside regional experiences we can see also a different approach (Case 3 above), developed by CREATE-NET, which applied the DE approach not to a specific territory but to a commercial sector: in this case the one of European Cooperatives. In this case, DE concept is going to be spread at European level, possibly impacting many and different territories, but - as we will see in the following paragraphs - the strategy of deployment is not regional based/focused.

All the people interviewed have been or are engaged in DE cluster projects, in some cases in more than one; consequently each project of DE deployment here analyzed is linked with one or more EU projects. We can speak of a DE community of researchers and practitioners that - thanks to different European projects - developed and applied the concept of DE in different territories. As the Table 2 makes evident, some projects are more represented in this survey than others, but all DE cluster projects are represented at least through one of the person interviewed.

Table 2. Link between regional experiences and EU projects

Regional experience and EU projects	
<i>Project</i>	<i>Respondents that participated to the project</i>
DBE	● ●
OPAALS	● ● ● ● ● ● ● ●
EFFORT	●
DEN4DEK	● ● ●
PEARDROP	● ●
ONE	●
SEAMLESS	●
EUROKLEIS	●

European projects represent also the first contact with the concept of DEs for the great majority of the interviewed. We asked them, “*When and how did you have the first knowledge on DEs?*” and with only one exception (that found out about DE concept through EU community web) all the others came across the concept because of personal contacts with researchers or EU representatives engaged in one of the above mentioned projects.

We then asked what pre-existing situation the interviewees intended to change thanks to the introduction of DE at local level. We can interpret the outputs of this questions as an answer to a core question: “*why to introduce DE?*”. The Table 3 presents the gathered data.

Table 3. Motivations for DE introduction

<i>Why to introduce DE</i>	<i>Score</i>
Fostering SMEs networking	● ● ● ● ●
Provide to SMEs and clusters new and more interoperable ICT solutions	● ● ● ● ● ●
Foster collaboration and information flow within Public Administration (PA) and between PA and enterprises	● ●
Support and further develop local innovation strategies	● ●

Table 4. Sectorwise DE adoption progress

Sector in which DE adoption has been or is going to be introduced	
<i>Sector</i>	<i>Score</i>
Tourism	● ● ●
ICT-based regional innovation system for the public sector	●
Longitudinal to different productive sectors	●
Textile	●
Logistic	●
Agriculture	●
Biotech/biomedical	● ● ●
Environmental tech	●

The aim to provide locally new and more interoperable ICT solutions (score 6) and the aim to foster SMEs networking (score 5) motivated the catalysts more than fostering collaboration with and within the PA (score 2) and develop local innovation strategies (score 2).

SMEs are at the center of many DE adoption actions, with reference to the industrial sector or belonging we can see that researchers and practitioners are working in many fields, adapting DE to different industrial fabric (Table 4). The touristic and the biotech/biomedical sectors are considered suitable for DE adoption.

Table 5. Innovation strategies and methodologies

Innovation strategy/methodology		
<i>Case</i>	<i>Initial</i>	<i>Changes</i>
1	DBE strategy	Privilege under-developed provinces; less involvement of the Regional Authority; carry on only a pilot project; reconsider the technology.
2	DBE strategy	<ul style="list-style-type: none"> • Start from concrete local needs • Work with people at the many levels (Managers, workers, citizens...) • Work on what make sense for participants • Avoid terms like DEs or Ecosystems outside the political arena
3	Identify an economic segment and companies that could take up the technology developed during and after the project lifetime	No
4	Facilitate collaboration between small companies of different sectors	No
5	Common sense	No
6	ICT led Networking and Communication	More role of social media in community creation
7	(no answer)	Strategy constantly changing to suit the very rapidly changing economic and business profile of regional development
8	Promotion of business ecosystems on the basis of advanced IT	No
9	Look at enhanced models for clustering & networking to achieve regional competitiveness	No
10	Look at enhanced models for clustering & networking to achieve regional competitiveness	No

Table 6. DE introduction strategy

DE introduction strategy		
<i>Case</i>	<i>Initial</i>	<i>Changes</i>
1	DBE and OPAALS projects strategy: introduce the DBE SW.	Found a Catalyst other than the Regional Authority.
2	DBE strategy: introduce the DBE SW and social network.	We facilitate the emergence of: <ul style="list-style-type: none"> • shared and formalized interest from the stakeholders • creation/governance rules from the Local Government. We renounced the DBE SW and considered specific services like ONE.
3	Tackle the DE adoption from a productivity point of view.	Improved the connections with the EU cooperatives.
4	By creating a network of interoperable intermediaries able to increase substantially the ICT adoption.	We are adding special purpose ICT services to solve the lack of suitable ICT tools for internal operation.
5	DBE strategy: move influencers, introduce the DBE SW in SW SMEs.	We initially planned to engage directly the users but we realized it was better to engage the SW SMEs and then they will engage the users.
6	Top-down push strategy: integrate the DE strategy with the existing development plans.	We shifted to study the online social interactions through various modes of social media platforms.
7	awareness raising; demonstrator to show DE capabilities; meetings of key players; dissemination	It is constantly under review
8	Project management tool	Rather than a project management tool the DE will be introduced as a more general knowledge sharing tool
9	...	No
10	Initially we intended to support cluster managers.	The project moved towards a support tool for collaboration between biomedical companies, clinicians and research departments.

Regarding the strategy and/or methodology of their specific innovation case (Table 5), initially the Trento and Lazio cases (1, 2) adopted the DBE strategy described in Section 2, but later reconsidered it substantially. Also the India and Ireland cases (6, 7) describe a change in their innovation strategy. The other cases do not mention the DBE strategy model and did not change their strategy after during the adoption process.

About the DE technologies introduction strategy (table 6) explicitly or implicitly most of the cases aimed to adopt the DBE project software tools at the beginning. The technology introduction strategy changes regard probably the movement through more reliable tools. The case 3 is different because it is connected to a specific service development project, working on a technological framework other than the other cases: from the beginning the ONE platform provided a web service.

Table 7. Actors involved

Actors and roles				
<i>Case</i>	<i>Public & influencers</i>	<i>Catalysts</i>	<i>Research centers</i>	<i>Enterprises, associations & users</i>
1	3	3	1	16
2	1	2	9	30
3				6
4	8		12	70
5	6	1		140
6	?	?	?	
7	2	1 (?)	6	33
8			5	80
9	5	3	2	15
10	9	1	3	29

Actors and roles involved in the 10 cases of adoption are extremely heterogeneous (Table 7). Unfortunately the data are not comparable since in some cases (i.e. case 3) the few users are in fact associations of users, therefore numbers are not so much reliable.

The relationships between the catalysts and the regional authority are the following:

- 1 case: part of the regional authority;
- 2 cases: independent from the regional authority, with a long and stable subcontracting activity;
- 3 cases: independent from the regional authority, with several project financed by the region;
- 3 cases: collaborates with the regional authority only for the DE related activities;
- 1 case: no relationship with the regional authority.

The technologies that have been chosen to support the DE are various (Table 8). As explained before the DBE project did not provide reliably working applications and actually only three cases are considering this option. Only four cases are explicitly

The state of the art of services adoption is described in the last column and says that only in the Indian case the services are currently under adoption:

- The service is a prototype, but the adoption is an idea (-o-): 1 case
- The services will be defined (--): 3 cases
- The services are being defined (-): 2 cases
- The services are under construction (+): 1 case
- Under adoption (++): 1 case

Finally we investigated the governance of the DEs (Table 10). The Governance system is not defined yet in three cases (Lazio, Aragon and Wales). Most of the cases are considering the creation of or involvement a foundation or a company or a board to govern the system. Regarding the service management, the distributed self-management suggested by the DBE cluster project is actually under consideration in only three cases (Aragon, East Midland, Cambridge and Peterborough). A more centralized solution is in operation or will be implemented in the other cases.

Table 10. Governance in DE adoptions / development

Case	Governance	
	<i>Governance system</i>	<i>Service manager</i>
1	Not yet defined.	Not yet defined.
2	Main rules: Local Government; Monitored: Board (Local Gov, Res Centers, Catalyst).	Catalyst will manage centralized services. Board will supervise.
3	Open ecosystem and public infrastructure. A foundation will coordinate the developers.	Initially a startup.
4	Based on equal rights and policies. Promoted by trusted intermediaries.	Intermediaries.
5	Not yet defined	Easily managed by the business owner.
6	Partially moderated and self-governed	IITK manages the platform.
7	(no answer)	(no answer)
8	Not yet defined.	The industrial promotion agency or the university.
9	Community Interest Company will provide a legal structure.	Project partnership.
10	Collaboration agreement initially, later more formal structure.	Project partnership.

5 Conclusions

As we saw in the previous paragraph, regional experiences of DE adoption are very different from many points of view such as: DE introduction strategy, reasons behinds

DE adoption, industrial sectors involved and so on. Another important difference deserves to be mentioned in this conclusive section.

We described the OPAALS model of DE adoption in Section IIB. It is composed of 11 steps; as obvious regional experience we considered in this article are at different steps of DE adoption. We have one case in stage two: “Introduction of DE approach in local innovation policies”; one case in stage 3 “Socio-economic regional analysis”, one case in stage 5 “Industries/sectors/communities definition”, one case in stage 6 “Definition of what a DE can be for selected users”, one more case between this stage and the followers “Development of a shared read-map for DE adoption”. Only two cases are in the last phases, one on “Participatory service development” and another in “Ecosystem population”. As evident, we are speaking - in most cases - about ongoing processes that are open to modification and are still sensible to various risks.

We will dedicate next phases of our research to the investigation of such risks, by analyzing more specifically what are the main difficulties that DE adoption process may imply. We are also really interested in describing the problems, issues, possible conflicts that occurred during the process among engaged actors.

Moreover, if in this article we focused our attention on similarities among cases; in the next step we will prioritize on the differences among them. We will go deeper on each case with the help of face to face, semi-structured interviews and we proceed with a more biographic approach in order to achieve better understanding of the actors, roles and responsibilities of different players at local level. We are really interested in understanding in depth: who is working at local level, with whom, following which specific goal and building what kind of social networks. Similarly, we will further investigate the technological aspects of DE adoption; in this respect we recognized once more the necessity of undergoing face to face interviews, in order to develop a shared language and restrict the multi-semantic nature of many terms.

In our next work, we plan to reconsider the variables used during this first stage and analyze interdependencies, moving toward a multiple-variable approach. Finally, the concrete role that DE is going to play in territorial policies will deserve a special attention. It is crucial to understand if DE can become a framework for sustainable regional development or will obtain only a minor role, due to the limited investment and impacts.

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