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DIGITAL INNOVATION: WHAT CAN PERIPHERY LEARN FROM GLOBAL CENTRES?

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ABSTRACT

Global industrial restructuring is a main reason for the current state and shape of contemporary European cities. A major problem in peripheral regions in Europe is the loss of the process and assembly segment of industrial production. Two approaches, tourism and high-tech innovation, are at the forefront of city transformation in post-industrial Europe. As tourism is a well-established development driver, we analyse whether digital innovation, a subset of high-tech innovation, can be a parallel pathway for peripheral regions to achieve more resilient and balanced development. This paper describes two digital innovation models, one in London and another in Berlin, as city development drivers to speculate on their limits and suitability for developing peripheral regions. As their direct translation is difficult, this paper defines assessment criteria within the triple helix model of innovation and re-casts them through the concept of slow innovation, which is applicable in peripheral regions. We conclude that there are different pathways to achieving suitable digital innovation conditions and that although digital innovation is currently not a major development driver in the periphery, it will be viable if interpreted through peripheral concepts.

Keywords: digital innovation, peripheral regions, redevelopment, Berlin digital innovation cluster, London digital innovation cluster

INNOVAZIONE DIGITALE: COSA PUÒ IMPARARE LA PERIFERIA DAI CENTRI GLOBALI?

SINTESI

La ristrutturazione industriale globale è una delle cause principali della condizione e della forma delle città europee contemporanee. Uno dei problemi più rilevanti delle regioni periferiche europee è stata la perdita del segmento processo e assemblaggio (P&A) nella produzione industriale. Due approcci, turismo e innovazione ad alto contenuto tecnologico, giocano un ruolo di primaria importanza per la trasformazione urbana dell'Europa post-industriale. Poiché il turismo è già una prassi consolidata, è utile chiedersi se l'innovazione digitale, un sub-settore dell'innovazione tecnologica, potrebbe rappresentare un percorso parallelo per favorire uno sviluppo più bilanciato e resiliente nelle regioni periferiche. L'articolo descrive due modelli di innovazione digitale, uno a Londra e uno a Berlino, come motori di sviluppo urbano, mettendone in luce limiti e potenzialità per lo sviluppo delle regioni periferiche. Essendo difficile replicare direttamente questi approcci, si utilizza qui la definizione di criteri di valutazione sulla base del modello di innovazione a tripla elica, rielaborandone i contenuti attraverso il concetto di innovazione lenta applicabile nelle regioni periferiche. Le conclusioni illustrano che esistono diversi percorsi verso l'innovazione digitale, e che nonostante quest'ultima non sia il principale motore di sviluppo nelle periferie, è altresì praticabile se reinterpretata attraverso concetti periferici.

Parole chiave: Innovazione digitale, regioni periferiche, riqualificazione, Berlin digital innovation cluster, London digital innovation cluster

INTRODUCTION AND RESEARCH QUESTION

Due to the occurrence of profound economic change related to the globalisation of production systems around the turn of the millennium, the European Union (EU) and the rest of the Global North saw an increased focus on both tertiary-sector services and the high-tech and innovation segment of industrial production. According to ESPON (2005, 9), *'manufacturing industries are in decline in most [EU] regions'*. A major reason for this was offshoring of the labour-intensive process and assembly (P&A) segment of industrial production (e.g. tailoring, shoe-making and assembly of kitchen appliances, toys and other low-tech products) to developing countries such as China (Lin, 1997; Yeung, 2001; Wu, 2007). Within the EU, the peripheral regions were more dependent on the P&A segment than the central areas, such as 'the European Pentagon'—which is the most urbanized area of the EU, surrounded by Hamburg, Munich, Milano, Paris and London. The economic consequences were more severe in the peripheral regions that were heavily dependent on industry and weaning protective policies. Suitable examples include the Multi Fibre Arrangement and the decline of the apparel industry of northern Italy after its conclusion (Hadjimichalis, 2006; Micelli & Sacchetti, 2014). Various strategies were proposed to substitute for the P&A loss – *'jobs were increasingly created in the service sector and in knowledge-intensive professions'* (OECD, 2015, 26). Just as Fordism instigated the rise of the middle class in the 1940s, the introduction of service economy ushered the rise of the 'creative class' (Florida, 2002), which is constantly engaged in the innovation and production of consumer products and services. An important service sector that reinvented itself during this time was tourism, which substantially aided the development of peripheral EU regions through concepts such as industrial culture (Harfst et al., 2018). This was followed by high-tech innovation—whose conceptual background can be traced back to Marshall's (1890) industrial agglomerations and the concept of region-related variety of production, which continues into a regional innovation system debate (Doloreux & Gomez, 2017). Creating a viable, innovation-based economy is a long-term effort and requires strategic development that is more readily achievable in central regions (Doloreux & Gomez, 2017; Benneworth & Hospers, 2007). However, the concept of slow innovation contradicts this belief and presents the conditions under which innovation can flourish in the periphery (Shearmur, 2015). Therefore, it offers a different reading of conditions for innovation and indicates that the dimensions of classical innovation approaches do not apply to the periphery (Eder, 2019; Eder & Trippel, 2019).

The reason we deal with digital innovation in peripheral regions is to examine the possibilities of widening the economic base. Ever since the P&A loss and reorientation of services, tourism has been one of the most visible and readily achievable sectors. However, heavy reliance on one service sector is strategically problematic, as it creates regions that are non-resilient to change. Marshall (1890), saw variety-poor industrial regions *'liable to extreme depression, in case of a falling-off in the demand for its produce'* (Marshall, 1890, 157). The same holds for service sectors as well. A timely example is the recent economic problems faced by inner-city areas where a high portion of the economy is based on cultural tourism. The non-existent touristic migration due to the COVID-19 pandemic (Gössling et al., 2021) made these areas virtually empty. Therefore, it is sensible to diversify the economic base, particularly in today's contemporary times, when the world is so interdependent and thus frequently in crisis. A successful region should, therefore, be based on the understanding of robustness and complementarity of either different industrial producers or different tertiary sectors that support and complement each other.

The diversification towards a knowledge economy, of which innovation is a part, is one such method that complements tourism well. *'Overall, globalisation and constantly changing markets have meant that knowledge and innovation have become key factors in the sustainable development of any economy'* (Galvao et al., 2019, 813). In parallel with the cohesion policy that strives for equal development of all EU regions, the knowledge economy is a key policy directive of the EU and foresees knowledge production as an important part of the EU economy. Innovation was one of the main development drivers in the Lisbon Strategy and the Europe 2020 policy, implemented through the Innovation Union flagship framework (EC, 2010).

This paper deals with the peripheral regions of the EU (ESPON, 2005; Davies & Michie, 2011) and analyses how 'digital innovation' (OECD, 2019)—a specific type of innovation—can aid in their transformation. Digital innovation can be exemplified through the new types of companies such as Uber, Netflix, Airbnb and easyJet. These companies rely heavily on digital data and digital infrastructure, and through their operations, radically disrupt the management practices of existing services in the field. In the report Digital Innovation: Seizing Policy Opportunities, OECD (2019) identifies four basic changes in innovation dynamics. (1) The data are becoming key input for innovation products; (2) the products are mainly services; (3) the speed of innovation is increasing because of its non-physical nature and

quick production capability and (4) innovation is ever more collaborative, as it is interdisciplinary and requires varied expertise (OECD, 2019, 26). The conditions regarding the classical innovation concepts of ‘knowledge spillovers’ (Komninos, 2002), ‘buzz’ (Storper & Venables, 2004) and ‘city as place’ (Amin & Thrift, 2002) indicate that digital innovation will favour global hubs such as Berlin and London, where it is indeed an important part of the economy.

This study investigates whether peripheral regions represent viable hubs for digital innovation ecosystems despite their less favourable global position, which is a prerequisite for digital innovation.

METHOD AND STRUCTURE

This study uses a qualitative rather than quantitative method of investigation. The theme of the study is examined in terms of examples and the conditions under which they are sustained. The study draws upon a ‘thick description’ defined by Geertz (1973), where through the narrative depth of the argument, the concrete world is described and individual examples are examined that seem relevant for the research question.

The paper describes two digital innovation models—‘Silicon Roundabout’ (Old Street) in London and ‘Silicon Allee’ (Torstrasse) in Berlin—as the city development drivers and speculates on their limits and suitability for developing peripheral regions. As it is difficult to translate the two examples onto the periphery, this paper achieves this by defining the assessment criteria within the triple helix of innovation (Etzkowitz & Leydesdorff, 1995) and recasts them through the concept of slow innovation (Shearmur, 2015), which is applicable in peripheral regions. The two examples are reviewed under these criteria to identify the characteristics that make them successful. This forms the basis for discussion to speculate which characteristics, and to what extent, are reproducible in the peripheral regions or if any characteristic of peripheral regions can substitute them.

As the theme of this study is to test the viability of the two models, it is impossible to deal with them through the classical approach of literature review. Thus, when describing the key concepts, we use review articles and key thinkers in parallel with the argument.

The case studies are explained through research articles and hard data. As there are limited hard data on the development of regional innovation systems and spin-offs generated by the research community (Kozina & Bole, 2018, 262), we augmented the research material with the reports provided by visible Inno-tech companies themselves. Although some

bias might exist, a rough estimate in terms of the investment value and direction of the innovation field is possible. In addition, these reports appropriately describe the topography of innovation in different cities. The data were gathered from several independent sources, such as the online data provider for start-ups Dealroom.co, the webpage of European Digital City Index 2016, State of EU Tech Report 2019 by the venture capital (VC) firm Atomico, and the Deloitte Tech Hub Potential Index for Germany.

The rest of the paper is organised into three sections. First, the main concepts of peripheral regions—digital innovation, triple helix of innovation and slow innovation—are reviewed and the assessment criteria are identified. Second, the two models of digital innovation—Silicon Allee and Silicon Roundabout—are reviewed under the identified criteria. Finally, the viability of the identified triple helix requirements is validated through slow innovation characteristics in peripheral regions; if they are not viable, the specific innovation concepts of peripheral regions that can substitute them are discussed.

DEFINITION OF CONCEPTS AND CRITERIA

Peripheral regions

In the literature and in policy, peripheral regions in the EU have not been clearly defined (Davies & Michie, 2011). Depending on the country and sector, the dimensions that define peripherality shift with the topic and geographic scale. Davies & Michie identified a set of criteria ranging from poor access to global markets and service centres, through low population density, aging or declining population, to limited access to the services of general interest. ESPON (2005) defines functional urban areas (FUAs) as a measurable agglomeration concept in which urban functions have a critical density. Here, the EU Pentagon, an area surrounded by Hamburg, Munich, Milano, Paris and London, represents ‘the European core with approximately 14% of the EU27 area, 32% of its population and 43% of its GDP’ (ESPON, 2005, 3). The rest is considered periphery. Meanwhile, the concept of developing Metropolitan European Growth Areas (MEGAs) additionally accounts for peripheral centres as important nodes. MEGAs are identified through the following four criteria: economic mass, competitiveness, global connectivity and knowledge basis. These criteria enable us to connect the concepts of geography to that of the triple helix of innovation, which has the following three dimensions: presence of industries (corresponding to the economic mass and global connectivity),

collaboration with universities (corresponding to the knowledge basis) and policies to support the connections (corresponding to competitiveness).

The peripheral regions referred to here are outside the Pentagon because of the factors such as lower competitiveness and human capital, and represent the FUAs around level-4 MEGAs (e.g. Ljubljana, Lodz, Poznan, Riga and Sofia) (ESPON, 2005, 117). These factors are mainly attributed to the lack of direct global connections or to absence of visible seat of multinationals. When talking about periphery, we should not ignore the importance of small- and medium-sized towns (SMESTOs), as they 'form important hubs and links, especially for rural regions' (ESDP, 1999). Bole et al. (2016) reported that it is exactly SMESTOs in peripheral regions like the Alps that achieve job density per inhabitant similar to that observed in larger towns, serving as Hinterland's employment centres. The SMESTO research suggests analysing the networked condition of smaller towns as providers of industry- and service-related activities, research and innovation (ESPON, 2006).

Innovation

The concept of innovation was developed for global cities, which are augmented by a vast increase in size and perceived as instruments of global capitalism (Sassen, 1991). Amin and Thrift (2002) summarised Sassen's view as '*centres of global command and control, based on the presence of global corporations, the transnational capitalist class, and labour power from around the world*' (Thrift, 2002, 53). They house the major global corporations, seats of financial institutions and banks which can offer management know-how, global connections to clients and opportunity and venture capital funds, creating a perfect condition for an 'innovation ecosystem' (Bassis & Armellini, 2018). Komninos (2002) described an array of services and external support required for such an environment to succeed, from large industrial complexes to innovation support programmes, high-tech education, business services and venture capital funds (Komninos, 2002, 29). Such an environment creates its own internal world, whose important allure for young people is 'the buzz' (Storper & Venables, 2004) and the possibility of (financial) success that is measured through the intellectual property of individual start-ups.

The proximity and density of global cities are beneficial, particularly for the infrastructure and services required by innovation teams. However, these dense sites never operate by themselves. '*What seems to matter instead is the combination of the global corporate reach of some firms and the economy of time that local proximity provides to highly mobile project teams*' (Amin & Thrift, 2002, 66). A global city's predominant function lies in its density of services and institutions required by start-ups whose workers represent an important part of Florida's 'creative class' (Florida, 2002).

Digital innovation

In the last 15–20 years, a new type of spatial restructuring led by innovation in digital services—termed 'digital disruption' (Skog et al., 2018), due to their radical change in the management structure—has emerged. The services of the 'sharing economy' (Grabher & van Tuijl, 2020) have radically transformed the organisation of global production networks. This digital restructuring, like the industrial restructuring at the turn of the millennium, has its own set of spatial and economic consequences. Companies like Uber, easyJet, Netflix, Amazon, Booking.com and Coursera are changing our way of life and the spatial organization of the territory. Just as easyJet and Booking.com abolished the need for touristic agencies and drove touristicisation of city cores through the roof, is Uber replacing the taxi dispatch services and Amazon department stores. The development of such services requires a particular type of environment, for which Amin and Thrift (2002) saw the rejuvenation of city cores as 'cities as sites' (Thrift, 2002, 63). With the reintroduction of digital innovation as a development driver, city centres have begun seeing reactivation due to its compact production (Engel et al., 2018; Kozina & Bole, 2018).

Digital innovation is a subset of innovation that has very special characteristics and spatial requirements. In the report Digital Innovation: Seizing Policy Opportunities, OECD (2019) identifies four basic changes in innovation dynamics that are typical for digital innovation. First, managing and being able to turn data into value is a key prerequisite; hence, the data are becoming key input for innovation. Second, digital innovation is permeating all sectors. Although each sector has different needs, one key feature remains the same: the products are services, which usually replace intermediaries (Uber) or force service providers to adapt. Third, the speed of innovation is increasing because of the quick production capabilities and the non-physical nature of innovation. Last, innovation is ever more collaborative, as it is interdisciplinary and requires varied expertise. Therefore, environments such as accelerators, co-working spaces, collaborative platforms (physical and virtual) and spatial ecosystems (with meeting, business and leisure infrastructure) are ever more important (OECD, 2019, 27–35).

Of the four abovementioned concepts, we select the following two for further investigation:

- Access to data in terms of policies and infrastructure
- Quality of infrastructure for collaboration

Slow and peripheral innovation

According to the literature, a major obstacle that hinders the implementation of innovation as a development driver in peripheral regions is their weak linkage to global networks. To address this issue, Shearmur (2015)

posited the concept of slow innovation. They identified three conditions under which innovation can also be implemented in peripheral regions. First, the value of innovation can change slowly or rapidly. Fast innovation is market-dependent, such as the fashion or stock market, whereas slow innovation is technical in nature (fabrication process, new materials and new software); even slower is the basic science produced in academic environments. The fast-decaying value of information can only be acted upon in global centres because of the mentioned infrastructure; however, the slow-decaying value can also be acted upon in non-global locations, such as peripheral regions. Second, some types of innovation are location-specific because knowledge is geographically rooted, replacing *'buzz and geographic proximity by various social and network proximities'* (Shearmur, 2015, 426). Some examples include natural conditions for wine growing or the law and regulation of a country. Third, the initial stage of innovation, where it is identified, does not require the entire supporting infrastructure. However, Shearmur (2015) conceded that all above-described concepts—the buzz, networks, access to global markets, proximity and VC—are required in the second stage when innovation ideas need to be commercialized and released in the market (Shearmur, 2015, 425–433).

Recently, a body of work on peripheral innovation that challenges the conception of innovation as defined for core regions has emerged. In his literature review, Eder (2019) challenged exactly the prerequisite for geographic proximities and showed how peripheral regions find other approaches for networking *'via organizational, cognitive, and technological proximity'* and through conferences (Eder, 2019, 121). They continued to identify a suitable integration of a local company into a *'global pipeline'* to substitute for the local buzz (and lack of knowledge spillovers). Furthermore, similar to Shearmur, they identified the importance of geography-specific knowledge that emerges through practice in specific occupations. To this end, we should add the networked condition of an SMESTO as a dispersed hub for geographic proximities of innovation as another viable peripheral structure that can accelerate innovation.

Based on the above, we draw the following important conclusions when considering how the London and Berlin models are transferable to peripheral regions.

- Innovation based on slow-decaying information in technology and basic science will be more successful.
- Localized and geography-specific knowledge can be a suitable source of innovation.
- Locally embedded companies with suitable access to global networks can substitute for geographic proximities.
- The local network of small towns can substitute for geographic proximities.

Triple helix of innovation

The field of innovation study is truly immense. For example, of the various fields that research regional innovation systems, Doloreux and Gomez (2017) identified eight major streams and conceded that the research is biased towards core regions, missing the *'approaches that seek to make sense of growth paths in peripheral and rural regions'* (Doloreux & Gomez, 2017, 385). A more approachable concept is the triple helix of innovation, because it connects well with the definition of the EU territory through the FUA and MEGA concepts, as identified above.

Etzkowitz and Leydesdorf (1995) introduced the term triple helix of innovation as a new relationship among the university, industry and government. They observed new behavioural patterns in the neo-liberal world of the 1990s, where innovation has become a pervasive economic driver of the developed North. One key change is that the classical innovation environment of universities, which used to produce basic knowledge, is becoming more application-oriented, connected to the industry and creating marketable products and spin-off companies. In contrast, the industry, with its global networks and market research background, is integrating its R&D departments into the newly established university outlets to augment its product development and marketing. These new dynamics are being supported by project-oriented government policies specifically targeting the applied research to achieve market readiness through various incentives. Galvao et al. (2019) identified the diversification of the triple helix concept into quadruple helix (adding the public dimension) and quintuple helix (adding the public and environment dimensions). As reported by Galvao et al. (2019), both models rely heavily on the first three dimensions but add time-sensitive dimensions, which in turn make the models more complicated. They commented that a comprehensive review of these models still lacks in terms of the triple helix, which has become an important economic model of reference.

Based on the above, we can set the following three criteria to validate how digital innovation responds to classical innovation requirements:

- Presence of global corporations
- Connection of applied university research to industry
- Government policies supporting start-ups and SMEs

DESCRIPTION AND COMPARISON OF INNOVATION MODELS

In this chapter, we analyse the two models through which digital innovation is implemented and compare them: *'Silicon Allee'* (Torstrasse) in Berlin and *'Silicon Roundabout'* (Old Street) in London. London and Berlin were the top two innovation hubs in the invested capital

Table 1: Top investment hubs in Europe by VC investment. London and Berlin have been holding the first two places for the last five years, with London clearly ahead but Berlin gaining fast (Dealroom.co, 2020).

Capital invested into start-ups and innvoation (Source dealroom.co, accessed July 2020)						
Naziv	2014	2015	2016	2017	2018	2019
London	€ 1.159.895.296	€ 2.152.693.654	€ 2.078.340.109	€ 4.654.469.384	€ 3.725.425.360	€ 4.901.708.793
Berlin	€ 1.337.544.063	€ 1.492.381.767	€ 909.010.657	€ 1.618.044.981	€ 1.613.698.883	€ 3.582.321.675
Paris	€ 603.279.862	€ 955.183.542	€ 1.094.278.015	€ 1.563.720.777	€ 1.900.571.891	€ 2.732.823.460
Stockholm	€ 323.734.111	€ 654.829.020	€ 286.044.088	€ 392.611.808	€ 465.413.721	€ 1.930.293.383
Munich	€ 145.690.905	€ 198.200.906	€ 221.865.903	€ 251.712.270	€ 419.428.539	€ 1.105.409.190
Tel Aviv-Yafo	€ 325.481.804	€ 210.073.624	€ 506.481.811	€ 212.978.170	€ 617.181.802	€ 889.616.339
Amsterdam	€ 400.798.633	€ 186.280.903	€ 171.368.361	€ 375.272.269	€ 374.361.812	€ 576.870.628
Barcelona	€ 113.691.561	€ 253.668.844	€ 299.010.028	€ 482.986.626	€ 789.247.629	€ 555.264.575
Madrid	€ 84.059.539	€ 103.068.056	€ 87.119.411	€ 244.608.361	€ 312.298.632	€ 454.528.951
Cambridge	€ 53.538.735	€ 32.413.293	€ 169.562.599	€ 138.706.179	€ 304.065.813	€ 356.325.734
Zurich	41109088	33621206	28961815	215942419	170744087	340768720
North West England	45753804	50896770	145927880	515004806	75121675	335765662
Copenhagen	73769990	164682869	92543328	88041768	282674994	335664046
Victoria State	120000	28945451	9090909	45229090	179625667	323806415
Helsinki	39807357	78483632	91244088	110758540	253621723	290380297
Utrecht	17100000	73070000	29610000	39136363	12432272	250708018
Dubai	72727272	18181816	339590904	207572724	29909088	216427266
South East England	150327463	89624729	298777038	220866434	310227743	213124226
Manchester	11605818	24534422	84584486	271065243	41461781	196806452
Hamburg	91668180	111465907	201363636	302922727	450539088	182593693
Atlanta	0	178186289	55749998	66309090	106927270	174163931
Vilnius	4805363	29187270	1381818	13454544	55224272	152351222
Scotland	138188756	46041314	267387944	110966646	116136726	151646929
Dublin	141543597	138595353	365748485	196941818	262741815	115574191
Milan	11399816	28118178	36420909	68529090	57909544	115441688
Edinburgh	84985667	27340002	180615144	38759374	61329526	111611272
Warsaw	3400636	17001132	32569089	26068180	17401815	109843303
Oxford	39452017	12530725	171354836	93092380	222938180	103249263
Lausanne	2137120	39763635	35771178	54549088	115645149	100870844
Rotterdam	2974090	1499090	145010000	32581818	9895000	93737736
Wales	24671400	34038952	25715018	29646912	83160000	93345202
Lyon	30440180	18420000	37500000	20880000	107464272	92399998
Marseille	7909090	1700000	8100000	26500000	34800000	89600000
North East England	57200419	116651609	76186566	97250000	249162726	86936670
Cardiff	14880000	6657000	15273818	17928000	14700000	85900567
Seoul	3999999	33111140	27090908	55964244	33090905	85281816
Vienna	19695452	64749998	52388181	77786362	71854545	81450000
Lisbon	2607725	2942107	8045453	7090908	24427271	78727271
Yorkshire and the Humber	29831878	29582085	47527111	51442253	104840362	75981350
Odense	2518181	1333333	7968164	3306060	67114665	72203633
Tallinn	9844999	42845108	25875453	17580363	186529086	69419086
Leiden	8200000	0	300000	15472727	41300000	66000000
Delft	2200000	0	13250000	3450000	16181818	64640908
Oslo	16009090	510011	49152253	49663537	95089811	64187316
Aarhus	272727	3513333	7800000	4830033	48900000	59000000
Northern Ireland	3901817	5099062	16370000	14382385	22215347	56792486
Ghent	2000000	0	7945454	11000000	0	56650000
Espoo	20454544	12253725	19360000	44709090	62985090	54396988
South West England	132542842	126670636	151606407	237426943	289160600	52704107
Eindhoven	31067726	6322727	33563635	60094181	9412000	51012426
Nantes	2181818	25709090	17610000	54270000	14968181	46818181
Budapest	6227725	17457724	10212181	14062362	70792452	46067617
Moscow	39470710	103847270	53081817	544529084	81169621	42909088
Bristol	50189664	20717054	56976000	134534056	253239489	41414292
Kraków	13694543	32405453	40125452	20699089	1742090	36204543
Bordeaux	995454	1042272	3800000	35577272	20900000	32200000
Frankfurt	18181817	13800000	20500000	30300000	31522726	28390908
Valencia	3354545	2035909	1852000	4599540	4160999	27798691
Lille	15000000	13995454	16890909	19100000	19650000	27390909
Cologne	13849999	29340907	33627272	36000000	80903634	24290000
Göteborg	8850054	4909090	10300027	23185599	48248824	22501949

Sheffield	3979998	1191102	5721563	11008981	5280000	22403635
Antwerp	0	15109089	23280000	19900000	3930000	21381817
Porto Metropolitan Area	1400000	1854544	28403636	2264545	7459000	21369943
Rennes	0	4000000	4900000	21366666	17400000	21270000
Toulouse	1181818	26715000	3600000	29850000	20530000	21000000
Belfast	3118181	4500072	5430000	14298385	4474544	20792486
Reading	18599997	5168556	13454544	43805200	7090909	19596056
Düsseldorf	14545454	22849090	0	18400000	28000000	18500000
Newcastle upon Tyne	10931709	2701320	33963439	3120000	37197272	18023633
Malmö	3768464	48484022	20433844	58377337	43376434	17978744
Riga	4538326	3185454	7324090	5036362	6480907	17654277
East Midlands	35609054	30425089	46302545	127334000	19977360	16373137
West Midlands	15167038	17678921	86232726	35632581	47351817	15962726
Kiev	11999998	2563634	4763591	656363	11429090	15587269
Strasbourg	1000000	2900000	6700000	1000000	2910000	15000000
Brighton	21390000	33107999	9923636	3245466	47528727	14738909
Dundee	4545454	1552800	0	2400000	0	13861817
Birmingham	5863150	5078921	13323636	14112581	21373636	13020000
Sofia	4500800	10705957	10999976	10051256	12654545	12880502
Nice	4300000	448572	5200000	4900000	8500000	11738090
Nottingham	35365454	21183272	31638545	10680000	16977360	10722886
Glasgow	11553090	5960432	76332800	22739272	38450000	10111358
Norwich	272727	7846188	0	199440	12640181	9151319
Bratislava	967181	5609090	3772727	0	12300000	8500000
Liverpool	14015892	3600000	1740000	12216000	13165454	6731989
Rome	5947126	4089999	7147272	5689000	5720000	6678758
Brussels	1600000	25000000	3740400	2000000	2127272	6618180
Prague	6590908	7788090	645453	0	2000000	6207953
Zagreb	4160909	36363	2500000	0	2074544	5836238
Leeds	1451880	20583855	12108000	9000000	72464362	5697090
Athens	200000	295454	1650000	1800000	21131817	5614042
Istanbul	2727271	14492268	13599997	24754542	22115450	5427269
Oulu	10529543	10094544	20370000	33599999	43086725	4620241
Wrocław	0	518181	1039089	5729545	2227272	3840908
Bucharest	0	1454545	750000	34652727	139535909	3670000
Redruth	0	0	0	0	1200000	3491094
The Hague	0	418181818	11250000	500000	3400000	3350000
Dortmund	3000000	10272727	181818	1090909	4000000	2000000
Minsk	18181	0	0	7713635	14999997	1727271
Bournemouth	240000	0	0	456000	0	1700000
Middlesbrough	0	144000	0	0	3600000	1636363
Leicester	0	2423636	14640000	60000000	0	1553888
Stuttgart	0	1000000	1487272	0	6500000	1000000
Poznań	350000	540909	11000000	8409088	670000	763908
Southampton	1636363	0	240000	8308000	6817200	720000
Newcastle-under-Lyme	0	0	0	0	0	563636
Braga	0	390000	400000	300000	227272	500000
Belgrade	368181	330000	1699999	1437801	2732000	499999
Cork	1550000	1090909	2700000	2200000	7100000	263636
Gdynia	0	300000	464000	240909	1090909	227272
Groningen	0	11272727	10580000	5015000	500000	200000
Luxembourg City	2272727	9090909	19581818	31900000	14545454	0
Geneva	1000000	0	48443181	0	0	0
Sarajevo	0	0	0	0	0	0
Brno	100000	100000	1200000	0	0	0
Nijmegen	0	9580454	0	0	50400000	0
Exeter	12816000	7392000	8760000	410052	10200000	0
Hull	0	607128	0	420000	240000	0
Ipswich	400800	0	0	1200000	0	0
Plymouth	2727272	6363636	1818181	0	0	0
Sunderland	1256590	10909090	24772727	300000	8640000	0
Truro	0	0	538428	0	0	0
Worcester	600000	0	0	0	19200000	0
Malvern	0	0	0	0	0	0
Gdańsk	360000	1522909	130000	700000	666157	0
Białystok	0	0	0	0	0	0

in 2019 (Tab. 1), and represent the first two choices of start-up founders in terms of location (Atomico, 2019, 206). However, their digital innovation environments are entirely different.

Silicon Allee

Unlike the rest of Germany, Berlin's core economy has always been that of services rather than industry. Historically, the creative sector and urban culture have always been strong economic and selling points. The environment and allure of the city form a significant basis for an innovation environment. Even though Munich is a more mature and established tech-hub in Germany (Deloitte, 2018), Berlin is more dynamic with the highest growth (13%) (Börsch, 2019) and highest investment in start-ups (Atomico, 2019). Moreover, the local innovation environment benefits hugely from Berlin's established academic environment, as it boasts the highest number of students in science, technology, engineering and mathematics (STEM) in Germany (Börsch, 2019; Deloitte, 2018). In addition to world-class universities, Berlin's innovation environment also benefits from the suitable institutional support received in the form of grants by the Investitionsbank Berlin, which '*actively contributes towards developing Berlin as a hub for business and industry*' (IBB, n.d.). Finally, its innovation ecology is heavily supported by German corporations through the creation of their own VC funds and accelerators, such as DB StartupXpress (Deutsche Bahn; dbmindbox.com); the famous Beyond1435 (beyond1435.com), which is a collaboration of LBA Group, Bombardier Transportation, Deutsche Bahn AG, Siemens AG, Swiss Federal Railways and TUI Group (Hatzfeld, 2017), or the Bayer CoLaborator with state-of-the-art research facilities and infrastructure (colaborator.bayer.com). EDCi (2016) cited startup hubs.eu, which reported 171,000 start-ups employing 667,000 people in 2016.

The example of Berlin represents a unicum on the world stage in terms of its buzz, and therefore, one of the most desirable locations for the young creative class. Its colourful history has always attracted entrepreneurial people, artists and creatives. Its post-World War II crisis and the subsequent transformation of East Berlin created unique conditions economically and spatially. Abandoned housing, industrial estates and dysfunctional economy were the preconditions for bottom-up interventions that created a lively non-institutional scene of urban squats, avant-garde artists and unfettered culture. Such an urban environment created a unique urban buzz that is difficult to recreate institutionally and is perfect for the creative class. Areas such as Kreuzberg and Neukölln, with numerous hipster cafes and night clubs; Mitte, with its chick boutiques, and the rugged Friedrichshain highlight the intriguing urban culture of Berlin. From cult night clubs, such as the Berghain across the cultural melting pots of Tacheles and Kopti art squats, to more institutionalised and development-

oriented Holzmarkt, Berlin represents an immense resource for young creatives and a fertile ground for innovation (Phillips, 2016; Moeller, 2016).

The creative class started to see opportunities in these areas in the 1990s. The start of digital innovation in Berlin can be pinned to 1999 when the Samwer brothers sold their internet start-up Alando, modelled after eBay, to eBay for 34 million USD (Moeller, 2016; Olarinoye, 2020). One of the main start-up clusters is located around Torstrasse at the edge of Prenzlauer Berg. In popular culture, this area has been nicknamed Silicon Allee with innovation connotations. Support and co-working hubs, such as Silicon Allee Campus and Google-backed Factory, are located here, both of which provide an ecosystem of services and infrastructure for start-ups (EDCi, 2016). In popular culture, the term Silicon Allee is frequently used (Freedman, 2020; Hanford, 2019; Adams, 2016); however, Phillips (2016) called it a misnomer as it is difficult to pin down the production of digital innovation in one part of Berlin. Moeller (2016) conceptualised four digital innovation clusters based on the classical requirements for digital innovation: urban and cultural amenities for young creative class and rent prices and available housing stock for re-appropriation. Their study results revealed two main clusters: the above-mentioned area of Silicon Allee focusing around Torstrasse and the fashionable Kreuz-Köln, west of Görlitzer Park. Furthermore, they identified two additional clusters: around Boxhagener Platz and the Kurfürsterdamm area in West Berlin (Moeller, 2016, 19, Figure 4).

A combination of Berlin's fertile environment of amenities and nightlife with the institutional backing of global German companies and STEM students from universities is a potent mix of conditions for digital innovation to prosper.

Silicon Roundabout

A complete opposite in terms of structure, funding and institutional support to Berlin's innovation environment is London. If Berlin represents an institutionally well-backed approach, London's laissez-faire tradition led to an organically grown innovation environment. A major benefit to the start-up economy is the UK's lowest administrative barriers to entrepreneurship globally (OECD, 2013, 37, Figure 11). Throughout the metrics in the Atomico (2019) report, London ranks first amongst the European innovation hubs. The huge pull of London is supported by its neo-liberal diversified economy based on Thatcher's deregulation of the banking sector, which provides a strong footing to fin-tech start-ups (digital solutions for the financial sector). EDCi (2016) cited Startup Hubs Europe, which reports 275,000 companies employing approximately 1.5 million people.

One of the most recognized clusters with a complete ecosystem for start-ups is the Old Street area, popularly called the Silicon Roundabout, and after its success, re-branded into Tech City (Nathan et al., 2019). Old Streets' morphogenesis is based on economic decline and spatial

degradation. It is layered upon the deindustrialization process of the 1980s, when vacant halls created a fertile ground for lively business services, loft renovations and a beginning of the creative, new media and art scene, which came to full fruition in the 1990s (Nathan & Vandore, 2014). This gave the area its feel and ‘buzz’—a perfect breeding ground for networking, knowledge spillovers and young people interested in experiencing urban life and creating a ‘bounded milieu’ of the innovation ecosystem (Nathan & Vandore, 2014, 2292). A suitable microcosm under this effect is the Shoreditch area with numerous cafes, bars, fixie bike shops, barber shops and an organic market—all fuelled by the local creative economy of information and communication technology (ICT) start-ups and seed funds investing heavily in innovation.

Even though London is home to the world’s top universities, such as Imperial College and UCL, there is an extremely high cost of ICT talent, which indicates a weak connection between the university environment and STEM jobs in London (Nathan & Vandore, 2014; EDCi, 2016). Additionally, ‘many of the “traditional” key actors in high-tech clusters, such as major employers, activist universities, or “Triple Helix” activity are absent’ (Nathan & Vandore, 2014, 2295). The authors also reported that compared to the US, UK VCs are considerably more cautious and that local entrepreneurs lack seniority and experience. Despite these detriments, London is still the foremost digital innovation hotspot in Europe. Its status as a global metropolis compensates through the sheer force of global connection volume that translates into opportunity.

Comparison of the two models

Both London and Berlin represent the two most important hubs for digital innovation in Europe. They have built upon a vibrant creative community and urban culture developed in both cities. Lively and rich art and night scene on one hand and good connections to capital and corporations on the other form a fertile ground for the creative class, which searches for big city experience and a productive environment for progressive start-ups. However, the similarities end there.

The London model is based solely on the neo-liberal tradition and the laissez-faire market, which can only exist in global city centres of command and control. It is an example of regional geography where trans-national corporations, primarily in banking (connected to other global hubs), sustain opportunities and the innovation environment itself. Even though Silicon Roundabout ecology is not connected to London’s university sector, it is the most successful innovation cluster in Europe.

In terms of the triple helix concept, the question is how the London example measures up against the three identified criteria. Clearly, the industry supports well and gives opportunities to spin-offs and start-ups; however, as indicated by Nathan and Vandore (2014), these do not connect well with the university environment. In terms

of policy support, liberal policies regarding taxation and non-bureaucratic procedures for company creation contribute substantially to the innovation environment as such. However, subsequent attempts at managing and supporting digital innovation by the government of David Cameron have been criticised (Nathan, 2011). This suggests that the policy segment is important in countries where such policies are more constrictive. Moreover, not all dimensions of the triple helix need to be equally represented for digital innovation to be viable.

In terms of digital innovation requirements, London meets all criteria. It has a great collaboration environment with co-working spaces, accelerator environments and whole innovation ecosystems, such as the Shoreditch area. Data access is one of the most relaxed in Europe, and with its succession from the EU, this can be further improved (however to the detriment of final users).

In contrast, Berlin is an example where the local institutions and German corporations provide strong support, primarily due to the long tradition of industries and their loyalty. However, their regional affiliation needs to be envisioned in global terms, which means that Berlin’s innovation ecology cannot exist without the global connection of its corporations. It is, as Micelli and Sachetti (2014) illustrated through an industrial model, a bounded local geography where small producers can only exist if there is a globally connected company as an ‘*interface between the local territory and global market*’ (Micelli & Sachetti, 2014, 85). Through the same mechanism, Bayern or Siemens in Berlin are obliged to support the local innovation environment if they want to continue producing value.

In terms of the triple helix conditions, Berlin’s digital innovation has a different disposition. First, there is a wealthy presence of global corporations; second, these corporations are well connected to the universities, creating incubators and appropriate STEM student supply. Third, although companies are subjected to more stringent policies and administration requirements, suitable policy incentives are provided by Berlin banks (IBB, n.d.) and the municipality through active development policies, such as the ‘be Berlin’ campaign (Phillips, 2016).

In terms of digital innovation prerequisites, further improvement is required. There is a general concern that the EU General Data Protection Regulation (GDPR) will impede digital innovation (Martin et al., 2019). On the other hand, Berlin contains numerous co-working and accelerator spaces that support collaborative work; furthermore, its social and cultural infrastructure for young creatives is unrivalled.

DISCUSSION: DIGITAL INNOVATION IN PERIPHERY

After reviewing the case studies through the identified criteria, we analyse whether the models can be transferred to peripheral regions. For this purpose, we will confront the conclusions obtained from the triple helix review with slow innovation requirements. Wherever we

identify problems, other qualities of peripheral innovation will be discussed. Discussion of the two models has already shown that different pathways to achieving digital innovation in cities are possible.

Triple helix and peripheral innovation

For the triple helix requirement, no particular constellation of drivers and local conditions is preferred; however, all three (global industries, applied research in universities and supportive policies) need to be present. In London, the university segment is lacking, but the open market policies are much more favourable to start-ups and SMEs. The latter is heavily taxed in Berlin, but industrial support in the form of infrastructure and government loans, as well as an appropriate STEM student market, will fill this gap. In both cases, global networks and fertile innovation ecosystems with suitable amenities and infrastructure are well developed. In the following paragraphs, we discuss each criterion in more detail.

Global industries' criteria seem the most problematic for peripheral regions to achieve adequately. Background research on the development and structure of the EU (ESPON, 2005) has shown a significant lack of peripheral regions in the global reach of their companies. City cores in such regions neither readily house a lively banking sector like London nor feature a pool of native industrial giants like Berlin. However, slow innovation suggests implementing the first stage of innovation (idea creation), which is less dependent on the global infrastructure. In addition, new research focusing specifically on innovation in peripheral regions (Eder & Trippel, 2019) criticises the classical innovation concepts, as they were developed for core regions. They suggest a set of responses available to peripheral regions, such as establishing branch offices in global centres or branding techniques for 'soft locational factors' emphasizing the natural and other qualities of the environment 'far from urban congestion' (Eder & Trippel, 2019, 1515). In addition, the SMESTO literature puts the network of small towns on par with larger towns in terms of job density per inhabitant (Bole et al., 2016), where this network can be considered a 'bounded milieu' for innovation. Finally, taking the example of Berlin's locally imbedded companies in connection to Micelli and Sacchetti's (2014) concept of a company as an interface between local producers and the global market, the possibilities for digital innovation in peripheral regions can be significantly expanded. We can adduce a few examples from the local environment, such as the pharmaceutical company Lek in Ljubljana, the avionics company Pipistrel in Ajdovščina or the diversified technology company Kolektor in Idrija. All the above-mentioned companies can act as interfaces to the global market for the local network of slow innovation that is bound within the SMESTO network. In addition to these regional solutions, level-4 MEGAs exhibit strong cultural tourism, and the environment of their city cores offers new research potential into tourism and innovation infrastructure synergies.

In terms of the second criterion of connecting industry to marketable university research, the situation is rather positive. Barra et al. (2019) reported that the second-tier universities, rather than the first tier, produce more marketable knowledge spillovers useful to the industry. This, coupled with the slow innovation concept to focus on technology and basic knowledge of research, yields a strong foundation for applied research in such regions in the segment of digital innovation. However, Bonaccorsi (2017) cautioned that only supporting institutional innovation in universities is problematic, as it yields limited success. Marques et al. (2019) indicated that in less-developed regions, universities can play a catalytic role in development of the region, but only with well-established innovation departments. However, the case studies related to the triple helix requirement indicate that London compensates in this segment with its global pull. The unique regional knowledge embedded locally and supported by slow innovation can be one such compensation in peripheral regions. Last, all MEAG-3 and MEGA-4 cities have well-established universities and research institutes, such as the local environment example of Chemical Institute in Ljubljana and the Institut Jozef Stefan focusing on applied physics and mathematics.

In terms of the triple helix criterion—the support of government policies—Kozina & Bole (2018) indicated that strategic policies can help steer the spatial patterns of innovation in a favourable direction. This is supported in the two case studies where policy played a vital role. In London's example, the liberal policies with low barriers to entrepreneurship (e.g. low VAT taxes and the simplicity of creating a company) are beneficial. However, in Germany, due to the more stringent economic policies, the environment compensates with suitable incentives for SMEs and start-ups, as well as a well-established support environment provided by the local industry. These examples suggest that in peripheral regions, policymakers need to recognise the importance of local producers and create tailored policies to that effect. Adapting local level policies is easier than national level. In contrast, the problem of constricting policies regarding data, such as the EU's newly adopted GDPR, can be problematic for digital innovation. Martin et al. (2019) reported that the GDPR is a two-edged sword for data-dependant start-ups. On one hand, it supports innovation in technologies for GDPR compliance or exploitation and suggests a higher possibility for the end-user to buy European digital products, due to security assurance. On the other hand, for the start-ups themselves, there might be a significant product abandonment, especially in the segment where data are used without clear benefit to the end-user. Even if the effect is mixed, the GDPR places additional administrative barriers on the 'lean start-up', on which the majority of digital innovation is based. Peripheral regions might have an upper hand due to favourable EU cohesion policies, which can enable local actors to 'exploit different innovation benefits encountered in peripheral regions' (Eder & Trippel, 2019, 1526).

CONCLUSION

As part of global restructuring at the turn of the millennium, when a significant part of the P&A segment moved to developing countries, the peripheral regions in the EU sought strategies that could better support their transformation. To consider the diversification of economic dependencies, we reviewed the possibility of digital innovation as an additional driver for these regions.

This paper presents two global examples of London and Berlin and their digital innovation ecosystems as case studies. As a direct translation of these models to peripheral regions is not possible, it is achieved through the triple helix of innovation concept, which is interpreted through the slow innovation principles.

In classical literature of regional innovation systems, innovation as such follows the Marshallian concept of industrial agglomerations; however, unlike traditional industries in the secondary sector, which require large areas to operate, digital innovation is compact, and thus, a great mechanism for densification and diversification. Global cities yield suitable evidence for micro-clustering in the digital sector, as the need for communication, connection and collaboration is very important (Nathan & Vandore, 2014). In addition, the classical literature proposes innovation requirements, such as connection to global markets, buzz, knowledge spillovers, managerial know-how and VC, all of which are scarce in peripheral regions. Digital innovation further requires suitable access to data related to policies and infrastructure, as well as suitable infrastructure for collaboration.

The digital innovation examples of London and Berlin are unique; thus, they cannot be directly replicated in peripheral regions. There are two main problems: lack of global industry with access to global markets and lack of the 'buzz' generated in these unique locations, which contributes to the much-needed knowledge spillovers that foster innovation. However, a review of the two models provides concrete conclusions for peripheral regions.

The two examples show that there are various pathways to digital innovation; if one segment is strong, the other can be compensated. Berlin achieves this through suitable industrial presence of locally embedded native corporations, collaborative infrastructure and strong connection to the university environment, where the policy aspect is quite constricted. In contrast, London has a weak connection to the university environment, which is compensated through liberal economic policies.

The classical RIS literature lists the presence of global corporations as the most difficult triple helix requirement for peripheral regions. Here, geographic proximity favours the key innovation concepts, such as knowledge spillovers, urban buzz, VC and access to global markets.

Both studied examples are well embedded in the world economy with numerous global corporations. However, innovation in peripheral regions works differently, and geographic proximities and global access can be achieved in different ways, such as branch offices, through a networked concept of SMESTO, or through an imbedded local company with global connections. In contrast, peripheral innovation substitutes some concepts. For example, the concept of urban buzz is replaced by the quality of a good natural environment, quietness and nature, which carry more value in contemporary times. Otherwise, research into touristic infrastructure to carry some functions of central cities can be investigated.

In terms of the connection of the applied university research to industry, the conditions are rather beneficial for peripheral regions, as their centres house second-tier universities, which more readily create marketable innovation than the first-tier ones. The niche market for these regions is in digital innovation, which takes local knowledge as the basis and focuses on technical or basic knowledge rather than knowledge that is fashionable and whose value can quickly decline.

In terms of government policies supporting start-ups and SMEs, EU-based innovation firms will always be at a disadvantage. However, the arguments of slow innovation suggest that peripheral regions have a specific advantage in nimble and quickly tailored local policies. If a regional or local administration recognises the significance of a local company, they can tailor the policies to suit their needs. In terms of a specific digital innovation policy, a major hurdle is the GDPR.

In conclusion, we can speculate on the initial question. Do peripheral regions represent viable hubs for digital innovation ecosystems despite their less favourable global position?

The proposed substitution of core innovation concepts with slow innovation concepts makes digital innovation viable in peripheral regions. The SMESTO concept can even be considered a networked condition for the innovation ecosystem. There is no reason why digital innovation cannot represent a parallel development driver to approaches such as cultural tourism and industrial culture. However, it will never represent a core activity of peripheral regions; it is difficult to imagine concepts such as quiet and beautiful nature replacing the allure of a vibrant city, or an annual institutionalised networking conference replacing knowledge spillovers in global centres overflowing with young talent. The density of connections to the global markets is a difficult resource to substitute in the innovation environment. However, digital innovation can and should augment peripheral regions to diversify their economic base, especially under the persistent global crisis.

DIGITALNA INOVACIJA: KAJ SE LAHKO OBROBJE NAUČI OD GLOBALNIH CENTROV?

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POVZETEK

Globalno industrijsko prestrukturiranje je eden glavnih razlogov za stanje in obliko sodobnih evropskih mest. Ena največjih težav obrobni regij Evrope je izguba industrijskega segmenta proizvodnje in izdelave (angl. process and assembly). Dva pristopa, turizem in visokotehnološke inovacije sta v ospredju prenove v postindustrijski Evropi. Ker je turizem dobro uveljavljeno gonilo razvoja, se sprašujemo ali je digitalna inovacija, kot podskupina visokotehnoloških inovacij, lahko vzporedno gonilo za doseganje odpornejšega in bolj uravnovešenega razvoja obrobni regij. Članek opisuje dva modela digitalne inovacije londonskega in berlinskega, z namenom razumevanja njune primernosti za razvoj obrobni regij. Ker so modeli globalnih mest stežka uporabni za obrobja, članek ugotavlja njuno uporabnost skozi koncept trojne vijačnice inovacij (angl. triple helix of innovation), ki govori o povezavi akademskega raziskovanja, produkcijske zmogljivosti in globalne vpetosti industrije ter podpornih politik. Dodatno članek naslavlja vprašanje inovacije v luči koncepta t.i. počasne inovacije (angl. slow innovation), ki je primernejši za obrobne regije. Prvi sklep članka ugotavlja, da je pogoje za digitalno inovacijo moč doseči z različnimi razmerji elementov trojne vijačnice. Berlinski digitalni grozd je dobro podprt z velikim številom študentov na področju informatike ter odličnim podpornim okoljem nemških korporacij, a ima visoke davke in administrativno zahtevno okolje za nova podjetja. Na drugi strani ima londonski digitalni grozd šibko vez z akademijo, ki jo kompenzira z liberalno tržnimi politikami Velike Britanije in močno globalno vpetostjo Londona. Drugi sklep članka pa ugotavlja, da čeravno digitalna inovacija ni primarno gonilo razvoja obrobni regij, je lahko pomembno gonilo, v kolikor se jo razume skozi koncept počasne inovacije. Tako je problem šibke globalne vpetosti obrobni regij lahko naslovljen z dinamiko mreže malih in srednjih mest ali s pomembnim lokalnim podjetjem, ki ima dobro globalno povezanost. Aplikativno akademsko raziskovanje je v obrobni regijah bolje zastopano kot v centralnih, saj so prav univerze na obrobju dosti bolj aktivne na področju patentov. Obenem je za počasno inovacijo pomembno osredotočanje na lokalno specifično inovacijo na področju tehničnih ali bazičnih znanj in ne na znanje katerega vrednost lahko hitro upade. Kar se tiče politik imajo lahko obrobne regije posebno prednost v gibčnih in hitro prilagodljivih lokalnih politikah. Če regionalna ali lokalna uprava prepozna pomen lokalnega podjetja, lahko politike prilagodi dejanskim potrebam. Predlaga na zamenjava temeljnih inovacijskih konceptov s počasnimi inovacijskimi koncepti omogoča razumevanje digitalne inovacije v obrobni regijah. Digitalna inovacija bi morala zavzeti večjo vlogo v razvoju obrobni regij, s čimer bi regija zagotovila večjo razpršenost gospodarstva, zlasti v času, ko so krize in ekonomska nihanja postali stalnica.

Ključne besede: digitalna inovacija, obrobne regije, obnova, berlinski digitalni grozd, londonski digitalni grozd

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