Proceedings of the 6th International Conference 2020 of HSWMA (Hellenic Solid Waste Management Association) in cooperation with ISWA, on 27-28 February 2020 in Athens, Greece

COLLABORATIVE CIRCULAR PRODUCTION IN TERMS OF SOCIAL TRUST AND ECOSYSTEM BUILDING

Yanna Pavlopoulou[1]

[1] Managing Partner at CommonLawgic Research Center; PhD candidate at National Technical University of Athens (NTUA) (Greece) Sector of Industrial Management and Operations Research, Environmental Economics and Sustainability Unit.
Contact details: yannapav@gmail.com

Abstract

Collaborative circular production can flourish if associated with community networks and ecosystems that share designs, produce upcycled goods, or distribute secondary raw materials through real-life makerspaces or online platforms. Collaborative production in urban areas, in conjunction with the maker movement, is a cultural trend valuing citizens' ability to become prosumers (creators as well as consumers of things). Despite its vast potential, collaborative production is still in its infancy in terms of digital infrastructure and makerspaces availability in cities. In this research paper, the main socio-ethical collaborative tools for stakeholders' and community engagement are those of mainstream social media/networks, i.e. Facebook, Twitter, LinkedIn, YouTube channel; as well as social recommender systems. Makerspaces and maker incubators could empower the maker communities to become entrepreneurs for the commercial launch of circular products/services. Circular endeavours may be fueled by makers movement, smart contracts and blockchain technologies. Social recommender systems have recently attracted research interest. Socio-ethical tools can personalise the e-commerce experience for users based on personalised interests. Besides, recommender systems rely on the trust of users; thus, social trust can be built on users' characteristics in a social network on a real-world dataset. Both the social media and the recommender systems should take into account the legal framework, the business context, and the possible financing opportunities of community engagement. Authors, under their capacity as research team members of Pop Machina Horizon 2020 project, introduced challenges of circular urban regeneration technologies, according to Pop-Machina vision. Besides, the study stressed out the main sustainability activities that may impact the success of the project, framing the paths of outcomes' dissemination, awareness-raising, and communication activities. This study consists an introductory guide of proposed methodologies for stimulating the creation and for managing the engagement of maker communities and their stakeholders in a circular ecosystem (e.g. makers within their makerspace, urban planners, and local business communities). To conclude, social media and recommender systems can act as fundamental pillars of a proposed online awareness strategy to provide ever-growing volumes of information, upscaling the dissemination and the communication among communities of users, as well as the greatest possible outreach of the circular collaborative production.

Keywords: collaborative production, social trust, circular economy, dissemination of outcomes, socio-ethical aspects.

1. INTRODUCTION

Currently, there is an imperative need to investigate the relationships developed between social trust and collaborative production. Indeed, people may be discouraged from taking entrepreneurial action because of the difficulties in accessing legal protections efficiently.

However, generalised faith in strangers can exert positive moderating effects on the direct relationship between constitutional protections and entrepreneurship (Kim and Li, 2014). Under this entrepreneurial environment, socio-ethical tools can personalise the e-shopping experience for users based on personalised interests. Besides, recommender systems rely on the trust of users; thus, social trust can be built on users' characteristics in a social network on a real-world dataset (Davoudi and Chatterjee, 2018). Both the social media and the recommender systems should take into account the legal framework, the business context, and the possible financing opportunities that may exist at the time and place of establishment. Recommender systems are based on social trust relationships. However, social recommender systems have only recently attracted research attention. Social relationships between users, especially trust relationships, can facilitate the design of social recommender systems. Such systems are based on the idea that users linked by a social network tend to share similar interests (Chen et al., 2013). Existing recommender approaches based on social trust relationships do not fully utilise such links and thus have low prediction accuracy or slow convergence speed. It was literature-proven that this research approach has both significantly higher prediction accuracy and convergence speed than traditional collaborative filtering technology and state-of-the-art trust-based recommendation approach (Chen et al., 2013). In this context, it can be stressed out that new technologies, such as blockchain, have the potential to transform the financial services industry, institutional functions, business operations, and other areas such as education (Franzoni et al., 2019).

This paper is an introductory guide on ways of community engagement and ecosystems building related to a Horizon 2020 European Grant project (2019-23) under the name Pop-Machina “Circular collaborative production a Community Approach”. Authors’ research is still in progress and will be open to public access on January 2021, as Pop Machina Deliverable D.3.2. Authors, under their capacity as research team members of Pop Machina introduced the challenges of circular urban regeneration technologies, according to Pop-Machina vision. In this study authors proposed methodologies for stimulating the creation and for managing the engagement of the ecosystem of maker communities and their stakeholders (e.g. makers within their makerspace, urban planners, and local business communities).

These methodologies have been structured upon specific Key Performance Indicators and Target Values which have been framed at Circular makerspaces and cities, EU Circular Economy Action Plan, Urban Agenda for the EU, and the Habitat III New Urban Agenda. The main drivers and barriers of the proposed methodology have also been determined. The primary research orientation is the linkage and the adaptation of such methods to a social context of mainly vulnerable social groups, by offering them such motivations to participate at local, commercial, and marketable endeavours under the principles of circular urban regeneration. Circular attempts of particular interest may be fueled by Factories of the Future (FoF) technologies, smart contracts, and blockchain technologies, potentially in a joint venture (e.g. spin-off or start-up company) with interested parties.

2. METHODS

2.1 Circular urban regeneration

From a literature viewpoint, it is noteworthy that circular economy (CE) supports a wide spectrum of activities and, subsequently, abiding legislative framework, including a) CE of

products and b) CE of processes, having distinct routes of implementation, abiding legislation, and strategic developmental planning. CE of products is primarily determined by handling products like plastics, food waste, critical raw materials, construction and demolition, biomass and biobased products, in promoting the circular innovation. Besides, CE of processes is primarily determined by different materials and energy cycling flows and is a matter of a three-level deployment: inter-enterprise circulation, regional circulation, and social circulation (Kyriakopoulos et al., 2019).

Complementary to EU's CE are the initiatives and guidelines regarding urban regeneration, among which the Urban Aquis is detrimental, calling for urban development strategies "to be developed, that create a balance between economic competitiveness, social cohesion and ecological sustainability and that contribute to economic growth, competitiveness, innovation and creation of jobs, as well as to environmental sustainability and a reduction of ecologic risks" (Urban Aquis, 2005). The link between CE and social economy is collaborative production. EC set forward its agenda on the collaborative economy and addressed the issue of production schemes that are beyond the traditional regulatory channels while simultaneously recognising their untapped capacity to contribute to growth, now seeking to transform them to collaborative circular production schemes. Legal challenges related to collaborative production are labour standards and rights, consumer protection, taxation, liability, quality of services and user safety. When combined with CE, these issues are added to the following: legal barriers for the commercialisation of circular products, reverse logistics, food safety, property rights, Intellectual Property. Two integrated approaches of developing CE and collaborative circular production schemes are that of the hierarchical analytical process (AHP) (Aravossis et al., 2019) and life cycle assessment (LCA) (Kapsalis et al., 2019).

Circular urban regeneration can also be related to proprietary assets, which can be considered a holistic indicator of sustainable, inclusive, safe, resilient cities. Under the Agenda 2030 for Sustainable Development, the UNESCO Recommendations on Historic Urban Landscape (HUL) has been valued as a dynamic and evolving system that changes over time to meet social needs by managing resources in a sustainable way (Fabbricatti and Biancamano, 2019). The confining factors of urban development are the state of abandonment and decay, as well as the lack of investments of often emigrated skills. In response to these destructors, the circular economy model can be applied to the HUL to maximise the value of settlements, activating social, economic and environmental synergies. The current research orientation is the investigation of the complex nature of HUL and the definition of "circular regeneration" according to the recreation of physical, environmental, social, economic systems (Fabbricatti and Biancamano, 2019).

Circular regeneration processes are driven to progress towards sustainable and inclusive cities and urban governance, while widening the decision-making arena, promoting virtuous circular dynamics based on knowledge transfer, strategic decision making and stakeholders' engagement. In this study, the main social stakeholders who are involved in the proposed urban circular regeneration, as well as the abiding circular endeavours and developed synergies are depicted at the following Figure 1.

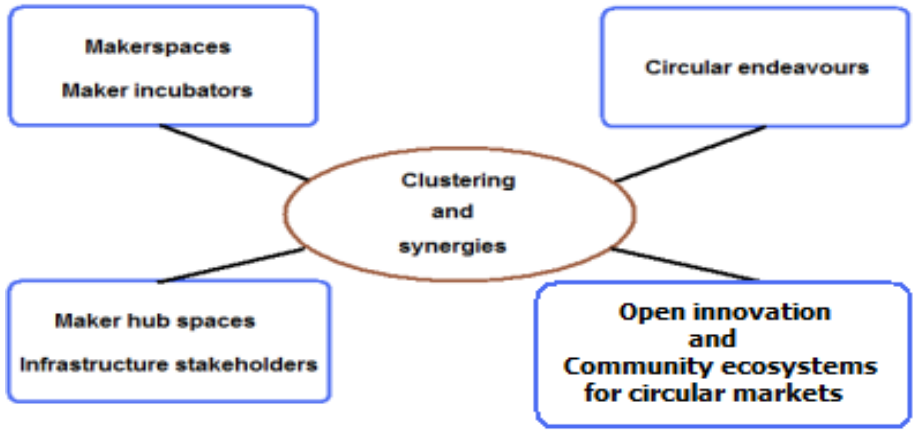

Figure 1. The profile of collaborative circular production. Source: Authors' own study.

Particularly, makerspaces and maker incubators can empower the maker communities to become entrepreneurs, for the commercial launch of circular products/services. Besides, maker hub spaces and infrastructure, other stakeholders are the investors and end-users (SME Chambers, SMEs, Industrial Unions, social enterprises, practitioners, citizens).

Moreover, circular endeavours can be fueled by the aforementioned FoF and blockchain technologies. Specifically, FoF technologies are oriented to assist community cooperation, knowledge sharing, data collection and analysis, while blockchain is a database (also called ledger) documenting all transactions ever been executed on it (Menne, 2019). Blockchain technology is at the foundation of all cryptocurrencies but has found wide application in the more traditional financial industry. It also introduced new applications such as smart contracts (Di Pierro, 2017) and utility tokens among open innovation communities. The blockchain technology is fairly new, and so are the legal issues relating to its use and operation. Although its future applications seem limitless, the legal implications of its use are now starting to fall under the loop in many legislations and the EU. Important legal issues to be tackled in the immediate future regarding the operation of blockchain ledgers include: recognising the blockchain registries, settling issues of territoriality and applicable tax law, ensuring the enforceability of smart contracts, overseeing regulatory compliance with pertinent existing legislation (e.g. data protection regulation, money laundering legislation) and issues of liability (Pop-Machina, D.2.4., Part 1, 2020).

Furthermore, based on the aforementioned Figure 1, the clustering and synergies with other projects and initiatives involve the interaction, networking and creation of synergies with other networks, associations and relevant EU initiatives (e.g. from the nature-based solutions, resource efficiency, smart cities fields, etc.) to be established from the very early stages of the projections' implementation. The anticipated clustering and synergies will provide researchers with the opportunity to benefit from others' experience and knowledge and maximise the impact of their own communication activities by leveraging multiplier and network effects. A feasible tool of upgrading accumulated knowledge and theory into action is the aforestated open innovation community ecosystem for circular makers.

2.2 Features of the Pop-Machina project

Pop-Machina 821479 is an H2020 European Grant project (2019-23) partially funded by the European Union, under the H2020-SC5-3-2018 call on Circular collaborative production a Community Approach (Pop-Machina 2019). The project substantially supports the Urban

Agenda for the EU in most of its priority themes, including circular economy, jobs and skills in the local economy, energy transition, sustainable use of land and nature-based solutions, as well as digital transition. At the Pop-Machina project, and in association with the research objectives of this study, the adopted methodologies aim to illustrate how to approach, stimulate and facilitate the engagement of makers within their makerspace, urban planners and local business communities to build circular maker ecosystems within cities. Pop-Machina's targeted offerings (makerspaces, maker academy, accelerator) aim to pave the way and empower the maker communities to become entrepreneurs, setting up new circular endeavours for the commercial launch of their products and services. These endeavours will emphasise activities needed for the roll-out of them (endeavours) after the project's completion, taking into account the legal framework, the business context and the possible financing opportunities that may exist at the time and place of establishment (Pop-Machina, D.2.4., Part 1, 2020). The integration of the life cycle assessment can be built-up on concrete cases, while elaborating evidence-based policy recommendations and guidelines, developing an integration guide that can be used as a baseline in assessing the impacts of circular collaborative production (Pop-Machina, 2019).

The scope of this study is to provide methodologies for stimulating the creation and managing the engagement within maker communities and stakeholders of the ecosystem. Pop-Machina is engaging stakeholders (local government, citizens, NGOs, investors, chambers of commerce) as well as potential start-ups (SMEs or existing social enterprises) who wish to capture the full value of their concept and to accelerate an idea-to-product cycle. Under the Pop-Machina implementation, the main critical aspects of consideration are the following (Pop-Machina, 2019):

- Who forms the stakeholders' ecosystem per pilot city?
- Are there best practices in each ecosystem?
- Can “lead users” be identified among the stakeholders?
- What can be the drivers for the engagement of circular makers?
- What will be the impact of Behavioural incentivisation and tokenisation through a digital platform?

Besides, the Pop-Machina outcomes and valuation to be thoroughly analysed at Pop Machina D.3.2.,2021, are the following (Pop-Machina, 2019):

- Addressing the issue of circular economy throughout the entire production lifecycle, to promote the remodelling of materials of high priority, and to activate ground-breaking measures (such as tokenisation), to increase innovation and sustainability of the resulting circular processes.
- Proposing practical tools from stakeholders on incentivisation methods, challenges, drivers and barriers of collaborative circular production.
- Promoting capacity-development initiatives to empower and strengthen the skills and abilities of vulnerable groups, i.e. women and girls, children and youth, older persons and persons with disabilities, and local communities.

3. RESULTS AND DISCUSSION

In structuring the collaborative circular production, it is significant to determine those social and trust relationships developed between users, which facilitate the design of social recommender systems. Such systems are built up when users are linked in a social network and tend to share similar interests. Existing recommender approaches based on social trust relationships are currently underdeveloped and sustain low prediction accuracy or slow convergence speed. Socio-ethical considerations are proven powerful tools for e-commerce

companies that personalise the shopping experience for users based on user interests and interactions (Phukseng and Sodsee, 2017). A realistic recommender system relies on the trust of users; thus, there is an imperative need to address the problem of social trust modelling where trust values are shaped based on users' characteristics in a social network on the real-world dataset (Davoudi and Chatterjee, 2018). Valuation of user similarity and recommendation systems can be described and analysed in the light of the relationship between ability tracking and citizens' social trust in the context of low-income social groups, as potential circular users (Li et al., 2018).

It is further noteworthy that slow-tracked social groups have a significantly lower level of social trust, comprised of interpersonal trust and confidence in public institutions, relative to their fast-tracked social groups. Besides, there is an imperative need to investigate why social trust and collaborative production are not commonly straightforward. Indeed, people may be discouraged from taking entrepreneurial action because of the difficulties in accessing legal protections efficiently (Li et al., 2018). Regarding the Pop-Machina D.3.2., 2021 the applied methodologies are used to evaluate the answers on building ecosystems and community engagement. These methodologies rely on the European Digital Social Innovation Index (EDSII) methodology that is based on steps detailed in the JRC/OECD Handbook on constructing composite indicators (EDSII, 2019). EDSI indexes are grouped alongside other related indicators into the following six themes: 1) Skills, 2) Infrastructure, 3) Funding, 4) Diversity and Inclusion, 5) Collaboration and 6) Civil Society. Given the open and multidisciplinary nature of DSI, collaboration (both online and offline) is a key success factor. DSI operability is better functioning when a diverse group of people with different background (such as technology, social challenges and provision of public services) work together. Explicitly outward-looking technologies powered and driven by collaboration are at the heart of DSI ecosystem. Collaboration and sharing of knowledge and best practice between policymakers, practitioners, investors and other stakeholders is enabling peer learning and supports the sustainable growth of Digital Social innovation for Europe (DSI4EU). The theme of collaboration applies specifically to Pop Machina's vision, including (Pop-Machina, D.2.4., Part 1, 2020):

- Events where people can meet to network and discuss DSI.
- Events relevant to DSI are important for those interested and involved in the field (and related fields) to share knowledge, network and collaborate.
- Online collaboration (As DSI is technology-based and open, online collaboration is common, including for software development on platforms such as GitHub).
- Government collaboration with civil society.
- Government collaboration with tech sector.
- Civil society collaboration with tech sector.
- Engagement with DSI (An active community of people talking about DSI can help foster informal sharing of knowledge, collaboration, and uptake by potential users).

Collaborative circular production can flourish if associated with community networks and ecosystems that share designs, produce upcycled goods, or distribute secondary raw materials through real-life makerspaces or online platforms. Collaborative production in urban areas, in conjunction with the maker movement, is a cultural trend valuing citizens' ability to become prosumers (creators as well as consumers of things). Despite its extensive potential, collaborative production is still in its infancy in terms of digital infrastructure and makerspaces availability in cities. The main actions to reach the Pop-Machina targets include the development of organic, demand-driven and sustainable maker networks; Dedicated policy discussion activities; and exploitation management, along with the dissemination,

awareness-raising, and communication activities. Particularly, the dissemination of the outcomes of the Pop-Machina project, includes (Pop-Machina, 2019):

- Media information and academic publications
- “Warm-up” events
- Workshops
- Presentation days
- Social Media
- Promotional video
- External events and conferences.

POP-Machina will create an online collaboration platform to facilitate communication and transactions among implicated stakeholders. Thus, it is imperative to focus on the recent European Regulation on platform-to-business relations which puts in place a harmonised framework for minimum transparency and redress rights (Regulation EU 2019/1150) as well as the Digital Single Market Strategy for Europe (Report EU COM 2015). Online platforms are closely related to the aforementioned blockchain technology and (utility) tokenisation as an alternative paying method. European legislation on the subject is rather new, but several legal challenges have emerged: recognising the blockchain registries, settling issues of territoriality and applicable law, ensuring the enforceability of smart contracts, overseeing regulatory compliance with pertinent existing tax legislation (e.g. data protection regulation, money laundering legislation) and issues of liability (Pop-Machina, D.2.4., Part 1, 2020).

4. Conclusions

Based on the aforementioned, the moderating role of generalised social trust can be stressed because of its normative influences on business creation. However, generalised faith in strangers exerts positive moderating effects on the direct relationship between legal protections and entrepreneurship. In this context, new technologies, such as blockchain, have the potential to transform the financial services industry, institutional functions, business operations, and other areas such as education (Franzoni et al., 2019). The research upon social trust for recommendation systems can unveil how entrepreneurs cope with uncertain business conditions; and what is the role of the state in the promotion of social or generalised trust (Herreros and Criado, 2008). The state can play a decisive role in the creation of social trust as a third-party enforcer of private agreements since the effects of the state on social trust are unevenly distributed among majoritarian and minoritarian social groups (Herreros and Criado, 2008). Besides, the trust of socio-ethical background is determined by social media systems, and it should be focused on exploiting multi-sourced information (including social networks, item contents and user feedbacks) to predict the ratings of users to items, to enlighten the development of recommender systems in social media, and to make recommendations (Wu et al., 2016). Conclusively, the preliminary research outcomes of this introductory study proved that collaborative digital platforms and social media could sustain circular production. Future research can focus in a deeper understanding of the spatial and social engagement methods for establishing circular collaborative production in urban areas, as well as in adopting the proper dissemination routes to optimise the sharing benefits among all stakeholders involved at the Pop-Machina project.

5. References

Aravossis, K.G., Kapsalis, V.C., Kyriakopoulos, G.L., Xouleis, T.G. (2019). Development of a holistic assessment framework for industrial organizations. *Sustainability,* 11 (14), 3946. DOI: 10.3390/su11143946.

Carayannis, E.G., Grigoroudis, E., Campbell, D.F.S., Meissner, D., and Stamati D. 2018. The ecosystem as helix: an exploratory theory-building study of regional co-opetitive entrepreneurial ecosystems as Quadruple/Quintuple Helix Innovation Models", *R&D Management 48*(1): 148-162

Chen C., Zeng J., Zheng X. and Chen, D. 2013. Recommender system based on social trust relationships. Proceedings - *2013 IEEE 10th Int. Conference on e-Business Engrng*, ICEBE 2013, 6686238: 32-37. DOI: 10.1109/ICEBE.2013.5.

Davoudi A. and Chatterjee M. 2018. Social trust model for rating prediction in recommender systems: Effects of similarity, centrality, and social ties. *Online Social Networks and Media,* 7: 1-11. DOI: 10.1016/j.osnem.2018.05.001.

De Asis Marti Nieto, F., Goepp., V. and Caillaud, E. 2017. From Factory of the Future to Future of the Factory: Integration Approaches. *IFAC-PapersOnLine 50*(1): 11695-11700. doi: 10.1016/j.ifacol.2017.08.1689.

De Medici S., Riganti, P. and Viola, S. 2018. Circular economy and the role of universities in urban regeneration: The case of Ortigia, Syracuse. *Sustainability,* 10(11): 4305. DOI: 10.3390/su10114305.

Di Pierro M. 2017. What is the Blockchain? In: Computing in Science & Engineering, IEEE, September/October 2017. Available at: https://ieeexplore.ieee.org/stamp/ stamp.jsp?tp=&arnumber=8024092&tag=1.

EDSII 2019. European Digital Social Innovation Index. Information available from: <https://public.tableau.com/views/DSIIndexVisualisation/TheDSIIndex?%3AshowVizHome=no&%3Aembed=true>;<https://digitalsocial.eu/what-is-dsi>; <https://digitalsocial.eu/viz/#/map?l=0&e=undefined&x=46.805&y=441&k=1>; <https://www.nesta.org.uk/blog/launching-european-digital-social-innovation-index/>

Fabbricatti, K. and Biancamano, P.F. 2019. Circular economy and resilience thinking for historic urban landscape regeneration: The case of Torre Annunziata, Naples. *Sustainability,* 11(12): 3391. DOI: 10.3390/su10023391.

Franzoni A.L., Cardenas C. and Almazan, A. 2019. Using blockchain to store teachers' certification in basic education in Mexico. Proceedings - *IEEE 19th Int. Conference on Advanced Learning Tech*, ICALT 2019, 8820921: 217-218. DOI: 10.1109/ICALT.2019.00070.

Herreros F. and Criado H. 2008. The state and the development of social trust. *Int. Political Sci. Review,* 29 (1): 53-71. DOI: 10.1177/0192512107083447.

Kapsalis, V.C., Kyriakopoulos, G.L., Aravossis, K.G. (2019). Investigation of ecosystem services and circular economy interactions under an inter-organizational framework. *Energies*, 12 (9), 1734. DOI: 10.3390/en12091734.

Kim, P.H. and Li, M. 2014. Seeking Assurances When Taking Action: Legal Systems, Social Trust, and Starting Businesses in Emerging Economies. *Organization Studies,* 35(3): 359-391. DOI: 10.1177/0170840613499566.

Kyriakopoulos, G.L., Kapsalis, V.C., Aravossis, K.G., Zamparas, M., Mitsikas, A. (2019). Evaluating circular economy under a multi-parametric approach: A technological review. *Sustainability*, 11 (21), 6139. DOI: 10.3390/su11216139.

Li F., Loyalka P., Yi H., Shi Y., Johnson N. and Rozelle, S. 2018. Ability tracking and social trust in China's rural secondary school system. *School Effectiveness and School Improvement,* 29(4): 545-572. DOI: 10.1080/09243453.2018.1480498.

Menne A. 2019. Blockchain in the Sharing Economy, Will Blockchain Disrupt Today's Winning Business Models? Available at: https://essay. utwente. nl/76517/ 1/Menne _BA_EEMCS.pdf.

Phukseng T. and Sodsee S. 2017. Calculating trust by considering user similarity and social trust for recommendation systems. Proceedings of the *12th Int. Conference on Intelligent Sys. Knowledge Engrng,* ISKE 2017, 1-6. DOI: 10.1109/ISKE.2017.8258748.

Pop-Machina 2019. Grant Agreement, outline. Information available at: www.pop-machina.eu

Pop-Machina, D.2.4., Part 1, 2020. European Framework conditions. CommonLawgic, February 2020.

Regulation EU 2019/1150. Promoting fairness and transparency for business users of online intermediation services. L186/57. Date issued 11 July 2019. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R1150.

Report EU COM 2015. Communication from the Commission to the European Parliament: The Council, the European Economic and Social Committee and the Committee of the Regions – A Digital Single Market Strategy for Europe. Brussels 06 May 2015, COM(2015) 192 final. Available at: https://eur-lex.europa.eu/ legal-content/ EN/TXT/PDF/?uri=CELEX:52015DC0192&from=EN.

Urban Acquis 2005. The "Acquis URBAN" Using Cities' Best Practises for European Cohesion Policy. Available at: https://ec.europa.eu/regional_policy/archive /newsroom/ document/pdf/saarbrucken_urban_en.pdf

Von Hippel, E. 1986. Lead users: a source of novel product concepts. *Management Science 32*(7): 791-805.

Wu H., Yue K., Pei Y., Li B., Zhao Y. and Dong F. 2016. Collaborative Topic Regression with social trust ensemble for recommendation in social media systems. Knowledge-Based Systems, 97: 111-122. DOI: 10.1016/j.knosys.2016.01.011.