Emerging Terms and Co-authorship Dynamics
The Case of Microneedles Technology

The present study aims to increase our understanding of how research actors contribute the variation and selection of topics within the domain of an emerging technology space. Emerging technologies are radically novel technologies with the potential of exerting prominent socio-economic impact, but their development and directionality is characterized by considerable uncertainty and ambiguity (e.g. Cozzens et al., 2010; Rotolo, Hicks, & Martin, 2015). A network perspective on how research actors contribute to the generation as well as selection of topics associated with an emerging technology is needed to provide insights on how uncertainty and ambiguity are reduced throughout the emergence process by increasing topic coherence as well as how certain pathways are selected out during this process.

We investigate this issue adopting a multilevel network perspective. Our network includes two types of nodes: (i) research actors involved in scientific publications around a given emerging technology (we focus on two different types of actors/networks, one including authors and one including affiliations of these authors); (ii) topics presented in scientific publications associated with the selected emerging technology. Collaborative ties (co-authorships) among research actors are considered in the first level of the network, similarity of topics (cosine similarity) are instead included in the second level, and ties between research actors and topics are considered as cross-level interactions.

We consider several endogenous and exogenous factors that may explain the formation of such networks. We characterize terms emerging and non-emerging terms, and organizations into different types of organisations – Research and Higher Education (RHE), Healthcare Provider (HCP), Government (GOV), Research Institute (RIN), Industry (IND), or Non-Governmental Organisation (NGO). We model the multi-level network dynamics estimating a multilevel Exponential Random Graph Models (mERGMs) (Wang, Robins, Pattison, & Lazega, 2013).

Our case study is Microneedles. The dataset we use in this study was built using a modularized Boolean approach for identifying Microneedle research on the Web of Science (WOS). Mark Browsnitz, a subject-matter expert, was consulted and provided guidance vis-à-vis what terms were best to search for. Title, Abstract and Keyword fields were utilized in our search. The specific search strategy used appears in Appendix A. The resultant dataset contains 2,884 records spanning

49 publication years, more than 8,000 authors and more than 1,700 affiliations. It also contains 174 Web of Science Categories, the most prominent (by record count) of which are: (i) Pharmacology & Pharmacy, (ii) Nanoscience & Nanotechnology and (iii) Electrical & Electronic Engineering. Microneedles is said to be highly multidisciplinary. Given its interdisciplinary character, the relationships we unearth in this study are likely to characterize and be representative of numerous disciplines.

Appendix A: Microneedles Search Stragey

The dataset used in this study was developed by entering the following into an advanced search on WOS:

TS=(microneedle*) OR
TS=(micro-needle*) OR
TS=("microprojection patch*") OR
TS=("micro-projection patch*") OR
TS=("microprojection array") OR
TS=("micro-projection array") OR
TS=("micromechanical piercing structure*") OR
TS=("micro-mechanical piercing structure*") OR
TS=("microscopic needle*") OR
TS=("micron-scale needle*")

References

Cozzens, S., Gatchair, S., Kang, J., Kim, K.-S., Lee, H. J., Ordóñez, G., & Porter, A. (2010). Emerging Technologies: Quantitative Identification and Measurement. *Technology Analysis & Strategic Management*, *22*(3), 361–376. https://doi.org/10.1080/09537321003647396

Rotolo, D., Hicks, D., & Martin, B. R. (2015). What is an emerging technology? *Research Policy*, *44*(10), 1827–1843. https://doi.org/10.1016/j.respol.2015.06.006

Wang, P., Robins, G., Pattison, P., & Lazega, E. (2013). Exponential random graph models for multilevel networks. *Social Networks*, *35*(1), 96–115. https://doi.org/10.1016/j.socnet.2013.01.004