Translating patentometrics into useful intelligence: the case of 3D bioprinting

Introduction

3D bioprinting is expected to revolutionize the health industry. This research aims to apply a competitive technology intelligence (CTI) hybrid model to 3D bioprinting. This model is based on the assessment of patent production, and is further supported by experts' feedback. It describes technology pathways, or more specifically *who*, *where* and *what* "hot topics" are being developed. In addition, it tracks the innovation pathway of 3D bioprinting technology from patents into specific products and applications using a roadmap. The outcome of this research is intended for stakeholders across the 3D bioprinting supply and value chain.

Methodology

The methodology presented here aims to assess breakthrough technologies–such as 3D bioprinting–through a synergy between patentometrics, altmetrics (business and news databases analyses), and expert consultations to generate a roadmap. Figure 1 shows the methodology developed.

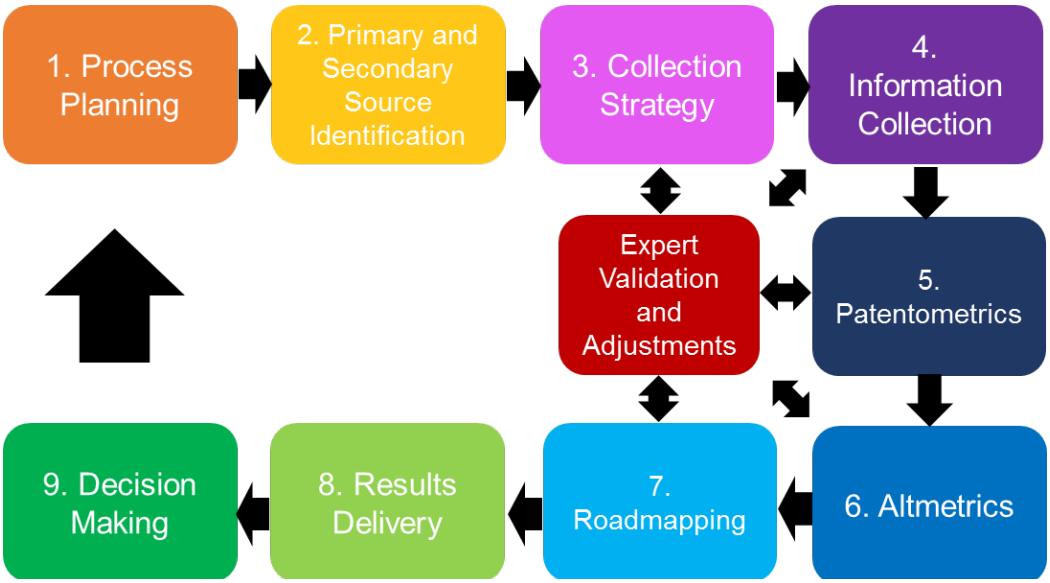

Figure 1: CTI hybrid model workflow.

This approach is developed through a cyclical process that comprises nine main steps. It starts with a planning process where the main goals, activities for development, participants, and the allocation of resources are stated. The second stage consists of the identification of reliable primary (expert) and secondary (literature) sources. Every activity in steps three through seven must be assessed and verified by experts. The third step comprises the determination of the most suitable information strategy collection including construction of queries to be used in retrieving information from databases. The fourth step consists of information gathering. In the fifth step, results obtained from databases are imported into text mining software and analyzed to produce insights regarding *who does what and where?* The sixth step is a novel addition to the original model. This step takes into consideration the insights previously generated to determine products and applications created from the technologies identified. The seventh step comprises a roadmapping process, which integrates results to concisely show the evolution of the technology. The eighth step is the results delivery, which must be done in a suitable format and language to facilitate understanding. The final step of this CTI process is the decision making.

Results

Top topics, organizations and technology areas were identified. In this respect, results showed that the predominant International Patent Codes (IPCs) focus on materials and coatings for prostheses (A61L27). Patentometrics and expert interviews allowed us to determine knowledge clusters, which indicated prevalent research on tissue engineering, polylactic acid and 3D printers. Finally, in order to identify the path towards 3D bioprinting products and applications, news and business databases (*EMIS, Google News, Factiva, LexisNexis* and *ProQuest News)* were analyzed. Insights revealed that vascular grafts and bone regeneration are the top 3D bioprinting technologies under investigation. Totipotent (embryonic) cells are being used to study future organ production and for cancer research. Moreover, skin printing appears to be a promising alternative to face a diversity of predominant health challenges. Specific types of biomaterials such as renal proximal tubule epithelial cells, or heart and liver tissue, are being printed for pharmaceutical research. Furthermore, human ears have been successfully printed and surgically placed. Figure 2 shows the 3D bioprinting roadmap that reflects these results.

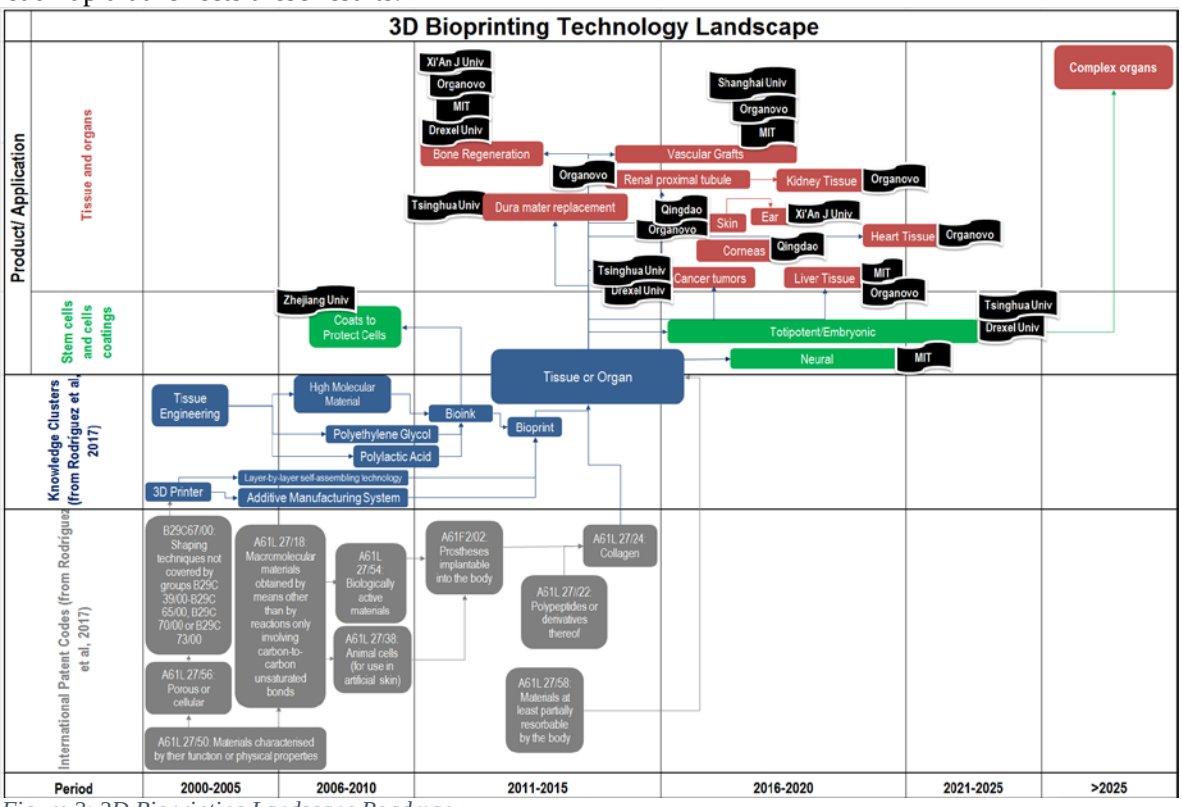

Figure 2: 3D Bioprinting Landscape Roadmap

Discussion and Conclusion

The hybrid CTI model presented herein has allowed us to track the progress of 3D bioprinting technology from conception to its final applications. Since 3D bioprinting is growing quickly (Shanler and Basiliere, 2016), annual updates are required to track the new advancements. One drawback of the model is the manual process for mining and analyzing business and news databases. However, the model successfully combined patentometrics with altmetrics into a roadmap, where more robust results were produced. Insights obtained can be used to support 3D bioprinting decision making related to research and innovation efforts.

References

Shanler, M. & Basiliere, Pete. (2016) Hype Cycle for 3D Printing, 2016. 19 July 2016. Report G00307807. *Gartner Inc*, Stamford, CT, USA.