Key Technological Trends in R&D of Electric Vehicle Extracted by Patent Analysis

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Governments see electric vehicle (EV) technology development as an essential way for the transportation sector to achieve low carbon and environmental protection. Although various policy incentives have been expanding over time, the priorities for investment in research and development (R&D) in EV technology development vary across countries and technology types. Under these circumstances, clarifying the characteristics and key trajectories of global EV technology development is becoming highly challenging but important. Because private firms apply for the largest number of EV technology patents, which is useful as a measure of technological resources, an analysis based on a patent database is an adequate way to observe EV technology R&D.

This research proposes a systematic and quantitative framework to identify priorities in R&D for EVs by using patent data for the interdisciplinary technical field of EVs from 2011 to 2019 to grasp key characteristics and trends in the rapid development of EV technology. In this research, two kinds of methodologies—decomposition analysis to find differences in the technical characteristics across different technology groups, and text mining to capture trends in the development of EV technology—are adopted in order to collate and analyze patent data. This framework helps us reveal what is the technology development trajectory of vehicle manufacturing centers, which are China, Japan, the USA, and the EU.

I find that the global number of EV technology patent applications increased from 2011 to 2019 in total; in particular, there was rapid growth in 2016, which was caused by a boost increase in China and then kept for serval years. Next, China and the USA have a clear advantage in the development of EV technology, not only in terms of the number of patent applications but also in terms of considerable investment in the development of advanced technologies. The effect of policy stimulation is not obvious in Japan and the EU, and the motivation for EV technology R&D is not high. Finally, the EV OEMs are more focused on digital technologies in addition to vehicle manufacturing, meantime the research frontier of EV technology is wireless charging technology.