

## **Technological convergence as antecedent of technological speciation**

### **Applying dynamic topic modelling and patent-laning to the action camera technology**

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Technological speciation is a term introduced by Ander & Levinthial (2002) to describe a process in which a new technology emerges due to “*transplanting the existing technological know-how to a new application domain where it evolves in new directions*” (Adner and Levinthal, 2002, p. 51). Crucial for a speciation event is therefore the existence of a market niche that occur as a result of variation in customer needs regarding functionality. To satisfy the customer needs in a market niche, the mainstream technology adapts to the selection environment with regard to functionality by recombining technical knowledge with other existing technologies. This convergence of existing technical knowledge may lead to the change or elimination of old functions or occurrence of new functions.

In a recent paper, Moehrle and Caferoglu (2017) introduced technological speciation as a source for emerging technologies. Applying a three steps method to the mainstream camera technology, the authors identified technological speciation candidates such as action-camera, dashboard camera or depth camera. Remarkably, they found for each speciation candidate some technological elements from other knowledge fields. They kept the question open how to trace back those technological elements in order to understand better the specific speciation. In particular, it is of interest for analysts which knowledge roots characterize the speciation technology as it may help assessing speciation candidates regarding novelty and complexity. To examine this open question, we focus on action-camera as one prominent technological speciation candidate and explore whether we could detect and trace back which knowledge converged with the mainstream technology knowledge and lead to the emergence of the action-camera.

For this purpose, we develop a four-step approach and apply it to the action-camera technology. First, based on a patent search we identify the characteristic knowledge flow to the action camera technology. For this purpose, we retrieve four data sets consisting of (i) patents for action camera technology, (ii) backward cited patents by the action camera technology, (iii) patents for mainstream camera technology and (iv) backward cited patents by the mainstream camera technology. We exclude all patents of pool (iv) from pool (ii). Doing so, we identify the technical knowledge flow that is characterizing the action-camera (ii\*). Second, we merge pool

(i) and (ii\*) and proceed with language pre-processing. We use the PatVisor® for eliminating useless elements such as stop words, numbers or symbols and apply a lemmatizer to get word stems. We use different n-gram models such as uni-gram, bi-gram and tri-gram to generate term-document matrices. Third, we perform a dynamic topic modeling as well as patent-laning with different design decisions regarding topic/lane number and input data (uni-gram, bi-gram and tri-gram). Fourth, we manually analyze topics in which at least one action camera patent has a probability of belonging to the topic of greater than 20% and combine it with the results of patent laning.

As a result, we observe that action camera emerges due to convergence of technical knowledge about attachment & mounting, stable lens parts (image stabilization) and wide-angle lenses (image stabilization). Our approach delivers some theoretical as well as managerial implications; for instance, it proves that recombination of existing technical knowledge with other technologies can lead to the emergence of new technologies due to technological speciation. On a practical side, we provide mainstream technology managers a method to detect which characteristic knowledge is needed to enter a market niche.

We are aiming in expanding our research regarding a more general perspective to obtain more broad knowledge about technological speciation. For instance, it is unclear whether the knowledge used for speciation is completely existing or also newly invented. Further on, whether the existing knowledge comes from the mainstream technology or is derived from other industries.

## References

- Adner, R. and Levinthal, D. (2002), "The Emergence of Emerging Technologies", *California Management Review*, Vol. 45 No. 1, pp. 50–66.
- Moehrle, Martin G.; Caferoglu, Huseyin (2017): Technological speciation as source for emerging technologies - Using semantic patent analysis for the case of camera technology, working paper.