Tribology in Biology:
Biomimetic Studies across Dimensions and across Fields

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Biomimetics is a field that has the potential to drive major technical advances. It might substantially support successful mastering of current tribological challenges, i.e., friction, adhesion and wear in machines and devices from the meter to the nanometer scale.

The first part of talk shall deal with the change that science currently goes through. A new Leitwissenschaft that can be called „Biological Physics“ is evolving, as in the old predominant science of physics as well as in biology more and more causation and natural laws are being uncovered [1]. Causation indicates the ratio of causal versus correlational knowledge, or the ratio of explanatory versus descriptive knowledge. The biomimetic approach might change the research landscape and the engineering culture dramatically, by the blending of disciplines (interdisciplinarity). The term “technoscience” denotes the field where science and technology are inseparably interconnected, the trend goes from papers to patents, the scientific “search for truth” is increasingly replaced by search for applications with a potential economic value. To accelerate scientific and technological breakthroughs we should aim at having a context of knowledge. To prevent being trapped in the inventor, innovator or investor gap (see Figure), a cross dialogue is necessary, a pipeline from “know-why” to “know-how” to “know-what”.

The second part of the talk shall deal with examples for biological tribosystems across dimensions (e.g., crack redirection in the horse hoof, biological tribosystems on the micrometer scale [2][3][4][5], plant wax structures preventing herbivores to adhere to plants, single switchable adhesive molecules that enable the rolling adhesion of red blood cells on the endothelium) exemplifying the hierarchical nature of biomaterials [6], and concepts such as integration instead of additive construction, optimization of the whole instead of maximization of a single component feature, multi-functionality instead of mono-functionality and development via trial-and-error processes [7][8].

The current state of biomimetics in tribology shall be reviewed, and subsequently, possible biomimetic scenarios to overcome current tribological challenges shall be envisaged (stable light-weight building materials, switchable adhesives, self-cleaning surfaces, micromechanic devices, scaffolds).

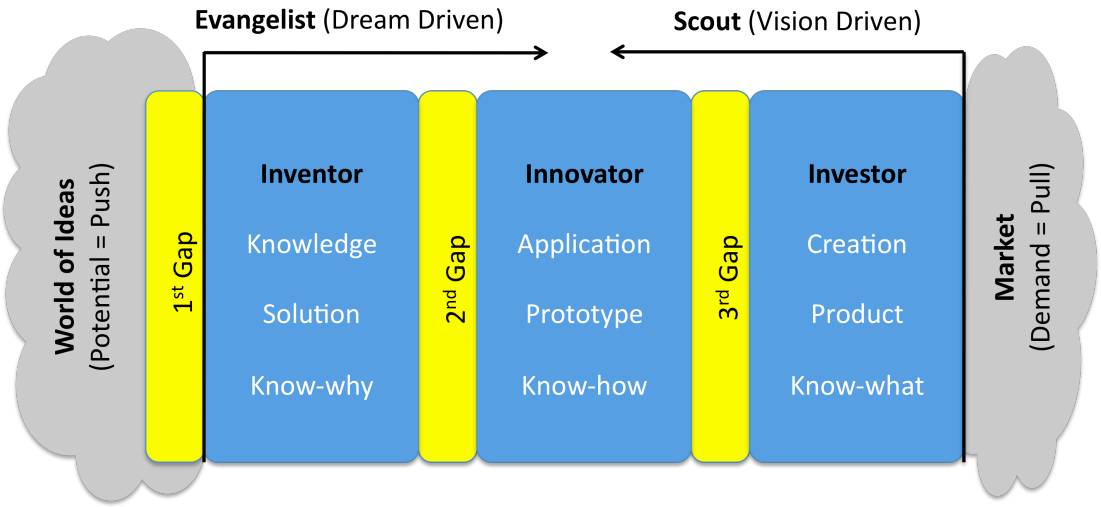

Figure: The Three-Gaps-Theory as proposed by Gebeshuber *et al.* [1]

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