ABSTRACT: Survival of the Cheapest: Information and Material in Biological Design

In order to be useful, biomimetics has to have a framework to organise the ideas and present a searchable system. Specific problems of design can then find suggestions or answers - if they exist. Further requirements of such a system are that it should be equally accessible to practitioners (designers, biologists and engineers) and that it should cover all areas of biology and design. The design of such a system has been my target for the last 15 years or so. The system is based on the Contradiction Matrix, part of the Russian system of identifying and solving problems, TRIZ. I recently discovered that this part of TRIZ is actually based on trade-offs, not on Hegel's dialectic definition of a problem as even the creators of TRIZ seem to have believed. Problems in engineering can be expressed as trade-offs; many biological phenomena (especially in behaviour and ecology) are expressed as trade-offs in research papers. In fact there is a good case for thinking that a large part of evolution can be considered as the resolution of trade-offs. So we have robust common ground between the practitioners which can be organised into a framework. Not only that, but from engineering we have mathematical tools for analysing and (probably) identifying trade-offs, even in biological systems which are typically very complex. The descriptive data has been organised within an ontology which has revealed some common themes with such trade-offs as speed-accuracy, reproduction-survival, and tolerance-defence. At the time of writing this we are about to start applying multi-objective (Pareto) analysis to some of these systems.This has already been done in a few systems by biologists, but the overall significance has not been realised. Bringing it all together, it seems that we not only have a framework and underlying system for biomimetics, but a new way of interrogating evolution.
Reference: JFV Vincent (2016). The trade-off: a central concept for biomimetics. Bioinspired, biomimetic and Nanobiomaterials. http://dx.doi.org/10.1680/jbibn.16.00005)