

IAF SPACE SYSTEMS SYMPOSIUM (D1)
Innovative and Visionary Space Systems (1)

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BIO-TRLS: AN EVOLVED TECHNOLOGY READINESS LEVELS FOR BIOLOGICALLY ACTIVE
MATERIALS AND ORGANISMS.**Abstract**

The Technology Readiness Levels (TRLs) developed by NASA are a widely-used nine level scale to assess the maturity of a technology to be launched into space. The TRLs are now also widely used in other engineering and design fields, for example architectural engineering. TRLs are a valuable scale to understand advancements in maturity and development of research which is critical for transdisciplinary research. The nine levels were developed with the principle that technology is designed and fabricated on Earth before being launched into space. However, to reduce mission costs, researchers are also looking into designing space systems and materials which will be manufactured or grown in situ using living materials or organisms. Traditional inert materials being assembled by autonomous systems in space can be simulated on Earth in analogue environments, however, the behaviour of living materials or organisms cannot be accurately reproduced in analogue environments. Moreover, scaling-up biological elements is a limiting factor as well, as micro scale prototypes do not exhibit the same behaviour as macro scale systems.

Therefore, the relevance of the current TRLs for these new biomaterials and (living) organisms is limited. It is critical to have an appropriate maturity assessment for these novel materials and applications. This paper presents a preliminary report on the development of an evolved TRLs scale for biologically active materials and organisms, including a review of current developments in the fields of biomaterials and biotechnology for the built environment and specifically for space habitats using the existing TRLs (visualised using a novel scale tool). A set of interviews with researchers in novel biomaterials and living materials are presented discussing the stages of maturity in bio-research, to build upon the review of current research developments.

A novel, evolved scale which sits alongside the existing TRLs, the BIO-TRLS, is used to assess the maturity of research in active biomaterials and organisms with a focus on space applications. The novel BIO-TRL focusses on space applications but also shows the repercussions of the research in any given environment and can thus be used in different transdisciplinary contexts.