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BIO-TRLs - FINDINGS FROM INTERDISCIPLINARY INTERVIEWS ON PROJECTS USING  
BIOLOGICALLY ACTIVE MATERIALS AND ORGANISMS**Abstract**

The TRLs are a widely-used nine level scale to assess the maturity of a technology to be launched into space and in other engineering and design fields e.g. architectural engineering. TRLs are a valuable scale to understand advancements in readiness 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 readiness assessment for these novel materials and applications. This paper builds on a preliminary report on the development of an evolved TRLs scale for biologically active materials and organisms using a bespoke Interview Canvas to gather data. The paper presents data from a set of interviews with interdisciplinary researchers working on biological projects that spans different scale and technology readiness levels. The researchers shared data on the different stages of their research projects including the aim of each stage, the scale, the developments reached, and the methods used. In a few cases, the data was complemented by visual ecosystems and metabolisms maps showing the process of the projects throughout those stages and the relations between system components and larger systems. The data was analysed using triangulation, including superimposed diagrams, by a group of experts in the field of biologically active materials and organisms. The analysis resulted in a pathway to develop an evolved scale which sits alongside the existing TRLs, the BIO-TRLs - to assess the readiness of research in active biomaterials and organisms with a focus on space applications.