Technology Readiness Level (TRL) Scale Explained | ReaDI-Watch

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The Technology Readiness Level (TRL) scale is one of the most widely used frameworks for assessing the maturity of technologies during research, development, and commercialisation. Originally developed by NASA, the TRL framework is now used globally by governments, research organisations, investors, and innovation agencies to evaluate how close a technology is to operational deployment.

The TRL scale provides a structured method for measuring technological progress from early-stage scientific research through to fully operational systems. By creating a common language for technology maturity, TRLs help organisations improve decision-making, reduce innovation risk, prioritise investment, and align technical development with commercial strategy.

The TRL scale was originally developed by NASA in the 1970s with for space technology (readiness for space!), and has been adapted and adopted by international innovation and R&D bodies since, to classify technology with respect to its market readiness.

By way of example, when companies apply for European funding for their Innovation and R&D, they often must classify what TRL their R&D project will begin at, and state the target TRL at the end of the project.

Types of R&D along the TRL Scale

The type of R&D taking place at lower TRL scales is usually categorized as "**Basic Research**".

Basic research is generally, publicly funded (or funded entirely by the government) and is often carried out in universities. However, applied research organisations and companies can also carry out **Basic Research**.

According to the Frascati Manual, OECD (2015): Basic research is experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying foundation of phenomena and observable facts, without any particular application or use in view.

"Such research is usually performed in the Higher education sector but also to some extent in the Government sector. Basic research can be oriented or directed towards some broad fields of general interest, with the explicit goal of a range of future applications. Business enterprises in the private sector may also undertake basic research even though there may be no specific commercial applications anticipated in the short term. Research on some kinds of energy saving technologies may be described as basic according to the above definition if it does not have a specific use in view. However, it does have a specific direction: improved energy savings. Such research in this manual is referred to as "oriented basic research".

Higher on the TRL scale, "**Applied Research**" is carried out, often partially industry funded and partially publicly funded. Applied research seeks to bring an area of science/technology to a more practical application, closer to market readiness.

According to the OECD Frascati Manual (2015), Applied research is original investigation undertaken to acquire new knowledge. It is, however, directed primarily towards a specific, practical aim or objective. A famous example of applied research is Fraunhofer's work into compressing audio files, now known as MP3. MP3 was licensed and drove millions in revenue for the Fraunhofer organisation from the 1980s to 2017.

As we move up the TRL scale towards 9, this indicates that a technology is close to being ready for the marketplace. At higher TRL scales, it is generally considered that the knowledge gained to bring the technology to market, will be converted to generate revenue for those who own the intellectual property. Typically, high TRL R&D activities are carried out by companies (and Applied Research Organisations) are classified as "**Experimental Development**":

Experimental Development is directed at producing new products or processes (or improving existing ones), and plenty of examples can be found in the profiles of ReaDI-Watch community members.

The TRL scale is currently the best known International methodology for classifying the different types of research development activities that are ongoing in R&D. Despite the prevalence of the TRL today, there are known limitations, such as the limitations of having R&D represented on a linear scale. These will no doubt be developed and advanced into the future. By way of example, the OECD Frascati Manual states:

"The order in which the three types of R&D activity appear is not meant to suggest that basic research leads to applied research and then to experimental development. There are many flows of information and knowledge in the R&D system. Experimental development can inform basic research, and there is no reason why basic research cannot lead directly to new products or processes."