



Technology Readiness Levels

ISC Technology Readiness Level Scale

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Technology Readiness Levels (TRL) describe the different stages of pre-commercial development. Find TRL 1 to 9 definitions, descriptions and examples below.

Short Definition and Description: Stages of component(s)/subsystem(s) development, or overall system maturity description at each level, and benchmark measures of system performance capability.

Examples of Activities: Generally occur when the technology is within the respective level. Typically, level activities occur and are completed before to the start of the next level.

TRL	Short Definition	Description	Examples of Activities
9	Actual technology proven through successful deployment in an operational setting.	Actual application of the technology in its final form and under real-life conditions, such as those encountered in operational tests and evaluations.	Activities include using the innovation under operational conditions.
8	Actual technology completed and qualified through tests and demonstrations.	Technology has been proven to work in its final form and under expected conditions.	Activities include developmental testing and evaluation of whether it will meet operational requirements.
7	Prototype system ready (form, fit, and function) for demonstration in an appropriate operational environment.	Prototype is ready for demonstration in an operational environment and is at planned operational level.	Activities include prototype field testing in a real-world operational setting.
6	System and/or process prototype demonstration in a simulated environment.	A model or prototype that represents a near desired configuration.	Activities include testing a model or prototype in a simulated or laboratory environment.
5	Semi-integrated component(s)/subsystem(s) and/or process validation in a simulated environment.	The basic technological components are integrated for testing in a simulated environment.	Activities include laboratory integration of components.
4	Component(s)/subsystem(s) and/or process validation in a laboratory environment.	Basic technological components are integrated to establish that they will work together.	Activities include integration of "ad hoc" hardware in the laboratory.
3	Analytical and experimental critical function and/or characteristic proof of concept.	Active R&D is initiated. This includes analytical studies and laboratory studies to physically validate the analytical predictions of separate elements of the technology.	Activities include components that are not yet integrated or representative.
2	Technology concept and/or application formulated.	Invention begins. Once basic principles are observed, practical applications can be invented. Applications are speculative, and there may be no proof or detailed analysis to support the assumptions.	Activities are limited to analytic studies.



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1	Basic principles observed and reported.	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development (R&D).	Activities might include paper studies of a technology's basic properties.

Definitions:

Proof of Concept:

Analytical and experimental demonstration of hardware/software concepts that may or may not be incorporated into subsequent development and/or operational unit.

Model:

A reduced scale, functional form of a system, near or at operational specification. Models will be sufficiently hardened to allow demonstration of the technical and operational capabilities required of the final system.

Prototype:

The first early representation of the system which offers the expected functionality and performance expected of the final implementation. Prototypes will be sufficiently hardened to allow demonstration of the technical and operational capabilities required of the final system.

Laboratory Environment:

An environment that does not address in any manner the environment to be encountered by the system, subsystem(s), or component(s) (hardware or software) during its intended operation. Tests in a laboratory environment are solely for the purpose of demonstrating the underlying principles of technical performance (functions), without respect to the impact of environment.

Simulated Environment:

Not all system(s), subsystem(s), and/or component(s) need to be operated in the operational environment in order to satisfactory address performance margin requirements. Simulated environment can simulate an operational environments, or key aspects thereof, to determine whether an innovation is ready for a test, which is not necessarily final end-user environment. It is an environment that focuses specifically on "stressing" the technology advance in question.

Operational Environment:

The environment in which the final product will be operated. For software, the environment will be defined by the operational platform.

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