

# 1 Background

The objectives of the prostep ivip Association include the promotion of communication and collaboration across company and domain boundaries, as well as the optimization of the value chain in product development. Focus in this context is placed on open, manufacturer-independent PLM standards that ensure the interoperability and quality of software solutions for the product development process. To this end, the Association records requirements, draws up guidelines and supports implementation in at present 30 projects. In these projects, interlinked technologies and digitalization create value irrespective of industry, domain and phase of the product lifecycle.

The Association supports the global promotion of openness and interoperability in general with initiatives such as the Code of PLM Openness (CPO). Increasing product complexity and the growing level of interconnection between the disciplines and standards involved gave rise to the question of an end-to-end demonstrator that can serve all the users, IT vendors, system integrators and research institutions in the prostep ivip Association as a new platform for testing realistic scenarios. What the Association wanted was an end-to-end reference model across all the components in the V-model that makes it possible to create links to the original requirements, domains and organizations.

The challenge was to find a product that was easy to understand as a whole – without further explanation of the environment and functions. At the same time, in its detailed form, it needed to be complex enough to test and demonstrate the variety and depth of the different use cases and software solutions in the prostep ivip project groups and thus do justice to the prostep ivip Association's operational mission more quickly and comprehensively. In addition, questions regarding know-how protection and restrictions related to funding needed to be taken into account. These conflicting demands meant that this type of product could not be provided by a single industrial company or research institution alone.

## 2 The digital Mars Rover

A number of remote-controlled probes and vehicles were sent into outer space with the aim of exploring the Red Planet, of which Opportunity was probably the best known. Launched in 2004 with a projected life of six months, it provided amazing images and data from Mars over a period of 15 years. NASA's Jet Propulsion Laboratory (JPL) used these images and data to publish the model of a build-it-yourself Mars Rover in summer 2018. The model's basic data (mechanics, electrics/electronics, software) is open source and thus freely available in the Internet. It is ideally suited to serve as a demonstrator for the prostep ivip Association because:

- The Mars Rover is a complex product with mechanical components, intelligent software-based control, electrics and electronics
- It involves different engineering sciences and, with its outstanding maneuverability and autonomous driving behavior under challenging environmental conditions, brings together concepts from the automotive and aerospace industries
- As an unmanned vehicle, it is perceived by the public as technologically advanced and offers a high level of practical relevance

The Mars Rover is a complete product that is suitable for demonstrating the end-to-end digitalization of product and process-related information throughout the entire lifecycle. This enables the Association to demonstrate the relevance of its results for the industrial sector, in particular through the use of IT standards, with the aim of making it possible to experience seamless virtual product creation.





All the project groups and organizations in the Association were included in the initiative via the Technical Steering Committee. They provide additional reference models for the Mars Rover based on the basic data provided by NASA JPL. Among other things, they are developing virtual product data models in various tools, e.g. for requirements, SysML, ECAD/MCAD and electrics. They are developing and testing use cases for cross-disciplinary change management based on linked data approaches in the Cross-Discipline Lifecycle Collaboration (CDLC) project group, which were recently presented at the prostep ivip Symposium in Stuttgart. A predictive maintenance scenario based on the Mars Rover was presented at the Hanover trade fair together with the FIWARE Foundation, Innovalia and PROSTEP AG. It illustrated the advantages of consistent data between product development, production, maintenance and service and attracted a large audience of industry professionals.

Numerous extensions will follow, and this is already having a noticeable impact on direct col-laboration between the project groups when it comes to requirements relating to the interfaces between their use cases and standards.

### 3 The future of the digital Mars Rover

The prostep ivip Association is now making all the data available to its working groups and to all of its members in the form of a digital model. This will create an open universal platform for a joint demonstrator. The data can be used free of charge. In keeping with the open source philosophy, the expected benefit will be the fact that supplementary data for the Mars Rover and data for the Mars Rover that has been developed further will be made available to the entire prostep ivip community. This Confluence platform is being developed for this purpose. The long-term objective is to create a demonstrator that is unique with regard to its type, scope, variety and agility and which allows all aspects of today's complex product development process to be represented and interlinked.

## 4 Licensing

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