

# HUMANOID ROBOTS FAMILY IS GROWING

## The Business

Aldebaran designs and produces user-friendly and interactive humanoid robots. In less than 10 years, we have become a leader in the humanoid robotics market. Today, we offer robots that assist professionals in education, research, health, distribution, and tourism, as well as those that help both families and individuals.

## The Challenge

Humanoid robots require a high degree of safety, due to their close interaction with humans. We must provide customers a product that is safe and secure by construction and which conforms to the principal robotic standards (such as IEC12100, ISO10218, ISO13482).

## The Solution

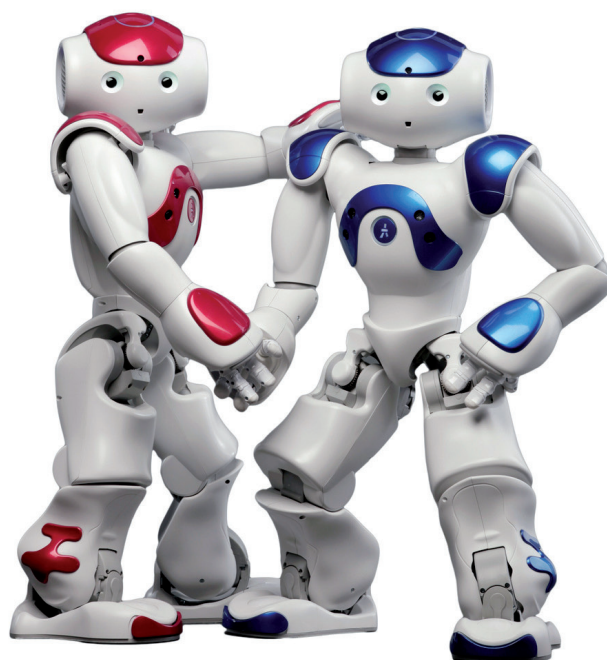
Aldebaran evaluated the Papyrus Robotic Platform, a design and development tool customized for the robotic domain. The RobotML language, an extension of the industry-standard UML integrated into the Papyrus Robotic Platform, is capable of modeling any kind of mobile robots. The Platform also provides modules for model-based safety and security analyses based on the ISO13482.

## The Benefit

The use of Papyrus helped Aldebaran to centralize project-related knowledge and supported development of different parts of the *Romeo II* robot. It also helped improve information exchange between different teams.

## [Romeo II Project]

« We believe in a future where humanoid robots will be assisting humans in their everyday lives, their family lives, their leisure activities, and in their work. »





# The Business & The Challenge



[Nao (on the left) was born in 2006. 9,000 Naos are now in use all over the world. © Aldebaran]

## The Business

### From Nao to Pepper

**F**rom the outset, our goal was to make robots accessible to everyone, based on the view that they will become our daily companions.

We designed our first robot, Nao, in 2006. As an impressive testimonial to this amazing pioneering adventure, over 9,000 Naos are currently in use throughout the world, with particular successes in research and education.

In 2009, we launched the *Romeo* project in collaboration with research several laboratories and institutions, with the goal to intensify our research into assistance aimed at people facing a loss of autonomy.

In 2014, Aldebaran introduced *Pepper* for the B2B market in Japan. Starting with the summer of 2015, *Pepper* is available to customers in Japan. More than 7000 *Peppers* have been sold today.

Aldebaran currently represents more than 400 Aldebaranians, 4 offices (Paris, Tokyo, Boston and Shanghai). It has recently become a subsidiary of the SoftBank group.



## The Challenge

« Most available standards, guidelines and norms are not adapted to the robotic domain »

**M**odern robotic systems and, in particular, humanoid robots, are complex and are capable of performing sophisticated tasks in different domains. Such robots must satisfy certain dependability requirements including notably reliability, availability, safety, and security. Unfortunately, most available standards, guidelines, and norms pertaining to functional safety propose classical methods and generic methodologies which are not adapted to the robotic domain. In particular, the fast evolution of modern humanoid robots, their ever-growing complexity and multi-disciplinary aspects, require new safety approaches capable of analyzing a system from the earliest development phases, as well as new tools adapted to the robotic domain.

# The Solution

[" For the safety study of its companion robots, Aldebaran uses Papyrus as complex system modelling tool." ]

« Dealing with complexity »

RODOLPHE GELIN - CHIEF SCIENTIST OFFICER  
ALDEBARAN ROBOTICS

**In order to cope with system complexity, Aldebaran turned to a model-driven engineering approach supported by Papyrus and tuned to the robotic domain.** This significantly simplified the support of system requirements, design, safety and security analysis, and verification and validation throughout the system life-cycle.

The RobotML language provided within the Papyrus Robotic Platform makes it easy to design, simulate and deploy robotic applications. With RobotML,

robotic systems can be defined using appropriate notations, abstractions, and facilities to automatically generate executable code. RobotML proved to be a good solution for Aldebaran's experts that deal with variability problems, as well as for system architects who no longer need to be concerned with the details of low-level programming.

In addition to modeling, the Papyrus Robotic Platform provides facilities to develop safe and secure robotic

systems. It can help Aldebaran to automate the safety analysis process and also to link it with ISO13482 and the different phases of the corporate development life-cycle practices.

The platform includes a language that defines the main safety concepts, libraries of various hazards and safety requirements as specified by ISO13482, FTA (fault tree analysis) and FMEA (failure mode and effects analysis) modules, and a report generation module.

[Pepper was first introduced for the B2B market in Japan in 2014. © Jake Curtis / Aldebaran]



# The Benefits

«A flexible tool, which enables the different teams to view the system as a whole, »



[Nao's Visitors Book in a recent event © Aldebaran]

[ The model-based safety and security analyses provided by the Papyrus Robotic Platform would allow Aldebaran to better control the quality of its products starting with the early phases of system life-cycle. ]

using UML profile mechanisms in Papyrus the Papyrus Robotic Platform provided a shared view of the system for both system and safety/security engineers. This allowed Aldebaran to integrate all data linked with the development and safety/security analysis to this single robotic model. As a result, Aldebaran experts got a flexible tool, which enables the different teams to view the system as a whole, to improve the communication on the project, and to facilitate collaborations between team members.

**T**he use of Papyrus can help Aldebaran to better cope with engineering time and cost by bridging the gap between system development and safety and security analysis. Indeed, the preliminary results of the safety and security analysis performed

in the early phases of robotic life-cycle, can reveal the most critical aspects of the design, which, thanks to Papyrus Robotic Platform, can be mitigated at minimum cost.

In the scope of the Romeo II project, by

**About Aldebaran Robotics**  
Nature : Industry  
Domain : Humanoid robotics  
Web Site : [www.aldebaran.com](http://www.aldebaran.com)  
Employees : 400

## PAPYRUS CASE STUDY SERIES



Publisher : CEA List // Chief Editor : Sébastien Gérard // Texts : Rodolphe Gelin // Layout : Florence Boulenger-Delplanque  
Copy Edit : Bran Selic // Cover Picture : © Aldebaran (Nao Robots) & LaCozza / Fotolia

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**About Papyrus ([www.eclipse.org/papyrus](http://www.eclipse.org/papyrus))** : Papyrus is an Eclipse project led by List (contact : Sébastien Gérard at [sebastien.gerard@cea.fr](mailto:sebastien.gerard@cea.fr)). Papyrus is also labelled as a solution of the Eclipse industrial working group Polarsys (<https://www.polarsys.org/solutions/papyrus>). Papyrus supports model-driven approaches by providing a standards-based modeling tool that supports, out of the box, both the UML and the SysML international industry standards from the OMG. In addition, Papyrus provides very advanced support for custom UML profiles that specialize UML, which enables users to define and implement their own domain- and project-specific modeling tools and languages (DSMLs). The user interface of Papyrus is highly configurable to support a broad spectrum of user-specific domains and concerns.