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# CLARITY: Open-Sourcing the Model-Based Systems Engineering Solution Capella

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**Abstract.** The central concern of the CLARITY project is to support open innovation for Model-Based Systems Engineering by structuring an ecosystem of major actors of the domain and providing an open-source environment, Capella, and its underlying methodology, Arcadia. In this experience report, we relate the Capella story from the initial development by Thales down to the open-sourcing strategy. The rationale for adopting the open-source model is detailed with commercial, competitive and strategic arguments. The global roadmap of Capella is then presented. One year after the start of the CLARITY project, a first feedback is shared.

## 1 Introduction

The CLARITY[5] project aims at developing and structuring an international ecosystem to support open innovation in the domain of model-based systems engineering (MBSE). The main objective is to propose major breakthroughs with regard to the common practices in the domain of MBSE. The vision is in line with the INCOSE recommendations by taking up the challenge of providing an integrated and model-oriented vision for complex systems modeling.

The starting point of CLARITY is to deliver the MBSE solution Capella as an open-source project within the Eclipse Industry Working Group Polarsys[6]. Capella is a Thales initiative that has been initially developed in house, and deployed in various Business Units since several years, taking the advantage offered by multiple and diversified projects within the Thales Group. Capella is a key solution for complex systems design providing major technological breakthroughs for MBSE, methodological support and guidance for systems engineers through the underlying integrated methodology Arcadia.

To support the open-sourcing of Capella, the CLARITY project investigates customization capabilities for Capella as well as specific extensions such

[5] CLARITY is a project funded by the call *embedded systems and connected objects* of the French future investment program. Cf. http://www.clarity-se.org
[6] Cf. https://www.polarsys.org/capella

as the integration of viewpoints to tackle domain specific system requirements, including functional and non-functional ones (e.g. performance, safety, cost, test, simulation). Connection of viewpoints with existing engineer specific tools in these domains is also promoted. Moreover, the CLARITY project aims at complementing the ecosystem with a community that brings together major actors of the entire engineering value chain (industrials, integrators, technology providers and consultants, academia) for open innovation in MBSE within Capella.

In this paper, we first present the initial motivations for open-sourcing Capella (Section 2). Then, we detail the approach implemented by the CLARITY project to support the open-sourcing of Capella, and to create an underlying ecosystem that foster the open innovation in that domain (Section 3). Finally, we conclude and discuss preliminary lessons learned in Section 4.

## 2 Motivations

Model Driven Engineering (MDE) has been identified as key to develop ever more complex systems at ever more constrained costs. MDE provides means:

- to formalize and tool up system and software architectural design, leading to strong productivity gains;
- to improve design consistency and quality;
- to early evaluate architectures;
- to share a common engineering reference, integrating multiple disciplines and allowing actual co-engineering;
- to leverage on engineering know-how and expertise, and reuse it;
- to ease collaborative engineering with clients, co-contractors and sub-contractors.

As the state-of-the-art engineering tool vendors did not provide the appropriate offer, Thales decided in 2007 to develop its own MDE method, i.e. Arcadia [3], and a dedicated MBSE solution, i.e. Melody Advance [2], together with an accompanying Group-wide deployment, training and coaching organization [1]. Thales has succeeded in implementing a deep cultural change based on highly innovative and first-in-class solutions. In the meantime, the success in the endeavor of rolling-out these new engineering approaches has been thoroughly monitored by a progressively maturing Make/Team/Buy strategy.

Ultimately, Thales decided to publish Arcadia and to open-source Melody Advance under the name of Capella, clearly choosing a Team strategy and implementing an open innovation scheme. As Arcadia and Capella represent a major investment and provide high value for Thales, one can wonder why such a strategic move has been chosen. The rationale is in fact driven by very concrete and opportunistic concerns:

- *For sharing the engineering environment within large multi-partners projects*: there is an increasing need for sub/co-contracting and third parties see it as a risk to benefit from an advanced but proprietary engineering environment in terms of long term availability and support.

- *For preserving the investment*: ARCADIA and CAPELLA were developed due to the fact that such solutions did not exist on the market and, because they fill a gap, there is a risk that concurrent solutions emerge on the market, not necessarily filling well Thales operational needs, that would become a standard. This would then require from additional migration and adoption costs to comply with the new standard. Open sourcing the Thales advanced and mature solution, and ensuring its adoption by a large community, will help in making it the *de facto* standard.
- *For sharing costs and risks* : there is also an obvious gain in terms of sharing maintenance and evolution costs once the open-source solution is adopted by a large community. Although CAPELLA is well ahead in the MBSE market, it still requires additional investments for preserving this advance with new capabilities both functional (e.g., additional specialty engineering extensions and/or environments integration, enhanced architecture alternatives management, integration within ALM and PLM solutions) and non-functional (e.g., cloud deployment capabilities, engineer activity pattern detection and support, further performance and customizability improvements). For some of these improvements, a critical mass is needed. By sharing its solutions, Thales will benefit from added value brought from the community and thus gain additional returns from its initial internal investment.
- *For leveraging Thales competitive advantage*: sharing maintenance and evolution costs allows Thales to better focus its investments on additional capabilities that are kept in-house (e.g., smart productivity tools, quality insurance tools, know-how and expertise capitalization), thus preserving some competitive advantage with Capella;
- *... And because it is the right time*: it is now well established that industrial needs for systems and architecture engineering are shared, that model-based engineering is a major lever for engineering improvement and transformation, that the market does not provide the right answer and that the open-source environment is ready to provide the right framework with PolarSys. So it is the right time for open-sourcing Capella.

This clearly targets the establishment of an open innovation dynamics, as shown in Fig. 1. This involves all actors in the whole engineering value chain, contributing together in synergy.

End-user organization, by confronting ARCADIA and CAPELLA to other business domains, help maturing, consolidate and complement the method and the tools, bringing additional value that Thales can benefit from, as well as additional activity to the other open innovation stakeholders. As a direct result from this strategy, collaborations can expand further with clients and partners that need to ensure engineering continuity for developing complex systems.

Open source foundations and communities provide the right framework and mindset for *de facto* standardization, while engineering communities, by gaining a rich and mature solution that fills a long lasting gap, help further adoption through communication, dissemination and promotion.

**Fig. 1.** The Arcadia and Capella open innovation scheme

Service and technology providers, gaining expertise and building offers on top of Arcadia and Capella, provide to end-user organizations, including Thales, a pool of expertise that is made available for new project needs.

Arcadia and Capella modules delivered in universities and engineering schools shape young engineers with a background that directly benefit to end-user organizations, including Thales, if they are recruited on operational projects, as well as spread Arcadia and Capella knowledge in other industries, favoring their adoption and standardization.

Arcadia and Capella, by establishing new open standards in MBSE environments made available to research communities, procure new research fields and favor further advanced capabilities that will pave their future.

## 3 Implementation

### 3.1 Preliminary Activities

Open-sourcing Melody Advance in the Eclipse project named Capella started with several preparatory activities:

1. The most important one was *to define the most appropriate business model.* Indeed, even if there are some theoretical open-source models which are, still today, innovative ones; finding the proper one for the targeted market (here, MBSE) and actors was not an easy task.

2. The second step was *to convince the top management* to follow the path written by this new business model.
3. Then, *the framework allowing to implement the open innovation strategy for MBSE had to be created*. CAPELLA was already partly based on open-source technologies hosted in the Eclipse Foundation, but Eclipse was not the proper host to support CAPELLA. Therefore, an important work has been done in order to ease the Polarsys Working Group (WG) creation (Thales and Obeo both founders of this WG). This genesis has been performed within the ITEA2 project OPEES[7].
4. *The components included within* MELODY ADVANCE *had to be open-sourced* as well in order to have a 100% open-source workbench. For instance, it has been done for EGF[8], KITALPHA[9] and SIRIUS[10]. SIRIUS was sold by Obeo through a commercial product called OBEO DESIGNER (which was the company's core business), therefore, open-sourcing SIRIUS had a major impact on the Obeo business model as well.
5. *An appropriate environment to open-source* MELODY ADVANCE *and to initiate its ecosystem had to be found*. This environment was the collaborative project CLARITY and its associated consortium gathering industrial partners, technology providers and consulting/services companies who could support Melody Advance/Capella deployments.

### 3.2 Cost Estimation

At the initial stage of the process, there was intensive work to estimate the cost of open-sourcing MELODY ADVANCE into CAPELLA. Cost estimation started with lots of meetings between Obeo and Thales to clarify: the impacts on the build process of the workbench (and on the future evolution), the scope, etc.

Moreover, MELODY ADVANCE represented a 100 m.y effort and more than 1 million of lines of code. Open-sourcing a software of this magnitude also means renaming its packages, so it is obvious that the refactoring represented a huge effort. Using its former experiences related to software components open-sourcing, Obeo was able to estimate the cost starting from code related metrics (number of plugins, classes, comments...) but some other elements also had to be taken into account, such as intellectual property and dependencies, migration to open-source of other technological components on which MELODY ADVANCE depended on (e.g., SIRIUS and KITALPHA, the MELODY ADVANCE technical foundation and development environment).

### 3.3 Governance Definition

Governance is a long term task which is managed today within the project CLARITY in order to take fair decisions for all the consortium members. Prior

[7] Cf. `http://www.opees.org`
[8] Cf. `https://eclipse.org/egf`
[9] Cf. `http://polarsys.org/kitalpha`
[10] Cf. `https://eclipse.org/sirius`

to this, a first governance organization was setup within the Eclipse Foundation and the Polarsys WG frameworks through :

- the definition of Capella leaders and commiters;
- the definition of a Polarsys solution.

Therefore technical governance was a day-to-day activity for Capella leaders and commiters while the more strategic topics were discussed within the Polarsys steering committee.

Community management and animation is also critical: indeed, open-sourcing a technology is not enough to gather people around it and create a supportive community. Hence:

- Capella stakeholders really wanted that the early adopters were carefully taken care of;
- An important work of communication and training have been done, and is still currently done (e.g., 2015 INCOSE Symposium, Eclipse Con 2015).

### 3.4 Schedule

Open-sourcing Melody Advance into Capella started in January, 2014, even if Obeo spent only a small effort mainly to prepare its activities at the beginning and really started to work actively on this topic in September, 2014. Weekly meetings between both partners have been quickly institutionalized in order to keep having the same understanding of what has to be done during the whole process.

The activities has been split into several batches, namely *Infrastructure and initial builds*, *Upgrading Sirius version to 0.9*, *Melody rebranding*, *IP submission preparation*, *Upgrading Sirius version to 1.0* and *Project Monitoring and Control*.

Each batch were followed by a validation phase. Thales could also integrate maintenance activities performed on the code of Melody Advance anytime, and performed a validation phase each time it was done.

To give an overview of the overall process, here are given the important dates of the open-sourcing effort :

- 2014-07-30: Submission of the proposal.
- 2014-09-10: Project proposal has been approved and the Capella project has been created.
- 2014-10-06: Initial CQ contribution of Capella for Intellectual Property review.
- 2014-10-12: Capella dissemination means (Support Forum and Wiki) are born.
- 2014-11-20: Capella technical infrastructure (Hudson, Code repository) is setup.
- 2014-12-08: Capella "pre-release" build 0.8RC is available.
- 2015-01-30: Capella IP review has been approved.
- 2015-02-13: Capella 0.8.1 Release Review has been submitted.
- 2015-03-20: Capella 0.8.1 IP Log has been submitted.
- 2015-04-02: Capella 0.8.1 Release Review has been approved.
- 2015-04-06: Capella 0.8.1 is available for download.
- 2015-06-05: Capella 0.8.2 Release Review has been submitted
- 2015-06-04: Infrastructure has been enhanced with the use of SonarQube and PolarSys Maturity Assessment.
- 2015-06-30: Capella 0.8.2 has been released.

## 4 Conclusion

This paper reports the origin and the current state of the CLARITY project which targets the creation of an international ecosystem for MBSE and the establishment of an open innovation dynamics model of development schema for Capella and the associated methodology Arcadia. The political and commercial choices of Thales for investing in such a strategic project are presented as well as the details on the open-sourcing implementation process of Capella. The CLARITY project is the appropriate environment to federate the actors of the consortium, all involved in the engineering value chain, contributing together to the maturation, the consolidation and the completion of the methodology and the tool solution.

At this stage of the project, partners provide an important work in development, communication and training to gather people around the solution. A particular attention is paid by all Capella stakeholders on early adopters which provide their industrial needs, present the solution to different business domains and give feedback on the solution.

Another ongoing strategic activity in the project is the investment of partners in the working tasks for preserving the technological advance of Capella. This include specific extensions such as the integration of viewpoints to tackle domain specific system requirements, both functional/non-functional. Extensions through viewpoints and integration of existing engineering specific tools in these domains is also covered by the project.

After only a few months, the published Arcadia and the open-sourced Capella start to be known by a larger community. The ecosystem, initialy limited to the CLARITY project consortium, starts to expand, validating the defined open innovation strategy.

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